

**PROJECT MANUAL
FOR THE
RAW WATER PROJECT**

LA PLATA WEST WATER AUTHORITY

**CONTRACT 1: RAW WATER PUMPING
FACILITIES AND PIPELINE**

**CONTRACT 2: UNDERWATER
INSTALLATION OF INTAKE SCREEN(S)**

LAKE DURANGO WATER AUTHORITY

**CONTRACT 3: LAKE DURANGO TREATED
WATER PIPELINE**

October 2015

**WO 17865.005
WO 18459.001**

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BARTLETT & WEST

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BARTLETT — **& WEST**

**La Plata West Water Authority
Lake Durango Water Authority
La Plata County, Colorado
Raw Water Project**

ADVERTISEMENT FOR BIDS

Sealed Bids for the construction of the Raw Water Project will be received, by La Plata West Water Authority and Lake Durango Water Authority, at the office of Bartlett & West, Inc., 1199 Main Ave., Suite 209, Durango, Colorado 81301, until 2:00 PM local time on December 3, 2015, at which time the Bids received will be publicly opened and read. The Project consists of constructing an Intake Pumping Station, Booster Pump Station, Water Intake Screen(s), raw water pipeline and appurtenances, treated water pipeline and appurtenances, and other associated Work.

Bids will be received for a three Contracts:

Contract 1: Raw Water Pumping Facilities and Pipeline

Contract 2: Underwater Installation of Cylindrical Water Intake Screen(s)

Contract 3: Lake Durango Treated Water Pipeline

Bids shall be on a lump sum and unit price basis, with alternate bid items as indicated in the Bid Form.

The Issuing Office for the Bidding Documents is:

Bartlett & West, Inc.

1199 Main Ave., Suite 209

Durango, CO 81301

(970) 306-0924

Jeffrey Shamburg, PE

jeff.shamburg@bartwest.com

Prospective Bidders may examine the Bidding Documents at the Issuing Office on Mondays through Fridays between the hours of 9:00 AM – 4:00 PM, and may obtain copies of the Bidding Documents from the Issuing Office as described below.

Bidding Documents may be viewed and ordered online by registering with the Issuing Office at their website (<http://www.bartwest.com>, follow "Bid Documents" link). Following registration and payment of \$40 download fee, complete sets of Bidding Documents may be downloaded from the Issuing Office's website as "zipped" portable document format (PDF) files. The cost of printed Bidding Documents, including shipping from the Issuing Office is \$400 for Contract 1 and Contract 3 documents and \$40 for Contract 2 documents. Cost of Bidding Documents and shipping is non-refundable. The date that the Bidding Documents are transmitted by the Issuing Office will be considered the Bidder's date of receipt of the Bidding Documents. Partial sets of the Bidding Documents will not be available from the Issuing Office.

A pre-bid conference will be held at 10:00 AM local time on November 10, 2015 at La Plata Electric Association, 45 Stewart St., Durango, Colorado. Attendance at the pre-bid conference is highly encouraged but is not mandatory.

Bid security shall be furnished in accordance with the Instructions to Bidders.

Owner: La Plata West Water Authority (Contracts 1 & 2), Lake Durango Water Authority
(Contract 3)

By: Roy Horvath

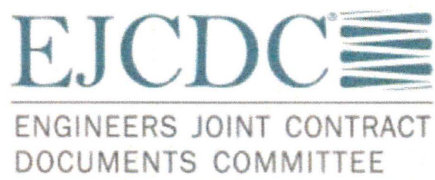
Title: President, LPWWA

Date: October 30, 2015

++ END OF ADVERTISEMENT FOR BIDS ++

INSTRUCTIONS TO BIDDERS FOR CONSTRUCTION CONTRACTS

Prepared by



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— **& WEST**

ARTICLE 1 – DEFINED TERMS

- 1.01 Terms used in these Instructions to Bidders have the meanings indicated in the General Conditions and Supplementary Conditions. Additional terms used in these Instructions to Bidders have the meanings indicated below:

A. *Issuing Office* – The office from which the Bidding Documents are to be issued.

ARTICLE 2 – COPIES OF BIDDING DOCUMENTS

- 2.01 Complete sets of the Bidding Documents may be obtained from the Issuing Office in the number and format stated in the advertisement or invitation to bid.
- 2.02 Complete sets of Bidding Documents shall be used in preparing Bids; neither Owner nor Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.
- 2.03 Owner and Engineer, in making copies of Bidding Documents available on the above terms, do so only for the purpose of obtaining Bids for the Work and do not authorize or confer a license for any other use.

ARTICLE 3 – QUALIFICATIONS OF BIDDERS

- 3.01 To demonstrate Bidder's qualifications to perform the Work, Bidder shall submit with its Bid (a) written evidence establishing its qualifications such as financial data, previous experience, and present commitments, and (b) the following additional information:
- A. Evidence of Bidder's authority to do business in the state where the Project is located.
 - B. Bidder's state or other contractor license number, if applicable.
 - C. Subcontractor and Supplier qualification information; coordinate with provisions of Article 12 of these Instructions, "Subcontractors, Suppliers, and Others."
 - D. Other required information regarding qualifications
- 3.02 A Bidder's failure to submit required qualification information within the times indicated may disqualify Bidder from receiving an award of the Contract.
- 3.03 No requirement in this Article 3 to submit information will prejudice the right of Owner to seek additional pertinent information regarding Bidder's qualifications.
- 3.04 Bidder is advised to carefully review those portions of the Bid Form requiring Bidder's representations and certifications.

ARTICLE 4 – SITE AND OTHER AREAS; EXISTING SITE CONDITIONS; EXAMINATION OF SITE; OWNER'S SAFETY PROGRAM; OTHER WORK AT THE SITE

- 4.01 *Site and Other Areas*
- A. The Site is identified in the Bidding Documents. By definition, the Site includes rights-of-way, easements, and other lands furnished by Owner for the use of the Contractor. Any additional lands required for temporary construction facilities, construction equipment, or storage of materials and equipment, and any access needed for such additional lands, are to be obtained and paid for by Contractor.

4.02 Existing Site Conditions

A. Subsurface and Physical Conditions; Hazardous Environmental Conditions

1. The Supplementary Conditions identify:
 - a. those reports known to Owner of explorations and tests of subsurface conditions at or adjacent to the Site.
 - b. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities).
 - c. reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site.
 - d. Technical Data contained in such reports and drawings.
2. Owner will make copies of reports and drawings referenced above available to any Bidder on request. These reports and drawings are not part of the Contract Documents, but the Technical Data contained therein upon whose accuracy Bidder is entitled to rely, as provided in the General Conditions, has been identified and established in the Supplementary Conditions. Bidder is responsible for any interpretation or conclusion Bidder draws from any Technical Data or any other data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings.
3. If the Supplementary Conditions do not identify Technical Data, the default definition of Technical Data set forth in Article 1 of the General Conditions will apply.
4. Geotechnical Baseline Report: The Bidding Documents contain a Geotechnical Baseline Report (GBR). The GBR describes certain select subsurface conditions that are anticipated to be encountered by Contractor during construction in specified locations ("Baseline Conditions"). The GBR is a Contract Document.

The Baseline Conditions in the GBR are intended to reduce uncertainty and the degree of contingency in submitted Bids. However, Bidders cannot rely solely on the Baseline Conditions. Bids should be based on a comprehensive approach that includes an independent review and analysis of the GBR, all other Contract Documents, Technical Data, other available information, and observable surface conditions. Not all potential subsurface conditions are baselined.

Nothing in the GBR is intended to relieve Bidders of the responsibility to make their own determinations regarding construction costs, bidding strategies, and Bid prices, nor of the responsibility to select and be responsible for the means, methods, techniques, sequences, and procedures of construction, and for safety precautions and programs incident thereto.

- B. Underground Facilities: Information and data shown or indicated in the Bidding Documents with respect to existing Underground Facilities at or adjacent to the Site are set forth in the Contract Documents and are based upon information and data furnished to Owner and Engineer by owners of such Underground Facilities, including Owner, or others.
- C. Adequacy of Data: Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to subsurface conditions, other physical conditions, and Underground Facilities, and possible changes in the Bidding Documents due to differing or unanticipated subsurface or physical conditions appear in Paragraphs 5.03, 5.04, and 5.05 of the General Conditions. Provisions concerning responsibilities for the adequacy of data

furnished to prospective Bidders with respect to a Hazardous Environmental Condition at the Site, if any, and possible changes in the Contract Documents due to any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work, appear in Paragraph 5.06 of the General Conditions.

4.03 *Site Visit and Testing by Bidders*

- A. Bidder shall conduct the required Site visit during normal working hours, and shall not disturb any ongoing operations at the Site.
- B. Bidder is not required to conduct any subsurface testing, or exhaustive investigations of Site conditions.
- C. On request, and to the extent Owner has control over the Site, and schedule permitting, the Owner will provide Bidder access to the Site to conduct such additional examinations, investigations, explorations, tests, and studies as Bidder deems necessary for preparing and submitting a successful Bid. Owner will not have any obligation to grant such access if doing so is not practical because of existing operations, security or safety concerns, or restraints on Owner's authority regarding the Site.
- D. Bidder shall comply with all applicable Laws and Regulations regarding excavation and location of utilities, obtain all permits, and comply with all terms and conditions established by Owner or by property owners or other entities controlling the Site with respect to schedule, access, existing operations, security, liability insurance, and applicable safety programs.
- E. Bidder shall fill all holes and clean up and restore the Site to its former condition upon completion of such explorations, investigations, tests, and studies.

4.04 *Owner's Safety Program*

- A. Site visits and work at the Site may be governed by an Owner safety program. As the General Conditions indicate, if an Owner safety program exists, it will be noted in the Supplementary Conditions.

4.05 *Other Work at the Site*

- A. Reference is made to Article 8 of the Supplementary Conditions for the identification of the general nature of other work of which Owner is aware (if any) that is to be performed at the Site by Owner or others (such as utilities and other prime contractors) and relates to the Work contemplated by these Bidding Documents. If Owner is party to a written contract for such other work, then on request, Owner will provide to each Bidder access to examine such contracts (other than portions thereof related to price and other confidential matters), if any.

ARTICLE 5 – BIDDER'S REPRESENTATIONS

5.01 It is the responsibility of each Bidder before submitting a Bid to:

- A. examine and carefully study the Bidding Documents, and any data and reference items identified in the Bidding Documents;
- B. visit the Site, conduct a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and satisfy itself as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work;

- C. become familiar with and satisfy itself as to all Laws and Regulations that may affect cost, progress, and performance of the Work;
- D. carefully study all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings, and (2) reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings;
- E. consider the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder; and (3) Bidder's safety precautions and programs;
- F. agree, based on the information and observations referred to in the preceding paragraph, that at the time of submitting its Bid no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of its Bid for performance of the Work at the price bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents;
- G. become aware of the general nature of the work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents;
- H. promptly give Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder discovers in the Bidding Documents and confirm that the written resolution thereof by Engineer is acceptable to Bidder;
- I. determine that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance and furnishing of the Work; and
- J. agree that the submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article, that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

ARTICLE 6 – PRE-BID CONFERENCE

- 6.01 A pre-Bid conference will be held at the time and location stated in the invitation or advertisement to bid. Representatives of Owner and Engineer will be present to discuss the Project. Bidders are encouraged to attend and participate in the conference. Engineer will transmit to all prospective Bidders of record such Addenda as Engineer considers necessary in response to questions arising at the conference. Oral statements may not be relied upon and will not be binding or legally effective.

ARTICLE 7 – INTERPRETATIONS AND ADDENDA

- 7.01 All questions about the meaning or intent of the Bidding Documents are to be submitted to Engineer in writing. Interpretations or clarifications considered necessary by Engineer in

response to such questions will be issued by Addenda delivered to all parties recorded as having received the Bidding Documents. Questions received less than seven days prior to the date for opening of Bids may not be answered. Only questions answered by Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

- 7.02 Addenda may be issued to clarify, correct, supplement, or change the Bidding Documents.

ARTICLE 8 – BID SECURITY

- 8.01 A Bid must be accompanied by Bid security made payable to Owner in an amount of 5 percent of Bidder's maximum Bid price (determined by adding the base bid and all alternates) and in the form of a certified check, bank money order, or a Bid bond (on the form included in the Bidding Documents) issued by a surety meeting the requirements of Paragraphs 6.01 and 6.02 of the General Conditions.
- 8.02 The Bid security of the apparent Successful Bidder will be retained until Owner awards the contract to such Bidder, and such Bidder has executed the Contract Documents, furnished the required contract security, and met the other conditions of the Notice of Award, whereupon the Bid security will be released. If the Successful Bidder fails to execute and deliver the Contract Documents and furnish the required contract security within 15 days after the Notice of Award, Owner may consider Bidder to be in default, annul the Notice of Award, and the Bid security of that Bidder will be forfeited. Such forfeiture shall be Owner's exclusive remedy if Bidder defaults.
- 8.03 The Bid security of other Bidders that Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of seven days after the Effective Date of the Contract or 61 days after the Bid opening, whereupon Bid security furnished by such Bidders will be released.
- 8.04 Bid security of other Bidders that Owner believes do not have a reasonable chance of receiving the award will be released within seven days after the Bid opening.

ARTICLE 9 – CONTRACT TIMES

- 9.01 The number of days within which, or the dates by which the Work is to be substantially completed, and completed and ready for final payment, are set forth in the Agreement.

ARTICLE 10 – LIQUIDATED DAMAGES

- 10.01 Provisions for liquidated damages, if any, for failure to timely attain a Milestone, Substantial Completion, or completion of the Work in readiness for final payment, are set forth in the Agreement.

ARTICLE 11 – SUBSTITUTE AND "OR-EQUAL" ITEMS

- 11.01 The Contract for the Work, as awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents, and those "or-equal" or substitute materials and equipment subsequently approved by Engineer prior to the submittal of Bids and identified by Addendum. No item of material or equipment will be considered by Engineer as an "or-equal" or substitute unless written request for approval has been submitted by Bidder and has been received by Engineer at least 15 days prior to the date for receipt of Bids. Each such request shall comply with the requirements of Paragraphs 7.04 and 7.05 of the General Conditions. The burden of proof of the merit of the proposed item is upon Bidder. Engineer's

decision of approval or disapproval of a proposed item will be final. If Engineer approves any such proposed item, such approval will be set forth in an Addendum issued to all prospective Bidders. Bidders shall not rely upon approvals made in any other manner.

- 11.02 All prices that Bidder sets forth in its Bid shall be based on the presumption that the Contractor will furnish the materials and equipment specified or described in the Bidding Documents, as supplemented by Addenda. Any assumptions regarding the possibility of post-Bid approvals of "or-equal" or substitution requests are made at Bidder's sole risk.

ARTICLE 12 – SUBCONTRACTORS, SUPPLIERS, AND OTHERS

- 12.01 A Bidder shall be prepared to retain specific Subcontractors, Suppliers, or other individuals or entities for the performance of the Work if required by the Bidding Documents (most commonly in the Specifications) to do so. If a prospective Bidder objects to retaining any such Subcontractor, Supplier, or other individual or entity, and the concern is not relieved by an Addendum, then the prospective Bidder should refrain from submitting a Bid.
- 12.02 Subsequent to the submittal of the Bid, Owner may not require the Successful Bidder or Contractor to retain any Subcontractor, Supplier, or other individual or entity against which Contractor has reasonable objection.
- 12.03 The apparent Successful Bidder, and any other Bidder so requested, shall within five days after Bid opening, submit to Owner a list of the Subcontractors or Suppliers proposed for the following portions of the Work: Electrical, Instrumentation and Control.

If requested by Owner, such list shall be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor, Supplier, or other individual or entity. If Owner or Engineer, after due investigation, has reasonable objection to any proposed Subcontractor, Supplier, individual, or entity, Owner may, before the Notice of Award is given, request apparent Successful Bidder to submit an acceptable substitute, in which case apparent Successful Bidder shall submit a substitute, Bidder's Bid price will be increased (or decreased) by the difference in cost occasioned by such substitution, and Owner may consider such price adjustment in evaluating Bids and making the Contract award.

- 12.04 If apparent Successful Bidder declines to make any such substitution, Owner may award the Contract to the next lowest Bidder that proposes to use acceptable Subcontractors, Suppliers, or other individuals or entities. Declining to make requested substitutions will constitute grounds for forfeiture of the Bid security of any Bidder. Any Subcontractor, Supplier, individual, or entity so listed and against which Owner or Engineer makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to Owner and Engineer subject to subsequent revocation of such acceptance as provided in Paragraph 7.06 of the General Conditions.

ARTICLE 13 – PREPARATION OF BID

- 13.01 The Bid Form is included with the Bidding Documents.
- A. All blanks on the Bid Form shall be completed in ink and the Bid Form signed in ink. Erasures or alterations shall be initialed in ink by the person signing the Bid Form. A Bid price shall be indicated for each section, Bid item, alternate, adjustment unit price item, and unit price item listed therein.

- B. If the Bid Form expressly indicates that submitting pricing on a specific alternate item is optional, and Bidder elects to not furnish pricing for such optional alternate item, then Bidder may enter the words "No Bid" or "Not Applicable."
- 13.02 A Bid by a corporation shall be executed in the corporate name by a corporate officer (whose title must appear under the signature), accompanied by evidence of authority to sign. The corporate address and state of incorporation shall be shown.
- 13.03 A Bid by a partnership shall be executed in the partnership name and signed by a partner (whose title must appear under the signature), accompanied by evidence of authority to sign. The partnership's address for receiving notices shall be shown.
- 13.04 A Bid by a limited liability company shall be executed in the name of the firm by a member or other authorized person and accompanied by evidence of authority to sign. The state of formation of the firm and the firm's address for receiving notices shall be shown.
- 13.05 A Bid by an individual shall show the Bidder's name and address for receiving notices.
- 13.06 A Bid by a joint venture shall be executed by an authorized representative of each joint venturer in the manner indicated on the Bid Form. The joint venture's address for receiving notices shall be shown.
- 13.07 All names shall be printed in ink below the signatures.
- 13.08 The Bid shall contain an acknowledgment of receipt of all Addenda, the numbers of which shall be filled in on the Bid Form.
- 13.09 Postal and e-mail addresses and telephone number for communications regarding the Bid shall be shown.
- 13.10 The Bid shall contain evidence of Bidder's authority and qualification to do business in the state where the Project is located. Bidder's state contractor license number, if any, shall also be shown on the Bid Form.

ARTICLE 14 – BASIS OF BID

14.01 Base Bid with Alternates

- A. Bidders shall submit a Bid on a lump sum basis for the base Bid and include a separate price for each alternate described in the Bidding Documents and as provided for in the Bid Form. The price for each alternate will be the amount added to or deleted from the base Bid if Owner selects the alternate.
- B. In the comparison of Bids, alternates will be applied in the same order of priority as listed in the Bid Form.

14.02 Unit Price

- A. Bidders shall submit a Bid on a unit price basis for each item of Work listed in the unit price section of the Bid Form.
- B. The "Bid Price" (sometimes referred to as the extended price) for each unit price Bid item will be the product of the "Estimated Quantity" (which Owner or its representative has set forth in the Bid Form) for the item and the corresponding "Bid Unit Price" offered by the Bidder. The total of all unit price Bid items will be the sum of these "Bid Prices"; such total will be used by Owner for Bid comparison purposes. The final quantities and Contract Price will be determined in accordance with Paragraph 13.03 of the General Conditions.

- C. Discrepancies between the multiplication of units of Work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.

14.03 Allowances

- A. For cash allowances, the Bid price shall include such amounts as the Bidder deems proper for Contractor's overhead, costs, profit, and other expenses on account of cash allowances, if any, named in the Contract Documents, in accordance with Paragraph 13.02.B of the General Conditions.

ARTICLE 15 – SUBMITTAL OF BID

- 15.01 With each copy of the Bidding Documents, a Bidder is furnished one separate unbound copy of the Bid Form, and, if required, the Bid Bond Form. The unbound copy of the Bid Form is to be completed and submitted with the Bid security and the other documents required to be submitted under the terms of Article 7 of the Bid Form.
- 15.02 A Bid shall be received no later than the date and time prescribed and at the place indicated in the advertisement or invitation to bid and shall be enclosed in a plainly marked package with the Project title (and, if applicable, the designated portion of the Project for which the Bid is submitted), the name and address of Bidder, and shall be accompanied by the Bid security and other required documents. If a Bid is sent by mail or other delivery system, the sealed envelope containing the Bid shall be enclosed in a separate package plainly marked on the outside with the notation "BID ENCLOSED." A mailed Bid shall be addressed as indicated in the advertisement or invitation to bid.
- 15.03 Bids received after the date and time prescribed for the opening of bids, or not submitted at the correct location or in the designated manner, will not be accepted and will be returned to the Bidder unopened.

ARTICLE 16 – MODIFICATION AND WITHDRAWAL OF BID

- 16.01 A Bid may be withdrawn by an appropriate document duly executed in the same manner that a Bid must be executed and delivered to the place where Bids are to be submitted prior to the date and time for the opening of Bids. Upon receipt of such notice, the unopened Bid will be returned to the Bidder.
- 16.02 If a Bidder wishes to modify its Bid prior to Bid opening, Bidder must withdraw its initial Bid in the manner specified in Paragraph 16.01 and submit a new Bid prior to the date and time for the opening of Bids.
- 16.03 If within 24 hours after Bids are opened any Bidder files a duly signed written notice with Owner and promptly thereafter demonstrates to the reasonable satisfaction of Owner that there was a material and substantial mistake in the preparation of its Bid, that Bidder may withdraw its Bid, and the Bid security will be returned. Thereafter, if the Work is rebid, that Bidder will be disqualified from further bidding on the Work.

ARTICLE 17 – OPENING OF BIDS

- 17.01 Bids will be opened at the time and place indicated in the advertisement or invitation to bid and, unless obviously non-responsive, read aloud publicly. An abstract of the amounts of the base Bids and major alternates, if any, will be made available to Bidders after the opening of Bids.

ARTICLE 18 – BIDS TO REMAIN SUBJECT TO ACCEPTANCE

- 18.01 All Bids will remain subject to acceptance for the period of time stated in the Bid Form, but Owner may, in its sole discretion, release any Bid and return the Bid security prior to the end of this period.

ARTICLE 19 – EVALUATION OF BIDS AND AWARD OF CONTRACT

- 19.01 Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, unbalanced, or conditional Bids. Owner will reject the Bid of any Bidder that Owner finds, after reasonable inquiry and evaluation, to not be responsible. If Bidder purports to add terms or conditions to its Bid, takes exception to any provision of the Bidding Documents, or attempts to alter the contents of the Contract Documents for purposes of the Bid, then the Owner will reject the Bid as nonresponsive; provided that Owner also reserves the right to waive all minor informalities not involving price, time, or changes in the Work.
- 19.02 If Owner awards the contract for the Work, such award shall be to the responsible Bidder submitting the lowest responsive Bid.
- 19.03 Evaluation of Bids
- A. In evaluating Bids, Owner will consider whether or not the Bids comply with the prescribed requirements, and such alternates, unit prices, and other data, as may be requested in the Bid Form or prior to the Notice of Award.
 - B. In the comparison of Bids, alternates will be applied in the same order of priority as listed in the Bid Form. To determine the Bid prices for purposes of comparison, Owner shall announce to all bidders a “Base Bid plus alternates” budget after receiving all Bids, but prior to opening them. For comparison purposes alternates will be accepted, following the order of priority established in the Bid Form, until doing so would cause the budget to be exceeded. After determination of the Successful Bidder based on this comparative process and on the responsiveness, responsibility, and other factors set forth in these Instructions, the award may be made to said Successful Bidder on its base Bid and any combination of its additive alternate Bids for which Owner determines funds will be available at the time of award. For the determination of the apparent low Bidder when unit price bids are submitted, Bids will be compared on the basis of the total of the products of the estimated quantity of each item and unit price Bid for that item, together with any lump sum items.
- 19.04 In evaluating whether a Bidder is responsible, Owner will consider the qualifications of the Bidder and may consider the qualifications and experience of Subcontractors and Suppliers proposed for those portions of the Work for which the identity of Subcontractors and Suppliers must be submitted as provided in the Bidding Documents.
- 19.05 Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders and any proposed Subcontractors or Suppliers.

ARTICLE 20 – BONDS AND INSURANCE

- 20.01 Article 6 of the General Conditions, as may be modified by the Supplementary Conditions, sets forth Owner’s requirements as to performance and payment bonds and insurance. When the Successful Bidder delivers the Agreement (executed by Successful Bidder) to Owner, it shall be accompanied by required bonds and insurance documentation.

ARTICLE 21 – SIGNING OF AGREEMENT

- 21.01 When Owner issues a Notice of Award to the Successful Bidder, it shall be accompanied by the unexecuted counterparts of the Agreement along with the other Contract Documents as identified in the Agreement. Within 15 days thereafter, Successful Bidder shall execute and deliver the required number of counterparts of the Agreement (and any bonds and insurance documentation required to be delivered by the Contract Documents) to Owner. Within ten days thereafter, Owner shall deliver one fully executed counterpart of the Agreement to Successful Bidder, together with printed and electronic copies of the Contract Documents as stated in Paragraph 2.02 of the General Conditions.

ARTICLE 22 – SALES AND USE TAXES

- 22.01 Owner is exempt from Colorado state sales and use taxes on materials and equipment to be incorporated in the Work. (Exemption No. to be provided upon request). Said taxes shall not be included in the Bid. Refer to Paragraph SC-7.09 of the Supplementary Conditions for additional information.

BID FORM FOR CONSTRUCTION CONTRACTS

Prepared by



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BID FORM

Contract 1: Raw Water Pumping Facilities and Pipeline

Raw Water Project

La Plata West Water Authority

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BARTLETT & WEST

ARTICLE 1 – BID RECIPIENT

- 1.01 This Bid is submitted to:

Bartlett & West, Inc.

c/o La Plata West Water Authority

1199 Main Ave, Suite 209

Durango, CO 81301

- 1.02 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with Owner in the form included in the Bidding Documents to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 2 – BIDDER'S ACKNOWLEDGEMENTS

- 2.01 Bidder accepts all of the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for 60 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

ARTICLE 3 – BIDDER'S REPRESENTATIONS

- 3.01 In submitting this Bid, Bidder represents that:

- A. Bidder has examined and carefully studied the Bidding Documents, and any data and reference items identified in the Bidding Documents, and hereby acknowledges receipt of the following Addenda:

<u>Addendum No.</u>	<u>Addendum, Date</u>
_____	_____
_____	_____
_____	_____
_____	_____

- B. Bidder has visited the Site, conducted a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and satisfied itself as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
- C. Bidder is familiar with and has satisfied itself as to all Laws and Regulations that may affect cost, progress, and performance of the Work.
- D. Bidder has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings, and (2) reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings.

- E. Bidder has considered the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and any Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder; and (3) Bidder's safety precautions and programs.
- F. Bidder agrees, based on the information and observations referred to in the preceding paragraph, that no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents.
- G. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.
- H. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and confirms that the written resolution thereof by Engineer is acceptable to Bidder.
- I. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance and furnishing of the Work.
- J. The submission of this Bid constitutes an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article, and that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

ARTICLE 4 – BIDDER'S CERTIFICATION

4.01 Bidder certifies that:

- A. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation;
- B. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid;
- C. Bidder has not solicited or induced any individual or entity to refrain from bidding; and
- D. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 4.01.D:
 - 1. "corrupt practice" means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the bidding process;
 - 2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
 - 3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels; and

4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

ARTICLE 5 – BASIS OF BID

5.01 Bidder will complete the Work in accordance with the Contract Documents for the following price(s):

Bid Package 1: Intake Pump Station

Base Bid Item 1: Intake Pump Station	\$
Bid Item 2: Sitework and Yard Piping	\$
Bid Item 3: Instrumentation and Control	\$
Alternate 1 Add: Air Burst System	\$
Alternate 2 Add: Bridge Crane	\$

Total of All Lump Sums \$ _____

Bid Package 2: Booster Pump Station

Base Bid Item 1: Booster Pump Station	\$
Bid Item 2: Sitework and Yard Piping	\$
Bid Item 3: Instrumentation and Control	\$
Alternate 1 Deduct: Alternate Pump Configuration 1	\$
Alternate 2 Deduct: Alternate Pump Configuration 2	\$
Alternate 3 Add: Extended Performance Test	\$

Total of All Lump Sums \$ _____

Bid Package 3: 210 Pipeline and Access Road**UNIT PRICE BID**

Item No.	Description	Unit	Estimated Quantity	Bid Unit Price	Bid Price
1	Unclassified Excavation	CF	7,800		
2	Rock Excavation	CY	2,000		
3	Roadway Sub-Base	CY	1,800		
4	Roadway Base	CY	870		
5	18" Storm Sewer Culvert Pipe	LF	135		
6	24" Storm Sewer Culvert Pipe	LF	190		
7	30" Ductile Iron Pipe	LF	4,100		
8	30" 11 1/4° Bend	EA	6		
9	30" 22 1/2° Bend	EA	7		
10	30" 45° Bend	EA	7		
11	Air/Vacuum Valve	EA	0		
12	Pig Retrieval Manhole	EA	1		
Total of All Unit Price Bid Items					\$
A1	Alternate Add Minimum Bury Depth – 60"	LF	4,100		

Bidder acknowledges that (1) each Bid Unit Price includes an amount considered by Bidder to be adequate to cover Contractor's overhead and profit for each separately identified item, and (2) estimated quantities are not guaranteed, and are solely for the purpose of comparison of Bids, and final payment for all unit price Bid items will be based on actual quantities, determined as provided in the Contract Documents.

Bid Package 4: 125 Pipeline**UNIT PRICE BID**

Item No.	Description	Unit	Estimated Quantity	Bid Unit Price	Bid Price
1	8" DR 18 (CL 235) AWWA C-900 PVC Pipe	LF	8,975		
2	8" DR 25 (CL 165) AWWA C-900 PVC Pipe	LF	3,045		
3	8" DR 18 (CL 235) AWWA C-900 RJ PVC Pipe	LF	300		
4	Rock Excavation	CY	356		
5	NOT USED				
6	8" 11 1/4° Bend and Block	EA	4		
7	8" 11 1/4° Vertical Bend and Block	EA	6		
8	8" 22 1/2° Bend and Block	EA	5		
9	8" 22 1/2° Vertical Bend and Block	EA	1		
10	8" 45° Bend and Block	EA	2		
11	8" 90° Bend and Block	EA	2		
12	8" 90° Vertical Bend and Block	EA	1		
13	8" Gate Valve, Buried	EA	1		
14	8" Type 2 Road Crossing	LF	2		
15	8" Low Point Drain	EA	11		
16	Air/Vacuum Valve	EA	4		
17	Remove and Replace Gravel Surface	SY	270		
18	Remove and Replace Asphaltic Concrete Pavement	SY	73		
19	High Pressure Gas Main Crossing	LS	1		
Total of All Unit Price Bid Items					\$

Bidder acknowledges that (1) each Bid Unit Price includes an amount considered by Bidder to be adequate to cover Contractor's overhead and profit for each separately identified item, and (2) estimated quantities are not guaranteed, and are solely for the purpose of comparison of Bids, and final payment for all unit price Bid items will be based on actual quantities, determined as provided in the Contract Documents.

Item No.	Description	Unit	Estimated Quantity	Bid Unit Price	Bid Price
A1.1	10" DR 18 (CL 235) AWWA C-900 PVC Pipe	LF	3,100		
A1.2	10" DR 25 (CL 165) AWWA C-900 PVC Pipe	LF	8,920		
A1.3	10" DR 18 (CL 165) AWWA C-900 RJ PVC Pipe	LF	300		
A1.4	Rock Excavation	CY	378		
A1.5	NOT USED				
A1.6	10" 11 1/4° Bend and Block	EA	4		
A1.7	10" 11 1/4° Bend and Block	EA	6		
A1.8	10" 22 1/2° Bend and Block	EA	5		
A1.9	10" 22 1/2° Vertical Bend and Block	EA	1		
A1.10	10" 45° Bend and Block	EA	2		
A1.11	10" 90° Bend and Block	EA	2		
A1.12	10" 90° Vertical Bend and Block	EA	1		
A1.13	10" Buried Gate Valve	EA	1		
A1.14	10" Type 2 Road Crossing	LF	2		
A1.15	10" Low Point Drain	EA	11		
A1.16	Air/Vacuum Valve	EA	4		
A1.17	Remove and Replace Gravel Surface	SY	270		
A1.18	Remove and Replace Asphaltic Concrete Pavement	SY	73		
A1.19	High Pressure Gas Main Crossing	LS	1		
Total of All Alternate 1 Unit Price Bid Items					\$

Bidder acknowledges that (1) each Bid Unit Price includes an amount considered by Bidder to be adequate to cover Contractor's overhead and profit for each separately identified item, and (2) estimated quantities are not guaranteed, and are solely for the purpose of comparison of Bids, and final payment for all unit price Bid items will be based on actual quantities, determined as provided in the Contract Documents.

Item No.	Description	Unit	Estimated Quantity	Bid Unit Price	Bid Price
A2.1	16" DR 18 (CL 235) AWWA C-900 PVC Pipe	LF	12,020		
A2.2	16" DR 18 (CL 235) AWWA C-900 RJ PVC Pipe	LF	300		
A2.3	Rock Excavation	CY	444		
A2.4	NOT USED				
A2.5	16" 11 1/4° Bend and Block	EA	4		
A2.6	16" 11 1/4° Bend and Block	EA	6		
A2.7	16" 22 1/2° Bend and Block	EA	5		
A2.8	16" 22 1/2° Vertical Bend and Block	EA	1		
A2.9	16" 45° Bend and Block	EA	2		
A2.10	16" 90° Bend and Block	EA	2		
A2.11	16" 90° Vertical Bend and Block	EA	1		
A2.12	16" Buried Gate Valve	EA	1		
A2.13	16" Type 2 Road Crossing	LF	2		
A2.14	16" Low Point Drain	EA	11		
A2.15	Air/Vacuum Valve	EA	4		
A2.16	Remove and Replace Gravel Surface	SY	270		
A2.17	Remove and Replace Asphaltic Concrete Pavement	SY	73		
A2.18	16" Tee and Cap Assembly	EA	1		
A2.19	High Pressure Gas Main Crossing	LS	1		
Total of All Alternate 2 Unit Price Bid Items					\$

Bidder acknowledges that (1) each Bid Unit Price includes an amount considered by Bidder to be adequate to cover Contractor's overhead and profit for each separately identified item, and (2) estimated quantities are not guaranteed, and are solely for the purpose of comparison of Bids, and final payment for all unit price Bid items will be based on actual quantities, determined as provided in the Contract Documents.

Item No.	Description	Unit	Estimated Quantity	Bid Unit Price	Bid Price
A2.21	Alternate Add Minimum Bury Depth – 60"	LF	12,320		

Bidder acknowledges that (1) each Bid Unit Price includes an amount considered by Bidder to be adequate to cover Contractor's overhead and profit for each separately identified item, and (2) estimated quantities are not guaranteed, and are solely for the purpose of comparison of Bids, and final payment for all unit price Bid items will be based on actual quantities, determined as provided in the Contract Documents.

Bid Package 5: Lake Durango Pipeline**UNIT PRICE BID**

Item No.	Description	Unit	Estimated Quantity	Bid Unit Price	Bid Price
1	8" DR 25 (CL 165) AWWA C-900 PVC Pipe	LF	7,220		
2	Rock Excavation	CY	215		
3	8" 11 1/4° Bend and Block	EA	11		
4	8" 22 1/2° Bend and Block	EA	8		
5	8" 45° Bend and Block	EA	4		
6	8" 90° Bend and Block	EA	3		
7	8" Gate Valve, Buried	EA	3		
8	8" Type 3 Road Crossing	LF	1		
9	8" Low Point Drain	EA	4		
10	Fire Hydrant Assembly	EA	1		
11	Air/Vacuum Valve	EA	5		
12	Remove and Replace Gravel Surface	SY	61		
13	Outlet Structure	LS	1		
Total of All Unit Price Bid Items					\$
A1	Alternate Add Minimum Bury Depth – 60"	LF	7,220		

Bidder acknowledges that (1) each Bid Unit Price includes an amount considered by Bidder to be adequate to cover Contractor's overhead and profit for each separately identified item, and (2) estimated quantities are not guaranteed, and are solely for the purpose of comparison of Bids, and final payment for all unit price Bid items will be based on actual quantities, determined as provided in the Contract Documents.

Time of Completion

- 5.02 Bidder agrees that the Work will be substantially complete and will be completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions on or before the dates or within the number of calendar days indicated in the Agreement.
- 5.03 Bidder accepts the provisions of the Agreement as to liquidated damages.

ARTICLE 6 – ATTACHMENTS TO THIS BID

- 6.01 The following documents are submitted with and made a condition of this Bid:
- A. Required Bid security;
 - B. List of Proposed Subcontractors;
 - C. List of Proposed Suppliers;
 - D. List of Project References;
 - E. Evidence of authority to do business in the state of the Project; or a written covenant to obtain such license within the time for acceptance of Bids;
 - F. Contractor's License No.: (if applicable); and
 - G. Required Bidder Qualification Statement with supporting data

ARTICLE 7 – DEFINED TERMS

- 7.01 The terms used in this Bid with initial capital letters have the meanings stated in the Instructions to Bidders, the General Conditions, and the Supplementary Conditions.

ARTICLE 8 – BID SUBMITTAL

BIDDER: Indicate correct name of bidding entity

By:

Signature _____

Printed name _____

(If Bidder is a corporation, a limited liability company, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest:

Signature _____

Printed name _____

Title: _____

Submittal Date: _____

Address for giving notices:

Telephone Number: _____

Fax Number: _____

Contact Name and e-mail address: _____

Bidder's License No.: _____

(where applicable)

BID FORM FOR CONSTRUCTION CONTRACTS

Prepared by



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BID FORM

Contract 2: Underwater Installation of Intake Screen(s)

Raw Water Project

La Plata West Water Authority

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BARTLETT & WEST

ARTICLE 1 – BID RECIPIENT

1.01 This Bid is submitted to:

Bartlett & West, Inc.

c/o La Plata West Water Authority

1199 Main Ave, Suite 209

Durango, CO 81301

1.02 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with Owner in the form included in the Bidding Documents to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 2 – BIDDER'S ACKNOWLEDGEMENTS

2.01 Bidder accepts all of the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for 60 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

ARTICLE 3 – BIDDER'S REPRESENTATIONS

3.01 In submitting this Bid, Bidder represents that:

A. Bidder has examined and carefully studied the Bidding Documents, and any data and reference items identified in the Bidding Documents, and hereby acknowledges receipt of the following Addenda:

<u>Addendum No.</u>	<u>Addendum, Date</u>
_____	_____
_____	_____
_____	_____
_____	_____

- B. Bidder has visited the Site, conducted a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and satisfied itself as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
- C. Bidder is familiar with and has satisfied itself as to all Laws and Regulations that may affect cost, progress, and performance of the Work.
- D. Bidder has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings, and (2) reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings.

- E. Bidder has considered the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and any Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder; and (3) Bidder's safety precautions and programs.
- F. Bidder agrees, based on the information and observations referred to in the preceding paragraph, that no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents.
- G. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.
- H. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and confirms that the written resolution thereof by Engineer is acceptable to Bidder.
- I. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance and furnishing of the Work.
- J. The submission of this Bid constitutes an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article, and that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

ARTICLE 4 – BIDDER'S CERTIFICATION

4.01 Bidder certifies that:

- A. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation;
- B. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid;
- C. Bidder has not solicited or induced any individual or entity to refrain from bidding; and
- D. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 4.01.D:
 - 1. "corrupt practice" means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the bidding process;
 - 2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
 - 3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels; and

4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

ARTICLE 5 – BASIS OF BID

- 5.01 Bidder will complete the Work in accordance with the Contract Documents for the following price(s):

Base Bid Item 1: Upper Portal Screen	\$
Alternate 1 Add: Lower Portal Screen	\$

Total of All Lump Sums \$ _____

Time of Completion

- 5.02 Bidder agrees that the Work will be substantially complete and will be completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions on or before the dates or within the number of calendar days indicated in the Agreement.
- 5.03 Bidder accepts the provisions of the Agreement as to liquidated damages.

ARTICLE 6 – ATTACHMENTS TO THIS BID

- 6.01 The following documents are submitted with and made a condition of this Bid:
- A. Required Bid security;
 - B. List of Proposed Subcontractors;
 - C. List of Proposed Suppliers;
 - D. List of Project References;
 - E. Evidence of authority to do business in the state of the Project; or a written covenant to obtain such license within the time for acceptance of Bids;
 - F. Contractor's License No.: (if applicable); and
 - G. Required Bidder Qualification Statement with supporting data

ARTICLE 7 – DEFINED TERMS

- 7.01 The terms used in this Bid with initial capital letters have the meanings stated in the Instructions to Bidders, the General Conditions, and the Supplementary Conditions.

ARTICLE 8 – BID SUBMITTAL

BIDDER: Indicate correct name of bidding entity

By:

Signature _____

Printed name _____

(If Bidder is a corporation, a limited liability company, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest:

Signature _____

Printed name _____

Title: _____

Submittal Date: _____

Address for giving notices:

Telephone Number: _____

Fax Number: _____

Contact Name and e-mail address: _____

Bidder's License No.: _____

(where applicable)

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BARTLETT —
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BID FORM FOR CONSTRUCTION CONTRACTS

Prepared by



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BID FORM

Contract 3: Lake Durango Treated Water Pipeline
Lake Durango Water Authority

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ARTICLE 1 – BID RECIPIENT

- 1.01 This Bid is submitted to:

Bartlett & West, Inc.

c/o Lake Durango Water Authority

1199 Main Ave, Suite 209

Durango, CO 81301

- 1.02 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with Owner in the form included in the Bidding Documents to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 2 – BIDDER'S ACKNOWLEDGEMENTS

- 2.01 Bidder accepts all of the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for 60 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

ARTICLE 3 – BIDDER'S REPRESENTATIONS

- 3.01 In submitting this Bid, Bidder represents that:

- A. Bidder has examined and carefully studied the Bidding Documents, and any data and reference items identified in the Bidding Documents, and hereby acknowledges receipt of the following Addenda:

<u>Addendum No.</u>	<u>Addendum, Date</u>
_____	_____
_____	_____
_____	_____
_____	_____

- B. Bidder has visited the Site, conducted a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and satisfied itself as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
- C. Bidder is familiar with and has satisfied itself as to all Laws and Regulations that may affect cost, progress, and performance of the Work.
- D. Bidder has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings, and (2) reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings.

- E. Bidder has considered the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and any Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder; and (3) Bidder's safety precautions and programs.
- F. Bidder agrees, based on the information and observations referred to in the preceding paragraph, that no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents.
- G. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.
- H. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and confirms that the written resolution thereof by Engineer is acceptable to Bidder.
- I. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance and furnishing of the Work.
- J. The submission of this Bid constitutes an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article, and that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

ARTICLE 4 – BIDDER'S CERTIFICATION

4.01 Bidder certifies that:

- A. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation;
- B. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid;
- C. Bidder has not solicited or induced any individual or entity to refrain from bidding; and
- D. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 4.01.D:
 - 1. "corrupt practice" means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the bidding process;
 - 2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
 - 3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels; and

4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

ARTICLE 5 – BASIS OF BID

- 5.01 Bidder will complete the Work in accordance with the Contract Documents for the following price(s):

UNIT PRICE BID

Item No.	Description	Unit	Estimated Quantity	Bid Unit Price	Bid Price
1	4" AWWA C-900 PVC Pipe	LF	5,397		
2	Rock Excavation	CY	10		
3	4" 11 1/4° Bend	EA	5		
4	4" 22 1/2° Bend	EA	6		
5	4" Buried Gate Valve	EA	1		
6	4" Connect to Existing	EA	1		
7	Air/Vacuum Valve	EA	1		
8	New Meter Installation	EA	10		
9	2 1/2" Flush Hydrant	EA	1		
Total of All Unit Price Bid Items					\$
A1	Deduct for Concurrent Award of Contract 1	LUMP SUM			

Bidder acknowledges that (1) each Bid Unit Price includes an amount considered by Bidder to be adequate to cover Contractor's overhead and profit for each separately identified item, and (2) estimated quantities are not guaranteed, and are solely for the purpose of comparison of Bids, and final payment for all unit price Bid items will be based on actual quantities, determined as provided in the Contract Documents.

Time of Completion

- 5.02 Bidder agrees that the Work will be substantially complete and will be completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions on or before the dates or within the number of calendar days indicated in the Agreement.
- 5.03 Bidder accepts the provisions of the Agreement as to liquidated damages.

ARTICLE 6 – ATTACHMENTS TO THIS BID

- 6.01 The following documents are submitted with and made a condition of this Bid:
- A. Required Bid security;
 - B. List of Proposed Subcontractors;
 - C. List of Proposed Suppliers;
 - D. List of Project References;
 - E. Evidence of authority to do business in the state of the Project; or a written covenant to obtain such license within the time for acceptance of Bids;
 - F. Contractor's License No.: (if applicable); and
 - G. Required Bidder Qualification Statement with supporting data

ARTICLE 7 – DEFINED TERMS

- 7.01 The terms used in this Bid with initial capital letters have the meanings stated in the Instructions to Bidders, the General Conditions, and the Supplementary Conditions.

ARTICLE 8 – BID SUBMITTAL

BIDDER: Indicate correct name of bidding entity

By:

Signature _____

Printed name _____

(If Bidder is a corporation, a limited liability company, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest:

Signature _____

Printed name _____

Title: _____

Submittal Date: _____

Address for giving notices:

Telephone Number: _____

Fax Number: _____

Contact Name and e-mail address: _____

Bidder's License No.: _____

(where applicable)

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BID BOND

Any singular reference to Bidder, Surety, Owner, or other party shall be considered plural where applicable.

BIDDER (*Name and Address*):

SURETY (*Name, and Address of Principal Place of Business*):

OWNER (*Name and Address*):

BID

Bid Due Date:

Description (*Project Name— Include Location*):

BOND

Bond Number:

Date:

Penal sum _____ \$ _____
(Words) (Figures)

Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.

BIDDER

SURETY

Bidder's Name and Corporate Seal

(Seal)

Surety's Name and Corporate Seal

(Seal)

By: _____
Signature

By: _____
Signature (Attach Power of Attorney)

Print Name

Print Name

Title

Title

Attest: _____
Signature

Attest: _____
Signature

Title

Title

Note: Addresses are to be used for giving any required notice.

Provide execution by any additional parties, such as joint venturers, if necessary.

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder any difference between the total amount of Bidder's Bid and the total amount of the Bid of the next lowest, responsible Bidder that submitted a responsive Bid as determined by Owner for the work required by the Contract Documents, provided that:

- 1.1 If there is no such next Bidder, and Owner does not abandon the Project, then Bidder and Surety shall pay to Owner the penal sum set forth on the face of this Bond, and
- 1.2 In no event shall Bidder's and Surety's obligation hereunder exceed the penal sum set forth on the face of this Bond.
- 1.3 Recovery under the terms of this Bond shall be Owner's sole and exclusive remedy upon default of Bidder.

2. Default of Bidder shall occur upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.

3. This obligation shall be null and void if:

- 3.1 Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or
- 3.2 All Bids are rejected by Owner, or
- 3.3 Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).

4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.

5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions shall not in the aggregate exceed 120 days from Bid due date without Surety's written consent.

6. No suit or action shall be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety and in no case later than one year after the Bid due date.

7. Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the Project is located.

8. Notices required hereunder shall be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Registered or Certified Mail, return receipt requested, postage pre-paid, and shall be deemed to be effective upon receipt by the party concerned.

9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.

10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond shall be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute shall govern and the remainder of this Bond that is not in conflict therewith shall continue in full force and effect.

11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

QUALIFICATIONS STATEMENT

THE INFORMATION SUPPLIED IN THIS DOCUMENT IS CONFIDENTIAL TO THE EXTENT
PERMITTED BY LAWS AND REGULATIONS

1. SUBMITTED BY:

Official Name of Firm:

Address:

2. SUBMITTED TO:

3. SUBMITTED FOR:

Owner:

Project Name:

TYPE OF WORK:

4. CONTRACTOR'S CONTACT INFORMATION

Contact Person:

Title:

Phone:

Email:

5. **AFFILIATED COMPANIES:**

Name:

Address:

6. **TYPE OF ORGANIZATION:**

☐ SOLE PROPRIETORSHIP

Name of Owner:

Doing Business As:

Date of Organization:

☐ PARTNERSHIP

Date of Organization:

Type of Partnership:

Name of General Partner(s):

☐ CORPORATION

State of Organization:

Date of Organization:

Executive Officers:

- President:

- Vice President(s):

- Treasurer:

- Secretary:

☐ LIMITED LIABILITY COMPANY

State of Organization:

Date of Organization:

Members:

☐ JOINT VENTURE

Sate of Organization:

Date of Organization:

Form of Organization:

Joint Venture Managing Partner

- Name:

- Address:

Joint Venture Managing Partner

- Name:

- Address:

Joint Venture Managing Partner

- Name:

- Address:

7. LICENSING

Jurisdiction: _____

Type of License: _____

License Number: _____

Jurisdiction: _____

Type of License: _____

License Number: _____

8. CERTIFICATIONS

CERTIFIED BY:

Disadvantage Business Enterprise: _____

Minority Business Enterprise: _____

Woman Owned Enterprise: _____

Small Business Enterprise: _____

Other (_____): _____

9. BONDING INFORMATION

Bonding Company: _____

Address: _____

Bonding Agent: _____

Address: _____

Contact Name: _____

Phone: _____

Aggregate Bonding Capacity: _____

Available Bonding Capacity as of date of this submittal: _____

EJCDC® C-451, Qualifications Statement.

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10. FINANCIAL INFORMATION

Financial Institution: _____

Address: _____

Account Manager: _____

Phone: _____

INCLUDE AS AN ATTACHMENT AN AUDITED BALANCE SHEET FOR EACH OF THE
LAST 3 YEARS

11. CONSTRUCTION EXPERIENCE:

Current Experience:

List on **Schedule A** all uncompleted projects currently under contract (If Joint Venture list each participant's projects separately).

Previous Experience:

List on **Schedule B** all projects completed within the last 5 Years (If Joint Venture list each participant's projects separately).

Has firm listed in Section 1 ever failed to complete a construction contract awarded to it?

☐ YES ☐ NO

If YES, attach as an Attachment details including Project Owner's contact information.

Has any Corporate Officer, Partner, Joint Venture participant or Proprietor ever failed to complete a construction contract awarded to them in their name or when acting as a principal of another entity?

☐ YES ☐ NO

If YES, attach as an Attachment details including Project Owner's contact information.

Are there any judgments, claims, disputes or litigation pending or outstanding involving the firm listed in Section 1 or any of its officers (or any of its partners if a partnership or any of the individual entities if a joint venture)?

☐ YES ☐ NO

If YES, attach as an Attachment details including Project Owner's contact information.

12. SAFETY PROGRAM:

Name of Contractor's Safety Officer: _____

Include the following as attachments:

Provide as an Attachment Contractor's (and Contractor's proposed Subcontractors and Suppliers furnishing or performing Work having a value in excess of 10 percent of the total amount of the Bid) OSHA No. 500- Log & Summary of Occupational Injuries & Illnesses for the past 5 years.

Provide as an Attachment Contractor's (and Contractor's proposed Subcontractors and Suppliers furnishing or performing Work having a value in excess of 10 percent of the total amount of the Bid) list of all OSHA Citations & Notifications of Penalty (monetary or other) received within the last 5 years (indicate disposition as applicable) - IF NONE SO STATE.

Provide as an Attachment Contractor's (and Contractor's proposed Subcontractors and Suppliers furnishing or performing Work having a value in excess of 10 percent of the total amount of the Bid) list of all safety citations or violations under any state all received within the last 5 years (indicate disposition as applicable) - IF NONE SO STATE.

Provide the following for the firm listed in Section V (and for each proposed Subcontractor furnishing or performing Work having a value in excess of 10 percent of the total amount of the Bid) the following (attach additional sheets as necessary):

Workers' compensation Experience Modification Rate (EMR) for the last 5 years:

YEAR	_____	EMR	_____
YEAR	_____	EMR	_____
YEAR	_____	EMR	_____
YEAR	_____	EMR	_____
YEAR	_____	EMR	_____

Total Recordable Frequency Rate (TRFR) for the last 5 years:

YEAR	_____	TRFR	_____
YEAR	_____	TRFR	_____
YEAR	_____	TRFR	_____
YEAR	_____	TRFR	_____
YEAR	_____	TRFR	_____

Total number of man-hours worked for the last 5 Years:

YEAR	_____	TOTAL NUMBER OF MAN-HOURS	_____
YEAR	_____	TOTAL NUMBER OF MAN-HOURS	_____
YEAR	_____	TOTAL NUMBER OF MAN-HOURS	_____
YEAR	_____	TOTAL NUMBER OF MAN-HOURS	_____
YEAR	_____	TOTAL NUMBER OF MAN-HOURS	_____

Provide Contractor's (and Contractor's proposed Subcontractors and Suppliers furnishing or performing Work having a value in excess of 10 percent of the total amount of the Bid) Days Away From Work, Days of Restricted Work Activity or Job Transfer (DART) incidence rate for the particular industry or type of Work to be performed by Contractor and each of Contractor's proposed Subcontractors and Suppliers) for the last 5 years:

YEAR	_____	DART	_____
YEAR	_____	DART	_____
YEAR	_____	DART	_____
YEAR	_____	DART	_____
YEAR	_____	DART	_____

13. EQUIPMENT:

MAJOR EQUIPMENT:

List on **Schedule C** all pieces of major equipment available for use on Owner's Project.

I HEREBY CERTIFY THAT THE INFORMATION SUBMITTED HERewith, INCLUDING ANY ATTACHMENTS, IS TRUE TO THE BEST OF MY KNOWLEDGE AND BELIEF.

NAME OF ORGANIZATION: _____

BY: _____

TITLE: _____

DATED: _____

NOTARY ATTEST:

SUBSCRIBED AND SWORN TO BEFORE ME

THIS _____ DAY OF _____, 20____

NOTARY PUBLIC - STATE OF _____

MY COMMISSION EXPIRES: _____

REQUIRED ATTACHMENTS

1. Schedule A (Current Experience).
2. Schedule B (Previous Experience).
3. Schedule C (Major Equipment).
4. Audited balance sheet for each of the last 3 years for firm named in Section 1.
5. Evidence of authority for individuals listed in Section 7 to bind organization to an agreement.
6. Resumes of officers and key individuals (including Safety Officer) of firm named in Section 1.
7. Required safety program submittals listed in Section 13.
8. Additional items as pertinent.

SCHEDULE A

CURRENT EXPERIENCE

Project Name	Owner's Contact Person	Design Engineer	Contract Date	Type of Work	Status	Cost of Work
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				

SCHEDULE B

PREVIOUS EXPERIENCE (Include ALL Projects Completed within last 5 years)

Project Name	Owner's Contact Person	Design Engineer	Contract Date	Type of Work	Status	Cost of Work
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				

SCHEDULE B

PREVIOUS EXPERIENCE (Include ALL Projects Completed within last 5 years)

Project Name	Owner's Contact Person	Design Engineer	Contract Date	Type of Work	Status	Cost of Work
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				

SCHEDULE C - LIST OF MAJOR EQUIPMENT AVAILABLE

[illegible]

NOTICE OF AWARD

Date of Issuance:

Owner: La Plata West Water Authority

Owner's Contract No.:

Engineer: Bartlett & West, Inc.

Engineer's Project No.: 17865.005

Project: Raw Water Project

Contract Name:

Bidder:

Bidder's Address:

TO BIDDER:

You are notified that Owner has accepted your Bid dated [] for the above Contract, and that you are the Successful Bidder and are awarded a Contract for:

[describe Work, alternates, or sections of Work awarded]

The Contract Price of the awarded Contract is: \$ [] [note if subject to unit prices, or cost-plus]

[] unexecuted counterparts of the Agreement accompany this Notice of Award, and one copy of the Contract Documents accompanies this Notice of Award, or has been transmitted or made available to Bidder electronically. [revise if multiple copies accompany the Notice of Award]

☐ a set of the Drawings will be delivered separately from the other Contract Documents.

You must comply with the following conditions precedent within 15 days of the date of this Notice of Award:

1. Deliver to Owner [] counterparts of the Agreement, fully executed by Bidder.
2. Deliver with the executed Agreement(s) the Contract security [e.g., performance and payment bonds] and insurance documentation as specified in the Instructions to Bidders and General Conditions, Articles 2 and 6.
3. Other conditions precedent (if any):

Failure to comply with these conditions within the time specified will entitle Owner to consider you in default, annul this Notice of Award, and declare your Bid security forfeited.

Within ten days after you comply with the above conditions, Owner will return to you one fully executed counterpart of the Agreement, together with any additional copies of the Contract Documents as indicated in Paragraph 2.02 of the General Conditions.

Owner:

Authorized Signature

By:

Title:

Copy: Engineer

This page intentionally left blank.

BARTLETT —
— **& WEST**

**AGREEMENT
BETWEEN OWNER AND CONTRACTOR FOR
CONSTRUCTION CONTRACT (STIPULATED PRICE)**

Prepared by



Issued and Published Jointly by



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**AGREEMENT
BETWEEN OWNER AND CONTRACTOR
FOR CONSTRUCTION CONTRACT (STIPULATED PRICE)**

THIS AGREEMENT is by and between La Plata West Water Authority ("Owner") and _____ ("Contractor").

Owner and Contractor hereby agree as follows:

ARTICLE 1 – WORK

- 1.01 Contractor shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows:

ARTICLE 2 – THE PROJECT

- 2.01 The Project, of which the Work under the Contract Documents is a part, is generally described as follows: _____

ARTICLE 3 – ENGINEER

- 3.01 The part of the Project that pertains to the Work has been designed by Bartlett & West, Inc., Durango, Colorado.
- 3.02 The Owner has retained Bartlett & West, Inc., Durango, Colorado ("Engineer") to act as Owner's representative, assume all duties and responsibilities, and have the rights and authority assigned to Engineer in the Contract Documents in connection with the completion of the Work in accordance with the Contract Documents.

ARTICLE 4 – CONTRACT TIMES

- 4.01 *Time of the Essence*
- A. All time limits for Milestones, if any, Substantial Completion, and completion and readiness for final payment as stated in the Contract Documents are of the essence of the Contract.
- 4.02 *Contract Times: Dates*
- A. The Work will be substantially completed on or before October 3, 2016, and completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions on or before November 30, 2016.
- 4.03 *Liquidated Damages*
- A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.01 above and that Owner will suffer financial and other losses if the Work is not completed and Milestones not achieved within the times specified in Paragraph 4.02 above, plus any extensions thereof allowed in accordance with the Contract. The parties also recognize the delays, expense, and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty):

1. Substantial Completion: Contractor shall pay Owner \$1,000 for each day that expires after the time (as duly adjusted pursuant to the Contract) specified in Paragraph 4.02.A above for Substantial Completion until the Work is substantially complete.
2. Completion of Remaining Work: After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Times (as duly adjusted pursuant to the Contract) for completion and readiness for final payment, Contractor shall pay Owner \$500 for each day that expires after such time until the Work is completed and ready for final payment.
3. Liquidated damages for failing to timely attain Substantial Completion and final completion are not additive and will not be imposed concurrently.

ARTICLE 5 – CONTRACT PRICE

- 5.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents the amounts that follow, subject to adjustment under the Contract:
- A. For all Work, at the prices stated in Contractor's Bid, attached hereto as an exhibit.

ARTICLE 6 – PAYMENT PROCEDURES

6.01 *Submittal and Processing of Payments*

- A. Contractor shall submit Applications for Payment in accordance with Article 15 of the General Conditions. Applications for Payment will be processed by Engineer as provided in the General Conditions.

6.02 *Progress Payments; Retainage*

- A. Owner shall make progress payments on account of the Contract Price on the basis of Contractor's Applications for Payment on or about the 5th day of each month during performance of the Work as provided in Paragraph 6.02.A.1 below, provided that such Applications for Payment have been submitted in a timely manner and otherwise meet the requirements of the Contract. All such payments will be measured by the Schedule of Values established as provided in the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no Schedule of Values, as provided elsewhere in the Contract.
1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as Owner may withhold, including but not limited to liquidated damages, in accordance with the Contract
 - a. 10 percent of Work completed (with the balance being retainage). If the Work has been 50 percent completed as determined by Engineer, and if the character and progress of the Work have been satisfactory to Owner and Engineer, then as long as the character and progress of the Work remain satisfactory to Owner and Engineer, there will be no additional retainage; and
 - b. 10 percent of cost of materials and equipment not incorporated in the Work (with the balance being retainage).
- B. Upon Substantial Completion, Owner shall pay an amount sufficient to increase total payments to Contractor to 100 percent of the Work completed, less such amounts set off by Owner pursuant to Paragraph 15.01.E of the General Conditions, and less 200 percent of

Engineer's estimate of the value of Work to be completed or corrected as shown on the punch list of items to be completed or corrected prior to final payment.

6.03 Final Payment

- A. Upon final completion and acceptance of the Work in accordance with Paragraph 15.06 of the General Conditions, Owner shall pay the remainder of the Contract Price as recommended by Engineer as provided in said Paragraph 15.06.

ARTICLE 7 – INTEREST

- 7.01 All amounts not paid when due shall bear interest at the rate of five (5) percent per annum.

ARTICLE 8 – CONTRACTOR'S REPRESENTATIONS

- 8.01 In order to induce Owner to enter into this Contract, Contractor makes the following representations:
 - A. Contractor has examined and carefully studied the Contract Documents, and any data and reference items identified in the Contract Documents.
 - B. Contractor has visited the Site, conducted a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
 - C. Contractor is familiar with and is satisfied as to all Laws and Regulations that may affect cost, progress, and performance of the Work.
 - D. Contractor has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings, and (2) reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings.
 - E. Contractor has considered the information known to Contractor itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Site-related reports and drawings identified in the Contract Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor; and (3) Contractor's safety precautions and programs.
 - F. Based on the information and observations referred to in the preceding paragraph, Contractor agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.
 - G. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.
 - H. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.

- I. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.
- J. Contractor's entry into this Contract constitutes an incontrovertible representation by Contractor that without exception all prices in the Agreement are premised upon performing and furnishing the Work required by the Contract Documents.

ARTICLE 9 – CONTRACT DOCUMENTS

9.01 *Contents*

- A. The Contract Documents consist of the following:
 - 1. This Agreement (pages 1 to [REDACTED], inclusive).
 - 2. Performance bond (pages [REDACTED] to [REDACTED], inclusive).
 - 3. Payment bond (pages [REDACTED] to [REDACTED], inclusive).
 - 4. General Conditions (pages [REDACTED] to [REDACTED], inclusive).
 - 5. Supplementary Conditions (pages [REDACTED] to [REDACTED], inclusive).
 - 6. Specifications as listed in the table of contents of the Project Manual.
 - 7. Drawings (not attached but incorporated by reference) consisting of [REDACTED] sheets with each sheet bearing the following general title: Raw Water Project
 - 8. Addenda (numbers [REDACTED] to [REDACTED], inclusive).
 - 9. Exhibits to this Agreement (enumerated as follows):
 - a. Contractor's Bid (pages [REDACTED] to [REDACTED], inclusive).
 - 10. The following which may be delivered or issued on or after the Effective Date of the Contract and are not attached hereto:
 - a. Notice to Proceed.
 - b. Work Change Directives.
 - c. Change Orders.
 - d. Field Orders.
- B. The documents listed in Paragraph 9.01.A are attached to this Agreement (except as expressly noted otherwise above).
- C. There are no Contract Documents other than those listed above in this Article 9.
- D. The Contract Documents may only be amended, modified, or supplemented as provided in the General Conditions.

ARTICLE 10 – MISCELLANEOUS

10.01 *Terms*

- A. Terms used in this Agreement will have the meanings stated in the General Conditions and the Supplementary Conditions.

10.02 *Assignment of Contract*

- A. Unless expressly agreed to elsewhere in the Contract, no assignment by a party hereto of any rights under or interests in the Contract will be binding on another party hereto without the written consent of the party sought to be bound; and, specifically but without limitation, money that may become due and money that is due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.

10.03 *Successors and Assigns*

- A. Owner and Contractor each binds itself, its successors, assigns, and legal representatives to the other party hereto, its successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.

10.04 *Severability*

- A. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation shall be deemed stricken, and all remaining provisions shall continue to be valid and binding upon Owner and Contractor, who agree that the Contract Documents shall be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

10.05 *Contractor's Certifications*

- A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 10.05:
 - 1. "corrupt practice" means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the bidding process or in the Contract execution;
 - 2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Owner, (b) to establish Bid or Contract prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
 - 3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and
 - 4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

10.06 *Other Provisions*

- A. Owner stipulates that if the General Conditions that are made a part of this Contract are based on EJCDC® C-700, Standard General Conditions for the Construction Contract, published by the Engineers Joint Contract Documents Committee®, and if Owner is the party that has furnished said General Conditions, then Owner has plainly shown all modifications to the standard wording of such published document to the Contractor,

through a process such as highlighting or “track changes” (redline/strikeout), or in the Supplementary Conditions.

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement.

This Agreement will be effective on _____ (which is the Effective Date of the Contract).

OWNER:

CONTRACTOR:

By: _____

By: _____

Title: _____

Title: _____

(If Contractor is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest: _____

Attest: _____

Title: _____

Title: _____

Address for giving notices:

Address for giving notices:

License No.: _____
(where applicable)

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BARTLETT —
— **& WEST**

NOTICE TO PROCEED

Owner:	Owner's Contract No.:
Contractor:	Contractor's Project No.:
Engineer:	Engineer's Project No.:
Project:	Contract Name:
	Effective Date of Contract:

TO CONTRACTOR:

Owner hereby notifies Contractor that the Contract Times under the above Contract will commence to run on [REDACTED], 20[REDACTED].

On that date, Contractor shall start performing its obligations under the Contract Documents. No Work shall be done at the Site prior to such date. In accordance with the Agreement, the date of Substantial Completion is _____, and the date of readiness for final payment is _____.

Before starting any Work at the Site, Contractor must comply with the following:

Owner:

Authorized Signature

By:

Title:

Date Issued:

Copy: Engineer

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BARTLETT — *&* — **WEST**

PERFORMANCE BOND

CONTRACTOR *(name and address):*

SURETY *(name and address of principal place of business):*

OWNER *(name and address):*

CONSTRUCTION CONTRACT

Effective Date of the Agreement:

Amount:

Description *(name and location):*

BOND

Bond Number:

Date *(not earlier than the Effective Date of the Agreement of the Construction Contract):*

Amount:

Modifications to this Bond Form: ☐ None ☐ See Paragraph 16

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL

SURETY

Contractor's Name and Corporate Seal *(seal)*

Surety's Name and Corporate Seal *(seal)*

By: _____
Signature

By: _____
Signature *(attach power of attorney)*

Print Name

Print Name

Title

Title

Attest: _____
Signature

Attest: _____
Signature

Title

Title

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

2. If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Paragraph 3.

3. If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond shall arise after:

3.1 The Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice shall indicate whether the Owner is requesting a conference among the Owner, Contractor, and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Paragraph 3.1 shall be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor, and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement shall not waive the Owner's right, if any, subsequently to declare a Contractor Default;

3.2 The Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and

3.3 The Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.

4. Failure on the part of the Owner to comply with the notice requirement in Paragraph 3.1 shall not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

5. When the Owner has satisfied the conditions of Paragraph 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

5.1 Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;

5.2 Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;

5.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owners concurrence,

to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Paragraph 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

5.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor, and with reasonable promptness under the circumstances:

5.4.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or

5.4.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

6. If the Surety does not proceed as provided in Paragraph 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Paragraph 5.4, and the Owner refuses the payment or the Surety has denied liability, in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.

7. If the Surety elects to act under Paragraph 5.1, 5.2, or 5.3, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety shall not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication for:

7.1 the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;

7.2 additional legal, design professional, and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 5; and

7.3 liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

8. If the Surety elects to act under Paragraph 5.1, 5.3, or 5.4, the Surety's liability is limited to the amount of this Bond.

9. The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors, and assigns.

10. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.

11. Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum periods of limitations available to sureties as a defense in the jurisdiction of the suit shall be applicable.

12. Notice to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears.

13. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

14. Definitions

14.1 Balance of the Contract Price: The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made including allowance for the Contractor for any amounts received or to be received by the Owner in settlement of insurance or other claims

for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

14.2 Construction Contract: The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.

14.3 Contractor Default: Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

14.4 Owner Default: Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

14.5 Contract Documents: All the documents that comprise the agreement between the Owner and Contractor.

15. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

16. Modifications to this Bond are as follows:

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BARTLETT — *&* — **WEST**

PAYMENT BOND

CONTRACTOR *(name and address):*

SURETY *(name and address of principal place of business):*

OWNER *(name and address):* La Plata West Water Authority

CONSTRUCTION CONTRACT

Effective Date of the Agreement:

Amount:

Description *(name and location):* Raw Water Project, La Plata County, Colorado

BOND

Bond Number:

Date *(not earlier than the Effective Date of the Agreement of the Construction Contract):*

Amount:

Modifications to this Bond Form: ☐ None ☐ See Paragraph 18

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Payment Bond to be duly executed by an authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL

SURETY

Contractor's Name and Corporate Seal

Surety's Name and Corporate Seal

By: _____
Signature

By: _____
Signature *(attach power of attorney)*

Print Name

Print Name

Title

Title

Attest: _____
Signature

Attest: _____
Signature

Title

Title

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner to pay for labor, materials, and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.
2. If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies, and holds harmless the Owner from claims, demands, liens, or suits by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.
3. If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond shall arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Paragraph 13) of claims, demands, liens, or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, and tendered defense of such claims, demands, liens, or suits to the Contractor and the Surety.
4. When the Owner has satisfied the conditions in Paragraph 3, the Surety shall promptly and at the Surety's expense defend, indemnify, and hold harmless the Owner against a duly tendered claim, demand, lien, or suit.
5. The Surety's obligations to a Claimant under this Bond shall arise after the following:
 - 5.1 Claimants who do not have a direct contract with the Contractor,
 - 5.1.1 have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and
 - 5.1.2 have sent a Claim to the Surety (at the address described in Paragraph 13).
 - 5.2 Claimants who are employed by or have a direct contract with the Contractor have sent a Claim to the Surety (at the address described in Paragraph 13).
6. If a notice of non-payment required by Paragraph 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Paragraph 5.1.1.
7. When a Claimant has satisfied the conditions of Paragraph 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:
 - 7.1 Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and
 - 7.2 Pay or arrange for payment of any undisputed amounts.
 - 7.3 The Surety's failure to discharge its obligations under Paragraph 7.1 or 7.2 shall not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Paragraph 7.1 or 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.
8. The Surety's total obligation shall not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Paragraph 7.3, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.
9. Amounts owed by the Owner to the Contractor under the Construction Contract shall be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfy obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.
10. The Surety shall not be liable to the Owner, Claimants, or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to or give notice on behalf of Claimants, or otherwise have any obligations to Claimants under this Bond.
11. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.

12. No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Paragraph 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.
13. Notice and Claims to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, shall be sufficient compliance as of the date received.
14. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.
15. Upon requests by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.
16. **Definitions**
- 16.1 **Claim:** A written statement by the Claimant including at a minimum:
1. The name of the Claimant;
 2. The name of the person for whom the labor was done, or materials or equipment furnished;
 3. A copy of the agreement or purchase order pursuant to which labor, materials, or equipment was furnished for use in the performance of the Construction Contract;
 4. A brief description of the labor, materials, or equipment furnished;
 5. The date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
 6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;
 7. The total amount of previous payments received by the Claimant; and
8. The total amount due and unpaid to the Claimant for labor, materials, or equipment furnished as of the date of the Claim.
- 16.2 **Claimant:** An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials, or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond shall be to include without limitation in the terms of "labor, materials, or equipment" that part of the water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.
- 16.3 **Construction Contract:** The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.
- 16.4 **Owner Default:** Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.
- 16.5 **Contract Documents:** All the documents that comprise the agreement between the Owner and Contractor.
17. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.
18. Modifications to this Bond are as follows:

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BARTLETT —
— **& WEST**

Contractor's Application for Payment No.

Application Period:		Application Date:
To (Owner):	From (Contractor):	Via (Engineer):
Project:	Contract:	
Owner's Contract No.:	Contractor's Project No.:	Engineer's Project No.:

Application For Payment

Change Order Summary

Approved Change Orders		
Number	Additions	Deductions
TOTALS		
NET CHANGE BY CHANGE ORDERS		

1. ORIGINAL CONTRACT PRICE.....	\$	_____
2. Net change by Change Orders.....	\$	_____
3. Current Contract Price (Line 1 ± 2).....	\$	_____
4. TOTAL COMPLETED AND STORED TO DATE (Column F total on Progress Estimates).....	\$	_____
5. RETAINAGE:		
a. X _____ Work Completed.....	\$	_____
b. X _____ Stored Material.....	\$	_____
c. Total Retainage (Line 5.a + Line 5.b).....	\$	_____
6. AMOUNT ELIGIBLE TO DATE (Line 4 - Line 5.c).....	\$	_____
7. LESS PREVIOUS PAYMENTS (Line 6 from prior Application).....	\$	_____
8. AMOUNT DUE THIS APPLICATION.....	\$	_____
9. BALANCE TO FINISH, PLUS RETAINAGE (Column G total on Progress Estimates + Line 5.c above).....	\$	_____

Contractor's Certification

The undersigned Contractor certifies, to the best of its knowledge, the following:
 (1) All previous progress payments received from Owner on account of Work done under the Contract have been applied on account to discharge Contractor's legitimate obligations incurred in connection with the Work covered by prior Applications for Payment;
 (2) Title to all Work, materials and equipment incorporated in said Work, or otherwise listed in or covered by this Application for Payment, will pass to Owner at time of payment free and clear of all Liens, security interests, and encumbrances (except such as are covered by a bond acceptable to Owner indemnifying Owner against any such Liens, security interest, or encumbrances); and
 (3) All the Work covered by this Application for Payment is in accordance with the Contract Documents and is not defective.

Contractor Signature

By:	Date:
-----	-------

Payment of: \$ _____
 (Line 8 or other - attach explanation of the other amount)

is recommended by: _____ (Date)
 (Engineer)

Payment of: \$ _____
 (Line 8 or other - attach explanation of the other amount)

is approved by: _____ (Date)
 (Owner)

Approved by: _____ (Date)
 Funding or Financing Entity (if applicable)

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CERTIFICATE OF SUBSTANTIAL COMPLETION

Owner: Contractor: Engineer: Project:	Owner's Contract No.: Contractor's Project No.: Engineer's Project No.: Contract Name:
--	---

This [preliminary] [final] Certificate of Substantial Completion applies to:

☐ All Work
 ☐ The following specified portions of the Work:

Date of Substantial Completion

The Work to which this Certificate applies has been inspected by authorized representatives of Owner, Contractor, and Engineer, and found to be substantially complete. The Date of Substantial Completion of the Work or portion thereof designated above is hereby established, subject to the provisions of the Contract pertaining to Substantial Completion. The date of Substantial Completion in the final Certificate of Substantial Completion marks the commencement of the contractual correction period and applicable warranties required by the Contract.

A punch list of items to be completed or corrected is attached to this Certificate. This list may not be all-inclusive, and the failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract.

The responsibilities between Owner and Contractor for security, operation, safety, maintenance, heat, utilities, insurance, and warranties upon Owner's use or occupancy of the Work shall be as provided in the Contract, except as amended as follows: *[Note: Amendments of contractual responsibilities recorded in this Certificate should be the product of mutual agreement of Owner and Contractor; see Paragraph 15.03.D of the General Conditions.]*

Amendments to Owner's responsibilities: ☐ None
☐ As follows

Amendments to Contractor's responsibilities: ☐ None
☐ As follows:

The following documents are attached to and made a part of this Certificate: *[punch list; others]*

This Certificate does not constitute an acceptance of Work not in accordance with the Contract Documents, nor is it a release of Contractor's obligation to complete the Work in accordance with the Contract.

EXECUTED BY ENGINEER:	RECEIVED:	RECEIVED:
By: _____ (Authorized signature)	By: _____ Owner (Authorized Signature)	By: _____ Contractor (Authorized Signature)
Title: _____	Title: _____	Title: _____
Date: _____	Date: _____	Date: _____

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STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared by



Issued and Published Jointly by



These General Conditions have been prepared for use with the Agreement Between Owner and Contractor for Construction Contract (EJCDC® C-520, Stipulated Sum, or C-525, Cost-Plus, 2013 Editions). Their provisions are interrelated and a change in one may necessitate a change in the other.

To prepare supplementary conditions that are coordinated with the General Conditions, use EJCDC's Guide to the Preparation of Supplementary Conditions (EJCDC® C-800, 2013 Edition). The full EJCDC Construction series of documents is discussed in the Commentary on the 2013 EJCDC Construction Documents (EJCDC® C-001, 2013 Edition).

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ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

- A. Wherever used in the Bidding Requirements or Contract Documents, a term printed with initial capital letters, including the term's singular and plural forms, will have the meaning indicated in the definitions below. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.
1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.
 2. *Agreement*—The written instrument, executed by Owner and Contractor, that sets forth the Contract Price and Contract Times, identifies the parties and the Engineer, and designates the specific items that are Contract Documents.
 3. *Application for Payment*—The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.
 4. *Bid*—The offer of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.
 5. *Bidder*—An individual or entity that submits a Bid to Owner.
 6. *Bidding Documents*—The Bidding Requirements, the proposed Contract Documents, and all Addenda.
 7. *Bidding Requirements*—The advertisement or invitation to bid, Instructions to Bidders, Bid Bond or other Bid security, if any, the Bid Form, and the Bid with any attachments.
 8. *Change Order*—A document which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, or other revision to the Contract, issued on or after the Effective Date of the Contract.
 9. *Change Proposal*—A written request by Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times, or both; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-off against payments due; or seeking other relief with respect to the terms of the Contract.
 10. *Claim*—(a) A demand or assertion by Owner directly to Contractor, duly submitted in compliance with the procedural requirements set forth herein: seeking an adjustment of Contract Price or Contract Times, or both; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting Engineer's decision regarding a Change Proposal; seeking resolution of a contractual issue that Engineer has declined to address; or seeking other relief with respect to the terms of the Contract; or (b) a demand or assertion by Contractor directly to Owner, duly submitted in compliance with the procedural requirements set forth herein, contesting Engineer's decision regarding a Change Proposal; or seeking resolution of a contractual issue that Engineer

has declined to address. A demand for money or services by a third party is not a Claim.

11. *Constituent of Concern*—Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to (a) the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. §§9601 et seq. ("CERCLA"); (b) the Hazardous Materials Transportation Act, 49 U.S.C. §§5101 et seq.; (c) the Resource Conservation and Recovery Act, 42 U.S.C. §§6901 et seq. ("RCRA"); (d) the Toxic Substances Control Act, 15 U.S.C. §§2601 et seq.; (e) the Clean Water Act, 33 U.S.C. §§1251 et seq.; (f) the Clean Air Act, 42 U.S.C. §§7401 et seq.; or (g) any other federal, state, or local statute, law, rule, regulation, ordinance, resolution, code, order, or decree regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.
12. *Contract*—The entire and integrated written contract between the Owner and Contractor concerning the Work.
13. *Contract Documents*—Those items so designated in the Agreement, and which together comprise the Contract.
14. *Contract Price*—The money that Owner has agreed to pay Contractor for completion of the Work in accordance with the Contract Documents. .
15. *Contract Times*—The number of days or the dates by which Contractor shall: (a) achieve Milestones, if any; (b) achieve Substantial Completion; and (c) complete the Work.
16. *Contractor*—The individual or entity with which Owner has contracted for performance of the Work.
17. *Cost of the Work*—See Paragraph 13.01 for definition.
18. *Drawings*—The part of the Contract that graphically shows the scope, extent, and character of the Work to be performed by Contractor.
19. *Effective Date of the Contract*—The date, indicated in the Agreement, on which the Contract becomes effective.
20. *Engineer*—The individual or entity named as such in the Agreement.
21. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but does not change the Contract Price or the Contract Times.
22. *Hazardous Environmental Condition*—The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated in the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, does not establish a Hazardous Environmental Condition.
23. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

24. *Liens*—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.
25. *Milestone*—A principal event in the performance of the Work that the Contract requires Contractor to achieve by an intermediate completion date or by a time prior to Substantial Completion of all the Work.
26. *Notice of Award*—The written notice by Owner to a Bidder of Owner's acceptance of the Bid.
27. *Notice to Proceed*—A written notice by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work.
28. *Owner*—The individual or entity with which Contractor has contracted regarding the Work, and which has agreed to pay Contractor for the performance of the Work, pursuant to the terms of the Contract.
29. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor's plan to accomplish the Work within the Contract Times.
30. *Project*—The total undertaking to be accomplished for Owner by engineers, contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Work to be performed under the Contract Documents is a part.
31. *Project Manual*—The written documents prepared for, or made available for, procuring and constructing the Work, including but not limited to the Bidding Documents or other construction procurement documents, geotechnical and existing conditions information, the Agreement, bond forms, General Conditions, Supplementary Conditions, and Specifications. The contents of the Project Manual may be bound in one or more volumes.
32. *Resident Project Representative*—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative or "RPR" includes any assistants or field staff of Resident Project Representative.
33. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and that establish the standards by which such portion of the Work will be judged.
34. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer's review of the submittals and the performance of related construction activities.
35. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.
36. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents.

37. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements, and such other lands furnished by Owner which are designated for the use of Contractor.
38. *Specifications*—The part of the Contract that consists of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable to the Work.
39. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work.
40. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms “substantially complete” and “substantially completed” as applied to all or part of the Work refer to Substantial Completion thereof.
41. *Successful Bidder*—The Bidder whose Bid the Owner accepts, and to which the Owner makes an award of contract, subject to stated conditions.
42. *Supplementary Conditions*—The part of the Contract that amends or supplements these General Conditions.
43. *Supplier*—A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or a Subcontractor.
44. *Technical Data*—Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (a) subsurface conditions at the Site, or physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) or (b) Hazardous Environmental Conditions at the Site. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then the data contained in boring logs, recorded measurements of subsurface water levels, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical or environmental report prepared for the Project and made available to Contractor are hereby defined as Technical Data with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06.
45. *Underground Facilities*—All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including but not limited to those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, fiber optic transmissions, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.
46. *Unit Price Work*—Work to be paid for on the basis of unit prices.
47. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction; furnishing, installing, and incorporating all materials and equipment into such construction; and may include related services such as testing, start-up, and commissioning, all as required by the Contract Documents.

48. *Work Change Directive*—A written directive to Contractor issued on or after the Effective Date of the Contract, signed by Owner and recommended by Engineer, ordering an addition, deletion, or revision in the Work.

1.02 *Terminology*

- A. The words and terms discussed in the following paragraphs are not defined but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.
- B. *Intent of Certain Terms or Adjectives:*
1. The Contract Documents include the terms “as allowed,” “as approved,” “as ordered,” “as directed” or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives “reasonable,” “suitable,” “acceptable,” “proper,” “satisfactory,” or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Article 10 or any other provision of the Contract Documents.
- C. *Day:*
1. The word “day” means a calendar day of 24 hours measured from midnight to the next midnight.
- D. *Defective:*
1. The word “defective,” when modifying the word “Work,” refers to Work that is unsatisfactory, faulty, or deficient in that it:
 - a. does not conform to the Contract Documents; or
 - b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or
 - c. has been damaged prior to Engineer’s recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 15.03 or 15.04).
- E. *Furnish, Install, Perform, Provide:*
1. The word “furnish,” when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.
 2. The word “install,” when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.

3. The words "perform" or "provide," when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.
 4. If the Contract Documents establish an obligation of Contractor with respect to specific services, materials, or equipment, but do not expressly use any of the four words "furnish," "install," "perform," or "provide," then Contractor shall furnish and install said services, materials, or equipment complete and ready for intended use.
- F. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 – PRELIMINARY MATTERS

2.01 *Delivery of Bonds and Evidence of Insurance*

- A. *Bonds*: When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner such bonds as Contractor may be required to furnish.
- B. *Evidence of Contractor's Insurance*: When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each named insured and additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract), the certificates and other evidence of insurance required to be provided by Contractor in accordance with Article 6.
- C. *Evidence of Owner's Insurance*: After receipt of the executed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor, with copies to each named insured and additional insured (as identified in the Supplementary Conditions or otherwise), the certificates and other evidence of insurance required to be provided by Owner under Article 6.

2.02 *Copies of Documents*

- A. Owner shall furnish to Contractor four printed copies of the Contract (including one fully executed counterpart of the Agreement), and one copy in electronic portable document format (PDF). Additional printed copies will be furnished upon request at the cost of reproduction.
- B. Owner shall maintain and safeguard at least one original printed record version of the Contract, including Drawings and Specifications signed and sealed by Engineer and other design professionals. Owner shall make such original printed record version of the Contract available to Contractor for review. Owner may delegate the responsibilities under this provision to Engineer.

2.03 *Before Starting Construction*

- A. *Preliminary Schedules*: Within 10 days after the Effective Date of the Contract (or as otherwise specifically required by the Contract Documents), Contractor shall submit to Engineer for timely review:
 1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract;
 2. a preliminary Schedule of Submittals; and

3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.04 *Preconstruction Conference; Designation of Authorized Representatives*

- A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in Paragraph 2.03.A, procedures for handling Shop Drawings, Samples, and other submittals, processing Applications for Payment, electronic or digital transmittals, and maintaining required records.
- B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit and receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.05 *Initial Acceptance of Schedules*

- A. At least 10 days before submission of the first Application for Payment a conference, attended by Contractor, Engineer, and others as appropriate, will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.03.A. Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.
 1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.
 2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.
 3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to the component parts of the Work.

2.06 *Electronic Transmittals*

- A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may transmit, and shall accept, Project-related correspondence, text, data, documents, drawings, information, and graphics, including but not limited to Shop Drawings and other submittals, in electronic media or digital format, either directly, or through access to a secure Project website.
- B. If the Contract does not establish protocols for electronic or digital transmittals, then Owner, Engineer, and Contractor shall jointly develop such protocols.
- C. When transmitting items in electronic media or digital format, the transmitting party makes no representations as to long term compatibility, usability, or readability of the items resulting from the recipient's use of software application packages, operating systems, or

computer hardware differing from those used in the drafting or transmittal of the items, or from those established in applicable transmittal protocols.

ARTICLE 3 – DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 *Intent*

- A. The Contract Documents are complementary; what is required by one is as binding as if required by all.
- B. It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents.
- C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic or digital versions of the Contract Documents (including any printed copies derived from such electronic or digital versions) and the printed record version, the printed record version shall govern.
- D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.
- E. Engineer will issue clarifications and interpretations of the Contract Documents as provided herein.

3.02 *Reference Standards*

- A. Standards Specifications, Codes, Laws and Regulations
 - 1. Reference in the Contract Documents to standard specifications, manuals, reference standards, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard specification, manual, reference standard, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Contract if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.
 - 2. No provision of any such standard specification, manual, reference standard, or code, or any instruction of a Supplier, shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees, from those set forth in the part of the Contract Documents prepared by or for Engineer. No such provision or instruction shall be effective to assign to Owner, Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the part of the Contract Documents prepared by or for Engineer.

3.03 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies:*

- 1. *Contractor's Verification of Figures and Field Measurements:* Before undertaking each part of the Work, Contractor shall carefully study the Contract Documents, and check and verify pertinent figures and dimensions therein, particularly with respect to applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy that Contractor discovers, or has actual knowledge of, and shall not proceed with any Work affected thereby until the conflict,

error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract Documents issued pursuant to Paragraph 11.01.

2. *Contractor's Review of Contract Documents:* If, before or during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) actual field conditions, (c) any standard specification, manual, reference standard, or code, or (d) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 7.15) until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract Documents issued pursuant to Paragraph 11.01.
3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. *Resolving Discrepancies:*

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the part of the Contract Documents prepared by or for Engineer shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between such provisions of the Contract Documents and:
 - a. the provisions of any standard specification, manual, reference standard, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference as a Contract Document); or
 - b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Requirements of the Contract Documents*

- A. During the performance of the Work and until final payment, Contractor and Owner shall submit to the Engineer all matters in question concerning the requirements of the Contract Documents (sometimes referred to as requests for information or interpretation—RFIs), or relating to the acceptability of the Work under the Contract Documents, as soon as possible after such matters arise. Engineer will be the initial interpreter of the requirements of the Contract Documents, and judge of the acceptability of the Work thereunder.
- B. Engineer will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract Documents. Engineer's written clarification, interpretation, or decision will be final and binding on Contractor, unless it appeals by submitting a Change Proposal, and on Owner, unless it appeals by filing a Claim.
- C. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work under the Contract Documents, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly give written notice to Owner and Contractor that Engineer is unable to provide a decision or interpretation. If Owner and Contractor are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in Article 12.

3.05 *Reuse of Documents*

- A. Contractor and its Subcontractors and Suppliers shall not:
 - 1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media editions, or reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer; or
 - 2. have or acquire any title or ownership rights in any other Contract Documents, reuse any such Contract Documents for any purpose without Owner's express written consent, or violate any copyrights pertaining to such Contract Documents.
- B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein shall preclude Contractor from retaining copies of the Contract Documents for record purposes.

ARTICLE 4 – COMMENCEMENT AND PROGRESS OF THE WORK

4.01 *Commencement of Contract Times; Notice to Proceed*

- A. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Contract or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Contract. In no event will the Contract Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Contract, whichever date is earlier.

4.02 *Starting the Work*

- A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work shall be done at the Site prior to such date.

4.03 *Reference Points*

- A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.04 *Progress Schedule*

- A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.05 as it may be adjusted from time to time as provided below.
 - 1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.05) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times.

2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 11.
- B. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, or during any appeal process, except as permitted by Paragraph 16.04, or as Owner and Contractor may otherwise agree in writing.

4.05 *Delays in Contractor's Progress*

- A. If Owner, Engineer, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Times and Contract Price. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
- B. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of Contractor. Delay, disruption, and interference attributable to and within the control of a Subcontractor or Supplier shall be deemed to be within the control of Contractor.
- C. If Contractor's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault of and beyond the control of Owner, Contractor, and those for which they are responsible, then Contractor shall be entitled to an equitable adjustment in Contract Times. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include but are not limited to the following:
 1. severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;
 2. abnormal weather conditions;
 3. acts or failures to act of utility owners (other than those performing other work at or adjacent to the Site by arrangement with the Owner, as contemplated in Article 8); and
 4. acts of war or terrorism.
- D. Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by Article 5.
- E. Paragraph 8.03 governs delays, disruption, and interference to the performance or progress of the Work resulting from the performance of certain other work at or adjacent to the Site.
- F. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor.

- G. Contractor must submit any Change Proposal seeking an adjustment in Contract Price or Contract Times under this paragraph within 30 days of the commencement of the delaying, disrupting, or interfering event.

ARTICLE 5 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

5.01 *Availability of Lands*

- A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work.
- B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which permanent improvements are to be made and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.
- C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

5.02 *Use of Site and Other Areas*

A. *Limitation on Use of Site and Other Areas:*

- 1. Contractor shall confine construction equipment, temporary construction facilities, the storage of materials and equipment, and the operations of workers to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and such other adjacent areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for (a) damage to the Site; (b) damage to any such other adjacent areas used for Contractor's operations; (c) damage to any other adjacent land or areas; and (d) for injuries and losses sustained by the owners or occupants of any such land or areas; provided that such damage or injuries result from the performance of the Work or from other actions or conduct of the Contractor or those for which Contractor is responsible.
- 2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.12, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or at law; and (c) to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claim, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused directly or indirectly, in whole or in part

by, or based upon, Contractor's performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible.

- B. *Removal of Debris During Performance of the Work:* During the progress of the Work the Contractor shall keep the Site and other adjacent areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.
- C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site and adjacent areas all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.
- D. *Loading of Structures:* Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent structures or land to stresses or pressures that will endanger them.

5.03 *Subsurface and Physical Conditions*

- A. *Reports and Drawings:* The Supplementary Conditions identify:
 - 1. those reports known to Owner of explorations and tests of subsurface conditions at or adjacent to the Site;
 - 2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities); and
 - 3. Technical Data contained in such reports and drawings.
- B. *Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely upon the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:
 - 1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or
 - 2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or
 - 3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions, or information.

5.04 *Differing Subsurface or Physical Conditions*

- A. *Notice by Contractor:* If Contractor believes that any subsurface or physical condition that is uncovered or revealed at the Site either:
1. is of such a nature as to establish that any Technical Data on which Contractor is entitled to rely as provided in Paragraph 5.03 is materially inaccurate; or
 2. is of such a nature as to require a change in the Drawings or Specifications; or
 3. differs materially from that shown or indicated in the Contract Documents; or
 4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except with respect to an emergency) until receipt of a written statement permitting Contractor to do so.

- B. *Engineer's Review:* After receipt of written notice as required by the preceding paragraph, Engineer will promptly review the subsurface or physical condition in question; determine the necessity of Owner's obtaining additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in Paragraph 5.04.A above; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise Owner in writing of Engineer's findings, conclusions, and recommendations.
- C. *Owner's Statement to Contractor Regarding Site Condition:* After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations, in whole or in part.
- D. *Possible Price and Times Adjustments:*
1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, or both, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:
 - a. such condition must fall within any one or more of the categories described in Paragraph 5.04.A;
 - b. with respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03; and,

- c. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
- 2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:
 - a. Contractor knew of the existence of such condition at the time Contractor made a commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract, or otherwise; or
 - b. the existence of such condition reasonably could have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas expressly required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such commitment; or
 - c. Contractor failed to give the written notice as required by Paragraph 5.04.A.
- 3. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.
- 4. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the subsurface or physical condition in question.

5.05 *Underground Facilities*

- A. *Contractor's Responsibilities:* The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or adjacent to the Site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities, including Owner, or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:
 - 1. Owner and Engineer do not warrant or guarantee the accuracy or completeness of any such information or data provided by others; and
 - 2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:
 - a. reviewing and checking all information and data regarding existing Underground Facilities at the Site;
 - b. locating all Underground Facilities shown or indicated in the Contract Documents as being at the Site;
 - c. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and
 - d. the safety and protection of all existing Underground Facilities at the Site, and repairing any damage thereto resulting from the Work.
- B. *Notice by Contractor:* If Contractor believes that an Underground Facility that is uncovered or revealed at the Site was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, then Contractor shall, promptly after

becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer.

- C. *Engineer's Review:* Engineer will promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the Underground Facility in question; determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Underground Facility; and advise Owner in writing of Engineer's findings, conclusions, and recommendations. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.
- D. *Owner's Statement to Contractor Regarding Underground Facility:* After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the Underground Facility in question, addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations in whole or in part.
- E. *Possible Price and Times Adjustments:*
 - 1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, or both, to the extent that any existing Underground Facility at the Site that was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:
 - a. Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated the existence or actual location of the Underground Facility in question;
 - b. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03;
 - c. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times; and
 - d. Contractor gave the notice required in Paragraph 5.05.B.
 - 2. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.
 - 3. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.

5.06 *Hazardous Environmental Conditions at Site*

A. *Reports and Drawings:* The Supplementary Conditions identify:

1. those reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; and
2. Technical Data contained in such reports and drawings.

B. *Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely on the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto; or
2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or
3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions or information.

C. Contractor shall not be responsible for removing or remediating any Hazardous Environmental Condition encountered, uncovered, or revealed at the Site unless such removal or remediation is expressly identified in the Contract Documents to be within the scope of the Work.

D. Contractor shall be responsible for controlling, containing, and duly removing all Constituents of Concern brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible, and for any associated costs; and for the costs of removing and remediating any Hazardous Environmental Condition created by the presence of any such Constituents of Concern.

E. If Contractor encounters, uncovers, or reveals a Hazardous Environmental Condition whose removal or remediation is not expressly identified in the Contract Documents as being within the scope of the Work, or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, then Contractor shall immediately: (1) secure or otherwise isolate such condition; (2) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 7.15); and (3) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 5.06.F. If Contractor or anyone for whom Contractor is responsible created the Hazardous Environmental Condition in question, then Owner may remove and remediate the Hazardous Environmental Condition, and impose a set-off against payments to account for the associated costs.

- F. Contractor shall not resume Work in connection with such Hazardous Environmental Condition or in any affected area until after Owner has obtained any required permits related thereto, and delivered written notice to Contractor either (1) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (2) specifying any special conditions under which such Work may be resumed safely.
- G. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, then within 30 days of Owner's written notice regarding the resumption of Work, Contractor may submit a Change Proposal, or Owner may impose a set-off.
- H. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work, following the contractual change procedures in Article 11. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 8.
- I. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition (1) was not shown or indicated in the Drawings, Specifications, or other Contract Documents, identified as Technical Data entitled to limited reliance pursuant to Paragraph 5.06.B, or identified in the Contract Documents to be included within the scope of the Work, and (2) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.I shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- J. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.J shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- K. The provisions of Paragraphs 5.03, 5.04, and 5.05 do not apply to the presence of Constituents of Concern or to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 6 – BONDS AND INSURANCE

6.01 *Performance, Payment, and Other Bonds*

- A. Contractor shall furnish a performance bond and a payment bond, each in an amount at least equal to the Contract Price, as security for the faithful performance and payment of all of Contractor's obligations under the Contract. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 15.08, whichever is later, except as provided otherwise by Laws or Regulations, the Supplementary Conditions, or other specific provisions of the Contract. Contractor shall also furnish such other bonds as are required by the Supplementary Conditions or other specific provisions of the Contract.
- B. All bonds shall be in the form prescribed by the Contract except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (as amended and supplemented) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. A bond signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority shall show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.
- C. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds in the required amounts.
- D. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or its right to do business is terminated in any state or jurisdiction where any part of the Project is located, or the surety ceases to meet the requirements above, then Contractor shall promptly notify Owner and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the bond and surety requirements above.
- E. If Contractor has failed to obtain a required bond, Owner may exclude the Contractor from the Site and exercise Owner's termination rights under Article 16.
- F. Upon request, Owner shall provide a copy of the payment bond to any Subcontractor, Supplier, or other person or entity claiming to have furnished labor or materials used in the performance of the Work.

6.02 *Insurance—General Provisions*

- A. Owner and Contractor shall obtain and maintain insurance as required in this Article and in the Supplementary Conditions.
- B. All insurance required by the Contract to be purchased and maintained by Owner or Contractor shall be obtained from insurance companies that are duly licensed or authorized, in the state or jurisdiction in which the Project is located, to issue insurance policies for the required limits and coverages. Unless a different standard is indicated in the Supplementary Conditions, all companies that provide insurance policies required under this Contract shall have an A.M. Best rating of A-VII or better.
- C. Contractor shall deliver to Owner, with copies to each named insured and additional insured (as identified in this Article, in the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Contractor has obtained and is

maintaining the policies, coverages, and endorsements required by the Contract. Upon request by Owner or any other insured, Contractor shall also furnish other evidence of such required insurance, including but not limited to copies of policies and endorsements, and documentation of applicable self-insured retentions and deductibles. Contractor may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

- D. Owner shall deliver to Contractor, with copies to each named insured and additional insured (as identified in this Article, the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Owner has obtained and is maintaining the policies, coverages, and endorsements required of Owner by the Contract (if any). Upon request by Contractor or any other insured, Owner shall also provide other evidence of such required insurance (if any), including but not limited to copies of policies and endorsements, and documentation of applicable self-insured retentions and deductibles. Owner may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.
- E. Failure of Owner or Contractor to demand such certificates or other evidence of the other party's full compliance with these insurance requirements, or failure of Owner or Contractor to identify a deficiency in compliance from the evidence provided, shall not be construed as a waiver of the other party's obligation to obtain and maintain such insurance.
- F. If either party does not purchase or maintain all of the insurance required of such party by the Contract, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage.
- G. If Contractor has failed to obtain and maintain required insurance, Owner may exclude the Contractor from the Site, impose an appropriate set-off against payment, and exercise Owner's termination rights under Article 16.
- H. Without prejudice to any other right or remedy, if a party has failed to obtain required insurance, the other party may elect to obtain equivalent insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and the Contract Price shall be adjusted accordingly.
- I. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests.
- J. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner and other individuals and entities in the Contract.

6.03 Contractor's Insurance

- A. *Workers' Compensation:* Contractor shall purchase and maintain workers' compensation and employer's liability insurance for:
 - 1. claims under workers' compensation, disability benefits, and other similar employee benefit acts.
 - 2. United States Longshoreman and Harbor Workers' Compensation Act and Jones Act coverage (if applicable).
 - 3. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees (by stop-gap endorsement in monopolist worker's compensation states).

4. Foreign voluntary worker compensation (if applicable).
- B. *Commercial General Liability—Claims Covered:* Contractor shall purchase and maintain commercial general liability insurance, covering all operations by or on behalf of Contractor, on an occurrence basis, against:
 1. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees.
 2. claims for damages insured by reasonably available personal injury liability coverage.
 3. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom.
- C. *Commercial General Liability—Form and Content:* Contractor's commercial liability policy shall be written on a 1996 (or later) ISO commercial general liability form (occurrence form) and include the following coverages and endorsements:
 1. Products and completed operations coverage:
 - a. Such insurance shall be maintained for three years after final payment.
 - b. Contractor shall furnish Owner and each other additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract) evidence of continuation of such insurance at final payment and three years thereafter.
 2. Blanket contractual liability coverage, to the extent permitted by law, including but not limited to coverage of Contractor's contractual indemnity obligations in Paragraph 7.18.
 3. Broad form property damage coverage.
 4. Severability of interest.
 5. Underground, explosion, and collapse coverage.
 6. Personal injury coverage.
 7. Additional insured endorsements that include both ongoing operations and products and completed operations coverage through ISO Endorsements CG 20 10 10 01 and CG 20 37 10 01 (together); or CG 20 10 07 04 and CG 20 37 07 04 (together); or their equivalent.
 8. For design professional additional insureds, ISO Endorsement CG 20 32 07 04, "Additional Insured—Engineers, Architects or Surveyors Not Engaged by the Named Insured" or its equivalent.
- D. *Automobile liability:* Contractor shall purchase and maintain automobile liability insurance against claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance, or use of any motor vehicle. The automobile liability policy shall be written on an occurrence basis.
- E. *Umbrella or excess liability:* Contractor shall purchase and maintain umbrella or excess liability insurance written over the underlying employer's liability, commercial general liability, and automobile liability insurance described in the paragraphs above. Subject to industry-standard exclusions, the coverage afforded shall follow form as to each and every one of the underlying policies.
- F. *Contractor's pollution liability insurance:* Contractor shall purchase and maintain a policy covering third-party injury and property damage claims, including clean-up costs, as a result

of pollution conditions arising from Contractor's operations and completed operations. This insurance shall be maintained for no less than three years after final completion.

- G. *Additional insureds:* The Contractor's commercial general liability, automobile liability, umbrella or excess, and pollution liability policies shall include and list as additional insureds Owner and Engineer, and any individuals or entities identified in the Supplementary Conditions; include coverage for the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of all such additional insureds; and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby (including as applicable those arising from both ongoing and completed operations) on a non-contributory basis. Contractor shall obtain all necessary endorsements to support these requirements.
- H. *Contractor's professional liability insurance:* If Contractor will provide or furnish professional services under this Contract, through a delegation of professional design services or otherwise, then Contractor shall be responsible for purchasing and maintaining applicable professional liability insurance. This insurance shall provide protection against claims arising out of performance of professional design or related services, and caused by a negligent error, omission, or act for which the insured party is legally liable. It shall be maintained throughout the duration of the Contract and for a minimum of two years after Substantial Completion. If such professional design services are performed by a Subcontractor, and not by Contractor itself, then the requirements of this paragraph may be satisfied through the purchasing and maintenance of such insurance by such Subcontractor.
- I. *General provisions:* The policies of insurance required by this Paragraph 6.03 shall:
1. include at least the specific coverages provided in this Article.
 2. be written for not less than the limits of liability provided in this Article and in the Supplementary Conditions, or required by Laws or Regulations, whichever is greater.
 3. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed, or renewal refused until at least 10 days prior written notice has been given to Contractor. Within three days of receipt of any such written notice, Contractor shall provide a copy of the notice to Owner, Engineer, and each other insured under the policy.
 4. remain in effect at least until final payment (and longer if expressly required in this Article) and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work as a warranty or correction obligation, or otherwise, or returning to the Site to conduct other tasks arising from the Contract Documents.
 5. be appropriate for the Work being performed and provide protection from claims that may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable.
- J. The coverage requirements for specific policies of insurance must be met by such policies, and not by reference to excess or umbrella insurance provided in other policies.

6.04 *Owner's Liability Insurance*

- A. In addition to the insurance required to be provided by Contractor under Paragraph 6.03, Owner, at Owner's option, may purchase and maintain at Owner's expense Owner's own liability insurance as will protect Owner against claims which may arise from operations under the Contract Documents.
- B. Owner's liability policies, if any, operate separately and independently from policies required to be provided by Contractor, and Contractor cannot rely upon Owner's liability policies for any of Contractor's obligations to the Owner, Engineer, or third parties.

6.05 *Property Insurance*

- A. *Builder's Risk:* Unless otherwise provided in the Supplementary Conditions, Contractor shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the full insurable replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:
 - 1. include the Owner and Contractor as named insureds, and all Subcontractors, and any individuals or entities required by the Supplementary Conditions to be insured under such builder's risk policy, as insureds or named insureds. For purposes of the remainder of this Paragraph 6.05, Paragraphs 6.06 and 6.07, and any corresponding Supplementary Conditions, the parties required to be insured shall collectively be referred to as "insureds."
 - 2. be written on a builder's risk "all risk" policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire; lightning; windstorm; riot; civil commotion; terrorism; vehicle impact; aircraft; smoke; theft; vandalism and malicious mischief; mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; flood; collapse; explosion; debris removal; demolition occasioned by enforcement of Laws and Regulations; water damage (other than that caused by flood); and such other perils or causes of loss as may be specifically required by the Supplementary Conditions. If insurance against mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; or flood, are not commercially available under builder's risk policies, by endorsement or otherwise, such insurance may be provided through other insurance policies acceptable to Owner and Contractor.
 - 3. cover, as insured property, at least the following: (a) the Work and all materials, supplies, machinery, apparatus, equipment, fixtures, and other property of a similar nature that are to be incorporated into or used in the preparation, fabrication, construction, erection, or completion of the Work, including Owner-furnished or assigned property; (b) spare parts inventory required within the scope of the Contract; and (c) temporary works which are not intended to form part of the permanent constructed Work but which are intended to provide working access to the Site, or to the Work under construction, or which are intended to provide temporary support for the Work under construction, including scaffolding, form work, fences, shoring, falsework, and temporary structures.
 - 4. cover expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects).

5. extend to cover damage or loss to insured property while in temporary storage at the Site or in a storage location outside the Site (but not including property stored at the premises of a manufacturer or Supplier).
 6. extend to cover damage or loss to insured property while in transit.
 7. allow for partial occupation or use of the Work by Owner, such that those portions of the Work that are not yet occupied or used by Owner shall remain covered by the builder's risk insurance.
 8. allow for the waiver of the insurer's subrogation rights, as set forth below.
 9. provide primary coverage for all losses and damages caused by the perils or causes of loss covered.
 10. not include a co-insurance clause.
 11. include an exception for ensuing losses from physical damage or loss with respect to any defective workmanship, design, or materials exclusions.
 12. include performance/hot testing and start-up.
 13. be maintained in effect, subject to the provisions herein regarding Substantial Completion and partial occupancy or use of the Work by Owner, until the Work is complete.
- B. *Notice of Cancellation or Change:* All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with this Paragraph 6.05 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 10 days prior written notice has been given to the purchasing policyholder. Within three days of receipt of any such written notice, the purchasing policyholder shall provide a copy of the notice to each other insured.
- C. *Deductibles:* The purchaser of any required builder's risk or property insurance shall pay for costs not covered because of the application of a policy deductible.
- D. *Partial Occupancy or Use by Owner:* If Owner will occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 15.04, then Owner (directly, if it is the purchaser of the builder's risk policy, or through Contractor) will provide notice of such occupancy or use to the builder's risk insurer. The builder's risk insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy; rather, those portions of the Work that are occupied or used by Owner may come off the builder's risk policy, while those portions of the Work not yet occupied or used by Owner shall remain covered by the builder's risk insurance.
- E. *Additional Insurance:* If Contractor elects to obtain other special insurance to be included in or supplement the builder's risk or property insurance policies provided under this Paragraph 6.05, it may do so at Contractor's expense.
- F. *Insurance of Other Property:* If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, such as tools, construction equipment, or other personal property owned by Contractor, a Subcontractor, or an employee of Contractor or a Subcontractor, then the entity or individual owning such property item will be responsible for deciding whether to insure it, and if so in what amount.

6.06 *Waiver of Rights*

- A. All policies purchased in accordance with Paragraph 6.05, expressly including the builder's risk policy, shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any insureds thereunder, or against Engineer or its consultants, or their officers, directors, members, partners, employees, agents, consultants, or subcontractors. Owner and Contractor waive all rights against each other and the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Engineer, its consultants, all Subcontractors, all individuals or entities identified in the Supplementary Conditions as insureds, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner or Contractor as trustee or fiduciary, or otherwise payable under any policy so issued.
- B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, for:
 - 1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other perils whether or not insured by Owner; and
 - 2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial occupancy or use pursuant to Paragraph 15.04, after Substantial Completion pursuant to Paragraph 15.03, or after final payment pursuant to Paragraph 15.06.
- C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 6.06.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them.
- D. Contractor shall be responsible for assuring that the agreement under which a Subcontractor performs a portion of the Work contains provisions whereby the Subcontractor waives all rights against Owner, Contractor, all individuals or entities identified in the Supplementary Conditions as insureds, the Engineer and its consultants, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by builder's risk insurance and any other property insurance applicable to the Work.

6.07 *Receipt and Application of Property Insurance Proceeds*

- A. Any insured loss under the builder's risk and other policies of insurance required by Paragraph 6.05 will be adjusted and settled with the named insured that purchased the

policy. Such named insured shall act as fiduciary for the other insureds, and give notice to such other insureds that adjustment and settlement of a claim is in progress. Any other insured may state its position regarding a claim for insured loss in writing within 15 days after notice of such claim.

- B. Proceeds for such insured losses may be made payable by the insurer either jointly to multiple insureds, or to the named insured that purchased the policy in its own right and as fiduciary for other insureds, subject to the requirements of any applicable mortgage clause. A named insured receiving insurance proceeds under the builder's risk and other policies of insurance required by Paragraph 6.05 shall distribute such proceeds in accordance with such agreement as the parties in interest may reach, or as otherwise required under the dispute resolution provisions of this Contract or applicable Laws and Regulations.
- C. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the money so received applied on account thereof, and the Work and the cost thereof covered by Change Order, if needed.

ARTICLE 7 – CONTRACTOR'S RESPONSIBILITIES

7.01 *Supervision and Superintendence*

- A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.
- B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

7.02 *Labor; Working Hours*

- A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site.
- B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours, Monday through Friday. Contractor will not perform Work on a Saturday, Sunday, or any legal holiday. Contractor may perform Work outside regular working hours or on Saturdays, Sundays, or legal holidays only with Owner's written consent, which will not be unreasonably withheld.

7.03 *Services, Materials, and Equipment*

- A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start up, and completion of the Work, whether or not such items are specifically called for in the Contract Documents.
- B. All materials and equipment incorporated into the Work shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and

guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.

- C. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

7.04 "Or Equals"

- A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the Contract Price has been based upon Contractor furnishing such item as specified. The specification or description of such an item is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or equal" item is permitted, Contractor may request that Engineer authorize the use of other items of material or equipment, or items from other proposed suppliers under the circumstances described below.
 - 1. If Engineer in its sole discretion determines that an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, Engineer shall deem it an "or equal" item. For the purposes of this paragraph, a proposed item of material or equipment will be considered functionally equal to an item so named if:
 - a. in the exercise of reasonable judgment Engineer determines that:
 - 1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;
 - 2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole;
 - 3) it has a proven record of performance and availability of responsive service; and
 - 4) it is not objectionable to Owner.
 - b. Contractor certifies that, if approved and incorporated into the Work:
 - 1) there will be no increase in cost to the Owner or increase in Contract Times; and
 - 2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.
- B. *Contractor's Expense:* Contractor shall provide all data in support of any proposed "or equal" item at Contractor's expense.
- C. *Engineer's Evaluation and Determination:* Engineer will be allowed a reasonable time to evaluate each "or-equal" request. Engineer may require Contractor to furnish additional data about the proposed "or-equal" item. Engineer will be the sole judge of acceptability. No "or-equal" item will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an "or-equal", which will be evidenced by an approved Shop Drawing or other written communication. Engineer will advise Contractor in writing of any negative determination.

- D. *Effect of Engineer's Determination:* Neither approval nor denial of an "or-equal" request shall result in any change in Contract Price. The Engineer's denial of an "or-equal" request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents.
- E. *Treatment as a Substitution Request:* If Engineer determines that an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer consider the proposed item as a substitute pursuant to Paragraph 7.05.

7.05 Substitutes

- A. Unless the specification or description of an item of material or equipment required to be furnished under the Contract Documents contains or is followed by words reading that no substitution is permitted, Contractor may request that Engineer authorize the use of other items of material or equipment under the circumstances described below. To the extent possible such requests shall be made before commencement of related construction at the Site.
 - 1. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is functionally equivalent to that named and an acceptable substitute therefor. Engineer will not accept requests for review of proposed substitute items of material or equipment from anyone other than Contractor.
 - 2. The requirements for review by Engineer will be as set forth in Paragraph 7.05.B, as supplemented by the Specifications, and as Engineer may decide is appropriate under the circumstances.
 - 3. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:
 - a. shall certify that the proposed substitute item will:
 - 1) perform adequately the functions and achieve the results called for by the general design,
 - 2) be similar in substance to that specified, and
 - 3) be suited to the same use as that specified.
 - b. will state:
 - 1) the extent, if any, to which the use of the proposed substitute item will necessitate a change in Contract Times,
 - 2) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item, and
 - 3) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty.
 - c. will identify:
 - 1) all variations of the proposed substitute item from that specified, and

- 2) available engineering, sales, maintenance, repair, and replacement services.
- d. shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including but not limited to changes in Contract Price, shared savings, costs of redesign, and claims of other contractors affected by any resulting change.
- B. *Engineer's Evaluation and Determination:* Engineer will be allowed a reasonable time to evaluate each substitute request, and to obtain comments and direction from Owner. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No substitute will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an acceptable substitute. Engineer's determination will be evidenced by a Field Order or a proposed Change Order accounting for the substitution itself and all related impacts, including changes in Contract Price or Contract Times. Engineer will advise Contractor in writing of any negative determination.
- C. *Special Guarantee:* Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.
- D. *Reimbursement of Engineer's Cost:* Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.
- E. *Contractor's Expense:* Contractor shall provide all data in support of any proposed substitute at Contractor's expense.
- F. *Effect of Engineer's Determination:* If Engineer approves the substitution request, Contractor shall execute the proposed Change Order and proceed with the substitution. The Engineer's denial of a substitution request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.05.D, by timely submittal of a Change Proposal.

7.06 *Concerning Subcontractors, Suppliers, and Others*

- A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner.
- B. Contractor shall retain specific Subcontractors, Suppliers, or other individuals or entities for the performance of designated parts of the Work if required by the Contract to do so.
- C. Subsequent to the submittal of Contractor's Bid or final negotiation of the terms of the Contract, Owner may not require Contractor to retain any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against which Contractor has reasonable objection.
- D. Prior to entry into any binding subcontract or purchase order, Contractor shall submit to Owner the identity of the proposed Subcontractor or Supplier (unless Owner has already deemed such proposed Subcontractor or Supplier acceptable, during the bidding process or otherwise). Such proposed Subcontractor or Supplier shall be deemed acceptable to Owner unless Owner raises a substantive, reasonable objection within five days.

- E. Owner may require the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work. Owner also may require Contractor to retain specific replacements; provided, however, that Owner may not require a replacement to which Contractor has a reasonable objection. If Contractor has submitted the identity of certain Subcontractors, Suppliers, or other individuals or entities for acceptance by Owner, and Owner has accepted it (either in writing or by failing to make written objection thereto), then Owner may subsequently revoke the acceptance of any such Subcontractor, Supplier, or other individual or entity so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity.
- F. If Owner requires the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, or both, with respect to the replacement; and Contractor shall initiate a Change Proposal for such adjustment within 30 days of Owner's requirement of replacement.
- G. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of the right of Owner to the completion of the Work in accordance with the Contract Documents.
- H. On a monthly basis Contractor shall submit to Engineer a complete list of all Subcontractors and Suppliers having a direct contract with Contractor, and of all other Subcontractors and Suppliers known to Contractor at the time of submittal.
- I. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions.
- J. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors, Suppliers, and all other individuals or entities performing or furnishing any of the Work.
- K. Contractor shall restrict all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed herein.
- L. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.
- M. All Work performed for Contractor by a Subcontractor or Supplier shall be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer.
- N. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor on account of Work performed for Contractor by the particular Subcontractor or Supplier.

O. Nothing in the Contract Documents:

1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier, or other individual or entity; nor
2. shall create any obligation on the part of Owner or Engineer to pay or to see to the payment of any money due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.

7.07 *Patent Fees and Royalties*

- A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by Owner in the Contract Documents.
- B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.
- C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

7.08 *Permits*

- A. Unless otherwise provided in the Contract Documents, Contractor shall obtain and pay for all construction permits and licenses. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of the submission of Contractor's Bid (or when Contractor became bound under a negotiated contract). Owner shall pay all charges of utility owners for connections for providing permanent service to the Work

7.09 *Taxes*

- A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

7.10 *Laws and Regulations*

- A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.
- B. If Contractor performs any Work or takes any other action knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all resulting costs and losses, and shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work or other action. It shall not be Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.
- C. Owner or Contractor may give notice to the other party of any changes after the submission of Contractor's Bid (or after the date when Contractor became bound under a negotiated contract) in Laws or Regulations having an effect on the cost or time of performance of the Work, including but not limited to changes in Laws or Regulations having an effect on procuring permits and on sales, use, value-added, consumption, and other similar taxes. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

7.11 *Record Documents*

- A. Contractor shall maintain in a safe place at the Site one printed record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, written interpretations and clarifications, and approved Shop Drawings. Contractor shall keep such record documents in good order and annotate them to show changes made during construction. These record documents, together with all approved Samples, will be available to Engineer for reference. Upon completion of the Work, Contractor shall deliver these record documents to Engineer.

7.12 *Safety and Protection*

- A. Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury, or loss to:
 - 1. all persons on the Site or who may be affected by the Work;

2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and
 3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, other work in progress, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.
- B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify Owner; the owners of adjacent property, Underground Facilities, and other utilities; and other contractors and utility owners performing work at or adjacent to the Site, when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property or work in progress.
 - C. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. The Supplementary Conditions identify any Owner's safety programs that are applicable to the Work.
 - D. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.
 - E. All damage, injury, or loss to any property referred to in Paragraph 7.12.A.2 or 7.12.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor at its expense (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).
 - F. Contractor's duties and responsibilities for safety and protection shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 15.06.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).
 - G. Contractor's duties and responsibilities for safety and protection shall resume whenever Contractor or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

7.13 *Safety Representative*

- A. Contractor shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

7.14 *Hazard Communication Programs*

- A. Contractor shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or

exchanged between or among employers at the Site in accordance with Laws or Regulations.

7.15 *Emergencies*

- A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent threatened damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are required as a result thereof. If Engineer determines that a change in the Contract Documents is required because of the action taken by Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued.

7.16 *Shop Drawings, Samples, and Other Submittals*

A. *Shop Drawing and Sample Submittal Requirements:*

1. Before submitting a Shop Drawing or Sample, Contractor shall have:
 - a. reviewed and coordinated the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;
 - b. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;
 - c. determined and verified the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and
 - d. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.
2. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that submittal, and that Contractor approves the submittal.
3. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be set forth in a written communication separate from the Shop Drawings or Sample submittal; and, in addition, in the case of Shop Drawings by a specific notation made on each Shop Drawing submitted to Engineer for review and approval of each such variation.

- B. *Submittal Procedures for Shop Drawings and Samples:* Contractor shall submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals. Each submittal will be identified as Engineer may require.

1. *Shop Drawings:*

- a. Contractor shall submit the number of copies required in the Specifications.
- b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to

provide and to enable Engineer to review the information for the limited purposes required by Paragraph 7.16.D.

2. *Samples:*

- a. Contractor shall submit the number of Samples required in the Specifications.
- b. Contractor shall clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the submittal for the limited purposes required by Paragraph 7.16.D.

3. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.

C. *Other Submittals:* Contractor shall submit other submittals to Engineer in accordance with the accepted Schedule of Submittals, and pursuant to the applicable terms of the Specifications.

D. *Engineer's Review:*

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction or to safety precautions or programs incident thereto.
3. Engineer's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.
4. Engineer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 7.16.A.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will document any such approved variation from the requirements of the Contract Documents in a Field Order.
5. Engineer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 7.16.A and B.
6. Engineer's review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, shall not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.
7. Neither Engineer's receipt, review, acceptance or approval of a Shop Drawing, Sample, or other submittal shall result in such item becoming a Contract Document.

8. Contractor shall perform the Work in compliance with the requirements and commitments set forth in approved Shop Drawings and Samples, subject to the provisions of Paragraph 7.16.D.4.

E. *Resubmittal Procedures:*

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.
2. Contractor shall furnish required submittals with sufficient information and accuracy to obtain required approval of an item with no more than three submittals. Engineer will record Engineer's time for reviewing a fourth or subsequent submittal of a Shop Drawings, sample, or other item requiring approval, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges.
3. If Contractor requests a change of a previously approved submittal item, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

7.17 *Contractor's General Warranty and Guarantee*

- A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its officers, directors, members, partners, employees, agents, consultants, and subcontractors shall be entitled to rely on Contractor's warranty and guarantee.
- B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
 1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or
 2. normal wear and tear under normal usage.
- C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:
 1. observations by Engineer;
 2. recommendation by Engineer or payment by Owner of any progress or final payment;
 3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;
 4. use or occupancy of the Work or any part thereof by Owner;
 5. any review and approval of a Shop Drawing or Sample submittal;
 6. the issuance of a notice of acceptability by Engineer;
 7. any inspection, test, or approval by others; or
 8. any correction of defective Work by Owner.

- D. If the Contract requires the Contractor to accept the assignment of a contract entered into by Owner, then the specific warranties, guarantees, and correction obligations contained in the assigned contract shall govern with respect to Contractor's performance obligations to Owner for the Work described in the assigned contract.

7.18 *Indemnification*

- A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable.
- B. In any and all claims against Owner or Engineer or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 7.18.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.
- C. The indemnification obligations of Contractor under Paragraph 7.18.A shall not extend to the liability of Engineer and Engineer's officers, directors, members, partners, employees, agents, consultants and subcontractors arising out of:
 - 1. the preparation or approval of, or the failure to prepare or approve maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or
 - 2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

7.19 *Delegation of Professional Design Services*

- A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable Laws and Regulations.
- B. If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of Contractor by the Contract Documents, Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, and other submittals prepared by such professional. Shop

Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.

- C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, or approvals performed by such design professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.
- D. Pursuant to this paragraph, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 7.16.D.1.
- E. Contractor shall not be responsible for the adequacy of the performance or design criteria specified by Owner or Engineer.

ARTICLE 8 – OTHER WORK AT THE SITE

8.01 *Other Work*

- A. In addition to and apart from the Work under the Contract Documents, the Owner may perform other work at or adjacent to the Site. Such other work may be performed by Owner's employees, or through contracts between the Owner and third parties. Owner may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.
- B. If Owner performs other work at or adjacent to the Site with Owner's employees, or through contracts for such other work, then Owner shall give Contractor written notice thereof prior to starting any such other work. If Owner has advance information regarding the start of any utility work at or adjacent to the Site, Owner shall provide such information to Contractor.
- C. Contractor shall afford each other contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected.
- D. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 8, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

8.02 *Coordination*

- A. If Owner intends to contract with others for the performance of other work at or adjacent to the Site, to perform other work at or adjacent to the Site with Owner's employees, or to arrange to have utility owners perform work at or adjacent to the Site, the following will be set forth in the Supplementary Conditions or provided to Contractor prior to the start of any such other work:
 - 1. the identity of the individual or entity that will have authority and responsibility for coordination of the activities among the various contractors;
 - 2. an itemization of the specific matters to be covered by such authority and responsibility; and
 - 3. the extent of such authority and responsibilities.
- B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

8.03 *Legal Relationships*

- A. If, in the course of performing other work at or adjacent to the Site for Owner, the Owner's employees, any other contractor working for Owner, or any utility owner for whom the Owner is responsible causes damage to the Work or to the property of Contractor or its Subcontractors, or delays, disrupts, interferes with, or increases the scope or cost of the performance of the Work, through actions or inaction, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times, or both. Contractor must submit any Change Proposal seeking an equitable adjustment in the Contract Price or the Contract Times under this paragraph within 30 days of the damaging, delaying, disrupting, or interfering event. The entitlement to, and extent of, any such equitable adjustment shall take into account information (if any) regarding such other work that was provided to Contractor in the Contract Documents prior to the submittal of the Bid or the final negotiation of the terms of the Contract. When applicable, any such equitable adjustment in Contract Price shall be conditioned on Contractor assigning to Owner all Contractor's rights against such other contractor or utility owner with respect to the damage, delay, disruption, or interference that is the subject of the adjustment. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
- B. Contractor shall take reasonable and customary measures to avoid damaging, delaying, disrupting, or interfering with the work of Owner, any other contractor, or any utility owner performing other work at or adjacent to the Site. If Contractor fails to take such measures and as a result damages, delays, disrupts, or interferes with the work of any such other contractor or utility owner, then Owner may impose a set-off against payments due to Contractor, and assign to such other contractor or utility owner the Owner's contractual rights against Contractor with respect to the breach of the obligations set forth in this paragraph.
- C. When Owner is performing other work at or adjacent to the Site with Owner's employees, Contractor shall be liable to Owner for damage to such other work, and for the reasonable direct delay, disruption, and interference costs incurred by Owner as a result of Contractor's failure to take reasonable and customary measures with respect to Owner's other work. In response to such damage, delay, disruption, or interference, Owner may impose a set-off against payments due to Contractor.

- D. If Contractor damages, delays, disrupts, or interferes with the work of any other contractor, or any utility owner performing other work at or adjacent to the Site, through Contractor's failure to take reasonable and customary measures to avoid such impacts, or if any claim arising out of Contractor's actions, inactions, or negligence in performance of the Work at or adjacent to the Site is made by any such other contractor or utility owner against Contractor, Owner, or Engineer, then Contractor shall (1) promptly attempt to settle the claim as to all parties through negotiations with such other contractor or utility owner, or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law, and (2) indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claims, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such damage, delay, disruption, or interference.

ARTICLE 9 – OWNER'S RESPONSIBILITIES

9.01 *Communications to Contractor*

- A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

9.02 *Replacement of Engineer*

- A. Owner may at its discretion appoint an engineer to replace Engineer, provided Contractor makes no reasonable objection to the replacement engineer. The replacement engineer's status under the Contract Documents shall be that of the former Engineer.

9.03 *Furnish Data*

- A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

9.04 *Pay When Due*

- A. Owner shall make payments to Contractor when they are due as provided in the Agreement.

9.05 *Lands and Easements; Reports, Tests, and Drawings*

- A. Owner's duties with respect to providing lands and easements are set forth in Paragraph 5.01.
- B. Owner's duties with respect to providing engineering surveys to establish reference points are set forth in Paragraph 4.03.
- C. Article 5 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of conditions at the Site, and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

9.06 *Insurance*

- A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 6.

9.07 *Change Orders*

- A. Owner's responsibilities with respect to Change Orders are set forth in Article 11.

9.08 *Inspections, Tests, and Approvals*

- A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 14.02.B.

9.09 *Limitations on Owner's Responsibilities*

- A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

9.10 *Undisclosed Hazardous Environmental Condition*

- A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 5.06.

9.11 *Evidence of Financial Arrangements*

- A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents (including obligations under proposed changes in the Work).

9.12 *Safety Programs*

- A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed.
- B. Owner shall furnish copies of any applicable Owner safety programs to Contractor.

ARTICLE 10 – ENGINEER'S STATUS DURING CONSTRUCTION

10.01 *Owner's Representative*

- A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract.

10.02 *Visits to Site*

- A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.
- B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 10.08. Particularly, but without limitation, during

or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

10.03 *Project Representative*

- A. If Owner and Engineer have agreed that Engineer will furnish a Resident Project Representative to represent Engineer at the Site and assist Engineer in observing the progress and quality of the Work, then the authority and responsibilities of any such Resident Project Representative will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in Paragraph 10.08. If Owner designates another representative or agent to represent Owner at the Site who is not Engineer's consultant, agent, or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the Supplementary Conditions.

10.04 *Rejecting Defective Work*

- A. Engineer has the authority to reject Work in accordance with Article 14.

10.05 *Shop Drawings, Change Orders and Payments*

- A. Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, are set forth in Paragraph 7.16.
- B. Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, are set forth in Paragraph 7.19.
- C. Engineer's authority as to Change Orders is set forth in Article 11.
- D. Engineer's authority as to Applications for Payment is set forth in Article 15.

10.06 *Determinations for Unit Price Work*

- A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor as set forth in Paragraph 13.03.

10.07 *Decisions on Requirements of Contract Documents and Acceptability of Work*

- A. Engineer will render decisions regarding the requirements of the Contract Documents, and judge the acceptability of the Work, pursuant to the specific procedures set forth herein for initial interpretations, Change Proposals, and acceptance of the Work. In rendering such decisions and judgments, Engineer will not show partiality to Owner or Contractor, and will not be liable to Owner, Contractor, or others in connection with any proceedings, interpretations, decisions, or judgments conducted or rendered in good faith.

10.08 *Limitations on Engineer's Authority and Responsibilities*

- A. Neither Engineer's authority or responsibility under this Article 10 or under any other provision of the Contract, nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer, shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

- B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.
- C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.
- D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 15.06.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals, that the results certified indicate compliance with the Contract Documents.
- E. The limitations upon authority and responsibility set forth in this Paragraph 10.08 shall also apply to the Resident Project Representative, if any.

10.09 *Compliance with Safety Program*

- A. While at the Site, Engineer's employees and representatives will comply with the specific applicable requirements of Owner's and Contractor's safety programs (if any) of which Engineer has been informed.

ARTICLE 11 – AMENDING THE CONTRACT DOCUMENTS; CHANGES IN THE WORK

11.01 *Amending and Supplementing Contract Documents*

- A. The Contract Documents may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.
 - 1. *Change Orders:*
 - a. If an amendment or supplement to the Contract Documents includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order. A Change Order also may be used to establish amendments and supplements of the Contract Documents that do not affect the Contract Price or Contract Times.
 - b. Owner and Contractor may amend those terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, without the recommendation of the Engineer. Such an amendment shall be set forth in a Change Order.
 - 2. *Work Change Directives:* A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including Paragraph 11.04 regarding change of Contract Price. Contractor must submit any Change Proposal seeking an

adjustment of the Contract Price or the Contract Times, or both, no later than 30 days after the completion of the Work set out in the Work Change Directive. Owner must submit any Claim seeking an adjustment of the Contract Price or the Contract Times, or both, no later than 60 days after issuance of the Work Change Directive.

3. *Field Orders*: Engineer may authorize minor changes in the Work if the changes do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Such changes will be accomplished by a Field Order and will be binding on Owner and also on Contractor, which shall perform the Work involved promptly. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

11.02 *Owner-Authorized Changes in the Work*

- A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work. Such changes shall be supported by Engineer's recommendation, to the extent the change involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters. Such changes may be accomplished by a Change Order, if Owner and Contractor have agreed as to the effect, if any, of the changes on Contract Times or Contract Price; or by a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work shall be performed under the applicable conditions of the Contract Documents. Nothing in this paragraph shall obligate Contractor to undertake work that Contractor reasonably concludes cannot be performed in a manner consistent with Contractor's safety obligations under the Contract Documents or Laws and Regulations.

11.03 *Unauthorized Changes in the Work*

- A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents, as amended, modified, or supplemented, except in the case of an emergency as provided in Paragraph 7.15 or in the case of uncovering Work as provided in Paragraph 14.05.

11.04 *Change of Contract Price*

- A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment of Contract Price shall comply with the provisions of Article 12.
- B. An adjustment in the Contract Price will be determined as follows:
 1. where the Work involved is covered by unit prices contained in the Contract Documents, then by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 13.03); or
 2. where the Work involved is not covered by unit prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.04.C.2); or
 3. where the Work involved is not covered by unit prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on

the basis of the Cost of the Work (determined as provided in Paragraph 13.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 11.04.C).

C. *Contractor's Fee:* When applicable, the Contractor's fee for overhead and profit shall be determined as follows:

1. a mutually acceptable fixed fee; or
2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:
 - a. for costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2, the Contractor's fee shall be 15 percent;
 - b. for costs incurred under Paragraph 13.01.B.3, the Contractor's fee shall be five percent;
 - c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 11.04.C.2.a and 11.04.C.2.b is that the Contractor's fee shall be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.A.1 and 13.01.A.2 by the Subcontractor that actually performs the Work, at whatever tier, and (2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of five percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor; provided, however, that for any such subcontracted work the maximum total fee to be paid by Owner shall be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the work;
 - d. no fee shall be payable on the basis of costs itemized under Paragraphs 13.01.B.4, 13.01.B.5, and 13.01.C;
 - e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and
 - f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 11.04.C.2.a through 11.04.C.2.e, inclusive.

11.05 *Change of Contract Times*

- A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment in the Contract Times shall comply with the provisions of Article 12.
- B. An adjustment of the Contract Times shall be subject to the limitations set forth in Paragraph 4.05, concerning delays in Contractor's progress.

11.06 *Change Proposals*

- A. Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; appeal an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; contest a set-off against payment due; or seek other relief under

the Contract. The Change Proposal shall specify any proposed change in Contract Times or Contract Price, or both, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents.

1. *Procedures:* Contractor shall submit each Change Proposal to Engineer promptly (but in no event later than 30 days) after the start of the event giving rise thereto, or after such initial decision. The Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any), to the Engineer and Owner within 15 days after the submittal of the Change Proposal. The supporting data shall be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event. Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal.
 2. *Engineer's Action:* Engineer will review each Change Proposal and, within 30 days after receipt of the Contractor's supporting data, either deny the Change Proposal in whole, approve it in whole, or deny it in part and approve it in part. Such actions shall be in writing, with a copy provided to Owner and Contractor. If Engineer does not take action on the Change Proposal within 30 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of Engineer's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under Article 12.
 3. *Binding Decision:* Engineer's decision will be final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.
- B. *Resolution of Certain Change Proposals:* If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then Engineer will notify the parties that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice shall be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.

11.07 Execution of Change Orders

- A. Owner and Contractor shall execute appropriate Change Orders covering:
1. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive;
 2. changes in Contract Price resulting from an Owner set-off, unless Contractor has duly contested such set-off;
 3. changes in the Work which are: (a) ordered by Owner pursuant to Paragraph 11.02, (b) required because of Owner's acceptance of defective Work under Paragraph 14.04 or Owner's correction of defective Work under Paragraph 14.07, or (c) agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters; and
 4. changes in the Contract Price or Contract Times, or other changes, which embody the substance of any final and binding results under Paragraph 11.06, or Article 12.

- B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of this Paragraph 11.07, it shall be deemed to be of full force and effect, as if fully executed.

11.08 *Notification to Surety*

- A. If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

ARTICLE 12 – CLAIMS

12.01 *Claims*

- A. *Claims Process:* The following disputes between Owner and Contractor shall be submitted to the Claims process set forth in this Article:
 - 1. Appeals by Owner or Contractor of Engineer's decisions regarding Change Proposals;
 - 2. Owner demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents; and
 - 3. Disputes that Engineer has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters.
- B. *Submittal of Claim:* The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to the Engineer, for its information only. The responsibility to substantiate a Claim shall rest with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, or both, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor's knowledge and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled.
- C. *Review and Resolution:* The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim shall be stated in writing and submitted to the other party, with a copy to Engineer.
- D. *Mediation:*
 - 1. At any time after initiation of a Claim, Owner and Contractor may mutually agree to mediation of the underlying dispute. The agreement to mediate shall stay the Claim submittal and response process.
 - 2. If Owner and Contractor agree to mediation, then after 60 days from such agreement, either Owner or Contractor may unilaterally terminate the mediation process, and the Claim submittal and decision process shall resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim

submittal and decision process shall resume as of the date of the conclusion of the mediation, as determined by the mediator.

3. Owner and Contractor shall each pay one-half of the mediator's fees and costs.
- E. *Partial Approval*: If the party receiving a Claim approves the Claim in part and denies it in part, such action shall be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 17 for final resolution of disputes.
- F. *Denial of Claim*: If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of the inaction, the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim shall be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 17 for the final resolution of disputes.
- G. *Final and Binding Results*: If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the agreement or action on the Claim shall be incorporated in a Change Order to the extent they affect the Contract, including the Work, the Contract Times, or the Contract Price.

ARTICLE 13 – COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

13.01 Cost of the Work

- A. *Purposes for Determination of Cost of the Work*: The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this Paragraph 13.01 are used for two distinct purposes:
 1. To determine Cost of the Work when Cost of the Work is a component of the Contract Price, under cost-plus-fee, time-and-materials, or other cost-based terms; or
 2. To determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.
- B. *Costs Included*: Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work shall be in amounts no higher than those prevailing in the locality of the Project, shall not include any of the costs itemized in Paragraph 13.01.C, and shall include only the following items:
 1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, and vacation and holiday pay applicable

thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.
3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 13.01.
4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.
5. Supplemental costs including the following:
 - a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.
 - b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.
 - c. Rentals of all construction equipment and machinery, and the parts thereof, whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.
 - d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.
 - e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.
 - f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 6.05), provided such losses and damages have resulted from causes

other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.

- g. The cost of utilities, fuel, and sanitary facilities at the Site.
- h. Minor expenses such as communication service at the Site, express and courier services, and similar petty cash items in connection with the Work.
- i. The costs of premiums for all bonds and insurance that Contractor is required by the Contract Documents to purchase and maintain.

C. *Costs Excluded:* The term Cost of the Work shall not include any of the following items:

- 1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 13.01.B.1 or specifically covered by Paragraph 13.01.B.4. The payroll costs and other compensation excluded here are to be considered administrative costs covered by the Contractor's fee.
- 2. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.
- 3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.
- 4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.
- 5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraph 13.01.B.

D. *Contractor's Fee:* When the Work as a whole is performed on the basis of cost-plus, Contractor's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor's fee shall be determined as set forth in Paragraph 11.04.C.

E. *Documentation:* Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 13, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

13.02 Allowances

- A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.

- B. *Cash Allowances*: Contractor agrees that:
1. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and
 2. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.
- C. *Contingency Allowance*: Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.
- D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

13.03 *Unit Price Work*

- A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.
- B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Payments to Contractor for Unit Price Work will be based on actual quantities.
- C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.
- D. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of the following paragraph.
- E. Within 30 days of Engineer's written decision under the preceding paragraph, Contractor may submit a Change Proposal, or Owner may file a Claim, seeking an adjustment in the Contract Price if:
1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement;
 2. there is no corresponding adjustment with respect to any other item of Work; and
 3. Contractor believes that it is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price, and the parties are unable to agree as to the amount of any such increase or decrease.

ARTICLE 14 – TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

14.01 *Access to Work*

- A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and authorities having jurisdiction will have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply therewith as applicable.

14.02 *Tests, Inspections, and Approvals*

- A. Contractor shall give Engineer timely notice of readiness of the Work (or specific parts thereof) for all required inspections and tests, and shall cooperate with inspection and testing personnel to facilitate required inspections and tests.
- B. Owner shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished and paid for by Owner, except that costs incurred in connection with tests or inspections of covered Work shall be governed by the provisions of Paragraph 14.05.
- C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.
- D. Contractor shall be responsible for arranging, obtaining, and paying for all inspections and tests required:
 - 1. by the Contract Documents, unless the Contract Documents expressly allocate responsibility for a specific inspection or test to Owner;
 - 2. to attain Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work;
 - 3. by manufacturers of equipment furnished under the Contract Documents;
 - 4. for testing, adjusting, and balancing of mechanical, electrical, and other equipment to be incorporated into the Work; and
 - 5. for acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

Such inspections and tests shall be performed by independent inspectors, testing laboratories, or other qualified individuals or entities acceptable to Owner and Engineer.

- E. If the Contract Documents require the Work (or part thereof) to be approved by Owner, Engineer, or another designated individual or entity, then Contractor shall assume full responsibility for arranging and obtaining such approvals.
- F. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation. Such uncovering shall be at Contractor's expense unless Contractor had given Engineer timely notice of Contractor's intention to

cover the same and Engineer had not acted with reasonable promptness in response to such notice.

14.03 *Defective Work*

- A. *Contractor's Obligation:* It is Contractor's obligation to assure that the Work is not defective.
- B. *Engineer's Authority:* Engineer has the authority to determine whether Work is defective, and to reject defective Work.
- C. *Notice of Defects:* Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor.
- D. *Correction, or Removal and Replacement:* Promptly after receipt of written notice of defective Work, Contractor shall correct all such defective Work, whether or not fabricated, installed, or completed, or, if Engineer has rejected the defective Work, remove it from the Project and replace it with Work that is not defective.
- E. *Preservation of Warranties:* When correcting defective Work, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.
- F. *Costs and Damages:* In addition to its correction, removal, and replacement obligations with respect to defective Work, Contractor shall pay all claims, costs, losses, and damages arising out of or relating to defective Work, including but not limited to the cost of the inspection, testing, correction, removal, replacement, or reconstruction of such defective Work, fines levied against Owner by governmental authorities because the Work is defective, and the costs of repair or replacement of work of others resulting from defective Work. Prior to final payment, if Owner and Contractor are unable to agree as to the measure of such claims, costs, losses, and damages resulting from defective Work, then Owner may impose a reasonable set-off against payments due under Article 15.

14.04 *Acceptance of Defective Work*

- A. If, instead of requiring correction or removal and replacement of defective Work, Owner prefers to accept it, Owner may do so (subject, if such acceptance occurs prior to final payment, to Engineer's confirmation that such acceptance is in general accord with the design intent and applicable engineering principles, and will not endanger public safety). Contractor shall pay all claims, costs, losses, and damages attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness), and for the diminished value of the Work to the extent not otherwise paid by Contractor. If any such acceptance occurs prior to final payment, the necessary revisions in the Contract Documents with respect to the Work shall be incorporated in a Change Order. If the parties are unable to agree as to the decrease in the Contract Price, reflecting the diminished value of Work so accepted, then Owner may impose a reasonable set-off against payments due under Article 15. If the acceptance of defective Work occurs after final payment, Contractor shall pay an appropriate amount to Owner.

14.05 *Uncovering Work*

- A. Engineer has the authority to require additional inspection or testing of the Work, whether or not the Work is fabricated, installed, or completed.

- B. If any Work is covered contrary to the written request of Engineer, then Contractor shall, if requested by Engineer, uncover such Work for Engineer's observation, and then replace the covering, all at Contractor's expense.
- C. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, then Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, and provide all necessary labor, material, and equipment.
 - 1. If it is found that the uncovered Work is defective, Contractor shall be responsible for all claims, costs, losses, and damages arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and pending Contractor's full discharge of this responsibility the Owner shall be entitled to impose a reasonable set-off against payments due under Article 15.
 - 2. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, then Contractor may submit a Change Proposal within 30 days of the determination that the Work is not defective.

14.06 *Owner May Stop the Work*

- A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, then Owner may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work shall not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

14.07 *Owner May Correct Defective Work*

- A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace rejected Work as required by Engineer, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, then Owner may, after seven days written notice to Contractor, correct or remedy any such deficiency.
- B. In exercising the rights and remedies under this Paragraph 14.07, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this paragraph.
- C. All claims, costs, losses, and damages incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 14.07 will be charged against Contractor as set-offs against payments due under Article 15. Such claims, costs, losses and damages will

include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.

- D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 14.07.

ARTICLE 15 – PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

15.01 Progress Payments

- A. *Basis for Progress Payments:* The Schedule of Values established as provided in Article 2 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed during the pay period, as determined under the provisions of Paragraph 13.03. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period.
- B. *Applications for Payments:*
1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens, and evidence that the materials and equipment are covered by appropriate property insurance, a warehouse bond, or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.
 2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.
 3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.
- C. *Review of Applications:*
1. Engineer will, within 10 days after receipt of each Application for Payment, including each resubmittal, either indicate in writing a recommendation of payment and present the Application to Owner, or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.
 2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:

- a. the Work has progressed to the point indicated;
 - b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 13.03, and any other qualifications stated in the recommendation); and
 - c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.
3. By recommending any such payment Engineer will not thereby be deemed to have represented that:
 - a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract; or
 - b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.
4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:
 - a. to supervise, direct, or control the Work, or
 - b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or
 - c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or
 - d. to make any examination to ascertain how or for what purposes Contractor has used the money paid on account of the Contract Price, or
 - e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.
5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 15.01.C.2.
6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer's opinion to protect Owner from loss because:
 - a. the Work is defective, requiring correction or replacement;
 - b. the Contract Price has been reduced by Change Orders;
 - c. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
 - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible; or

- e. Engineer has actual knowledge of the occurrence of any of the events that would constitute a default by Contractor and therefore justify termination for cause under the Contract Documents.

D. *Payment Becomes Due:*

- 1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended (subject to any Owner set-offs) will become due, and when due will be paid by Owner to Contractor.

E. *Reductions in Payment by Owner:*

- 1. In addition to any reductions in payment (set-offs) recommended by Engineer, Owner is entitled to impose a set-off against payment based on any of the following:
 - a. claims have been made against Owner on account of Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages on account of Contractor's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;
 - b. Contractor has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site;
 - c. Contractor has failed to provide and maintain required bonds or insurance;
 - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;
 - e. Owner has incurred extra charges or engineering costs related to submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;
 - f. the Work is defective, requiring correction or replacement;
 - g. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
 - h. the Contract Price has been reduced by Change Orders;
 - i. an event that would constitute a default by Contractor and therefore justify a termination for cause has occurred;
 - j. liquidated damages have accrued as a result of Contractor's failure to achieve Milestones, Substantial Completion, or final completion of the Work;
 - k. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;
 - l. there are other items entitling Owner to a set off against the amount recommended.
- 2. If Owner imposes any set-off against payment, whether based on its own knowledge or on the written recommendations of Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and the specific amount of the reduction, and promptly pay Contractor any amount

remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, if Contractor remedies the reasons for such action. The reduction imposed shall be binding on Contractor unless it duly submits a Change Proposal contesting the reduction.

3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 15.01.C.1 and subject to interest as provided in the Agreement.

15.02 *Contractor's Warranty of Title*

- A. Contractor warrants and guarantees that title to all Work, materials, and equipment furnished under the Contract will pass to Owner free and clear of (1) all Liens and other title defects, and (2) all patent, licensing, copyright, or royalty obligations, no later than seven days after the time of payment by Owner.

15.03 *Substantial Completion*

- A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete and request that Engineer issue a certificate of Substantial Completion. Contractor shall at the same time submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.
- B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.
- C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a preliminary certificate of Substantial Completion which shall fix the date of Substantial Completion. Engineer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Owner shall have seven days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the preliminary certificate to Owner, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefor. If Owner does not object to the provisions of the certificate, or if despite consideration of Owner's objections Engineer concludes that the Work is substantially complete, then Engineer will, within said 14 days, execute and deliver to Owner and Contractor a final certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Engineer believes justified after consideration of any objections from Owner.
- D. At the time of receipt of the preliminary certificate of Substantial Completion, Owner and Contractor will confer regarding Owner's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by Owner. Unless Owner and Contractor agree otherwise in writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner's use or occupancy of the Work.

- E. After Substantial Completion the Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.
- F. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the punch list.

15.04 *Partial Use or Occupancy*

- A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:
 - 1. At any time Owner may request in writing that Contractor permit Owner to use or occupy any such part of the Work that Owner believes to be substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 15.03.A through E for that part of the Work.
 - 2. At any time Contractor may notify Owner and Engineer in writing that Contractor considers any such part of the Work substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.
 - 3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 15.03 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.
 - 4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 6.05 regarding builder's risk or other property insurance.

15.05 *Final Inspection*

- A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work, or agreed portion thereof, is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

15.06 *Final Payment*

- A. *Application for Payment:*
 - 1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of

inspection, annotated record documents (as provided in Paragraph 7.11), and other documents, Contractor may make application for final payment.

2. The final Application for Payment shall be accompanied (except as previously delivered) by:
 - a. all documentation called for in the Contract Documents;
 - b. consent of the surety, if any, to final payment;
 - c. satisfactory evidence that all title issues have been resolved such that title to all Work, materials, and equipment has passed to Owner free and clear of any Liens or other title defects, or will so pass upon final payment.
 - d. a list of all disputes that Contractor believes are unsettled; and
 - e. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of the Work, and of Liens filed in connection with the Work.
3. In lieu of the releases or waivers of Liens specified in Paragraph 15.06.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (b) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.

B. *Engineer's Review of Application and Acceptance:*

1. If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the Application for Payment to Owner for payment. Such recommendation shall account for any set-offs against payment that are necessary in Engineer's opinion to protect Owner from loss for the reasons stated above with respect to progress payments. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to the provisions of Paragraph 15.07. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.
- C. *Completion of Work:* The Work is complete (subject to surviving obligations) when it is ready for final payment as established by the Engineer's written recommendation of final payment.
- D. *Payment Becomes Due:* Thirty days after the presentation to Owner of the final Application for Payment and accompanying documentation, the amount recommended by Engineer (less any further sum Owner is entitled to set off against Engineer's recommendation,

including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions above with respect to progress payments) will become due and shall be paid by Owner to Contractor.

15.07 *Waiver of Claims*

- A. The making of final payment will not constitute a waiver by Owner of claims or rights against Contractor. Owner expressly reserves claims and rights arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 15.05, from Contractor's failure to comply with the Contract Documents or the terms of any special guarantees specified therein, from outstanding Claims by Owner, or from Contractor's continuing obligations under the Contract Documents.
- B. The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against Owner other than those pending matters that have been duly submitted or appealed under the provisions of Article 17.

15.08 *Correction Period*

- A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents, or by any specific provision of the Contract Documents), any Work is found to be defective, or if the repair of any damages to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas used by Contractor as permitted by Laws and Regulations, is found to be defective, then Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:
 - 1. correct the defective repairs to the Site or such other adjacent areas;
 - 2. correct such defective Work;
 - 3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and
 - 4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting therefrom.
- B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others).
- C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.
- D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

- E. Contractor's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph shall not be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

ARTICLE 16 – SUSPENSION OF WORK AND TERMINATION

16.01 *Owner May Suspend Work*

- A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by written notice to Contractor and Engineer. Such notice will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be entitled to an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension. Any Change Proposal seeking such adjustments shall be submitted no later than 30 days after the date fixed for resumption of Work.

16.02 *Owner May Terminate for Cause*

- A. The occurrence of any one or more of the following events will constitute a default by Contractor and justify termination for cause:
 - 1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule);
 - 2. Failure of Contractor to perform or otherwise to comply with a material term of the Contract Documents;
 - 3. Contractor's disregard of Laws or Regulations of any public body having jurisdiction; or
 - 4. Contractor's repeated disregard of the authority of Owner or Engineer.
- B. If one or more of the events identified in Paragraph 16.02.A occurs, then after giving Contractor (and any surety) ten days written notice that Owner is considering a declaration that Contractor is in default and termination of the contract, Owner may proceed to:
 - 1. declare Contractor to be in default, and give Contractor (and any surety) notice that the Contract is terminated; and
 - 2. enforce the rights available to Owner under any applicable performance bond.
- C. Subject to the terms and operation of any applicable performance bond, if Owner has terminated the Contract for cause, Owner may exclude Contractor from the Site, take possession of the Work, incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and complete the Work as Owner may deem expedient.
- D. Owner may not proceed with termination of the Contract under Paragraph 16.02.B if Contractor within seven days of receipt of notice of intent to terminate begins to correct its failure to perform and proceeds diligently to cure such failure.
- E. If Owner proceeds as provided in Paragraph 16.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds the cost to complete the Work, including all related claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals) sustained by Owner, such excess will be paid to Contractor. If the cost to complete the Work including such related claims, costs, losses,

and damages exceeds such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this paragraph, Owner shall not be required to obtain the lowest price for the Work performed.

- F. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue, or any rights or remedies of Owner against Contractor or any surety under any payment bond or performance bond. Any retention or payment of money due Contractor by Owner will not release Contractor from liability.
- G. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 6.01.A, the provisions of that bond shall govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

16.03 *Owner May Terminate For Convenience*

- A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):
 - 1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;
 - 2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses; and
 - 3. other reasonable expenses directly attributable to termination, including costs incurred to prepare a termination for convenience cost proposal.
- B. Contractor shall not be paid on account of loss of anticipated overhead, profits, or revenue, or other economic loss arising out of or resulting from such termination.

16.04 *Contractor May Stop Work or Terminate*

- A. If, through no act or fault of Contractor, (1) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (2) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (3) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the contract and recover from Owner payment on the same terms as provided in Paragraph 16.03.
- B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this paragraph are not intended to preclude Contractor from submitting a Change Proposal for an adjustment in Contract Price or Contract Times or otherwise for

expenses or damage directly attributable to Contractor's stopping the Work as permitted by this paragraph.

ARTICLE 17 – FINAL RESOLUTION OF DISPUTES

17.01 *Methods and Procedures*

- A. *Disputes Subject to Final Resolution:* The following disputed matters are subject to final resolution under the provisions of this Article:
 - 1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full; and
 - 2. Disputes between Owner and Contractor concerning the Work or obligations under the Contract Documents, and arising after final payment has been made.
- B. *Final Resolution of Disputes:* For any dispute subject to resolution under this Article, Owner or Contractor may:
 - 1. elect in writing to invoke the dispute resolution process provided for in the Supplementary Conditions; or
 - 2. agree with the other party to submit the dispute to another dispute resolution process; or
 - 3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, give written notice to the other party of the intent to submit the dispute to a court of competent jurisdiction.

ARTICLE 18 – MISCELLANEOUS

18.01 *Giving Notice*

- A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:
 - 1. delivered in person, by a commercial courier service or otherwise, to the individual or to a member of the firm or to an officer of the corporation for which it is intended; or
 - 2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the sender of the notice.

18.02 *Computation of Times*

- A. When any period of time is referred to in the Contract by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

18.03 *Cumulative Remedies*

- A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract. The provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

18.04 *Limitation of Damages*

- A. With respect to any and all Change Proposals, Claims, disputes subject to final resolution, and other matters at issue, neither Owner nor Engineer, nor any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, shall be liable to Contractor for any claims, costs, losses, or damages sustained by Contractor on or in connection with any other project or anticipated project.

18.05 *No Waiver*

- A. A party's non-enforcement of any provision shall not constitute a waiver of that provision, nor shall it affect the enforceability of that provision or of the remainder of this Contract.

18.06 *Survival of Obligations*

- A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract, as well as all continuing obligations indicated in the Contract, will survive final payment, completion, and acceptance of the Work or termination or completion of the Contract or termination of the services of Contractor.

18.07 *Controlling Law*

- A. This Contract is to be governed by the law of the state in which the Project is located.

18.08 *Headings*

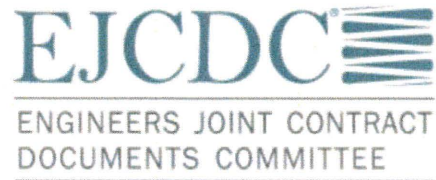
- A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

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BARTLETT & WEST

SUPPLEMENTARY CONDITIONS

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These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract, EJCDC® C-700 (2013 Edition). All provisions that are not so amended or supplemented remain in full force and effect.

The terms used in these Supplementary Conditions have the meanings stated in the General Conditions. Additional terms used in these Supplementary Conditions have the meanings stated below, which are applicable to both the singular and plural thereof.

The address system used in these Supplementary Conditions is the same as the address system used in the General Conditions, with the prefix "SC" added thereto.

ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

SC-1.01 *Defined Terms*

SC-1.01.A.48 Add the following language at the end of the last sentence of Paragraph 1.01.A.48:

A Work Change Directive cannot change Contract Price of Contract Times without a subsequent Change Order.

SC-1.01.A.49 Add the following language at the end of the last sentence of Paragraph 1.01.A.49:

Abnormal Weather Conditions – Conditions of extreme or unusual weather for a given region, elevation, or season as determined by Engineer. Engineer will consult local NOAA records for climatological data to evaluate and establish criteria for extreme or unusual weather. Extreme or unusual weather that is typical for a given region, elevation, or season should not be considered Abnormal Weather Conditions.

ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

SC-3.03 *REPORTING AND RESOLVING DISCREPANCIES*

SC-3.03.C Add the following new paragraph 3.03 C, "Order of Precedence of Contract Documents". immediately after paragraph 3.03 B:

In resolving differences resulting from conflicts, errors or discrepancies in any of the Contract Documents, the order of precedence shall be as follows:

1. Permits
2. Change Orders
3. Contract Agreement
4. Specifications
5. Drawings

Within the Specifications, the order of precedence is as follows:

1. Addenda
2. Notice to Bids
3. Instruction to Bidders

4. **Supplementary General Conditions**
5. **General Conditions**
6. **Division 1, General Requirements**
7. **Technical Specifications**
8. **Referenced Standard Specifications**

With reference to the Drawings, the order of precedence is as follows:

1. **Figures Govern over Scaled Dimensions**
2. **Detail Drawings Govern over General Drawings**
3. **Change Order Drawings Govern over Contract Drawings**
4. **Contract Drawings Govern over Standard or Shop Drawings**

ARTICLE 4 – COMMENCEMENT AND PROGRESS OF THE WORK

SC-4.01 Commencement of Contract Times; Notice to Proceed

SC-4.01 Add the following text immediately after Paragraph 4.01.A:

In no event will the Contract Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Contract, whichever date is earlier.

SC-4.05 Delays in Contractor's Progress

SC-4.05 Amend Paragraph 4.05.A by striking through the following text: "and Contract Price"

Amend Paragraph 4.05.C.2 by striking through the following text: "abnormal weather conditions;" and inserting the following text:

Abnormal Weather Conditions;

Amend Paragraph 4.05.G by striking through the following text: "Contract Price or"

ARTICLE 5 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

SC-5.04 Differing Subsurface or Physical Conditions

SC-5.04 Amend Paragraph 5.04.D.1 by striking through the following text: "or any related delay, disruption or interference" and "decrease".

5.06 Hazardous Environmental Conditions

SC 5.06 Delete Paragraphs 5.06.A and 5.06.B in their entirety and insert the following:

- A. No reports or drawings related to Hazardous Environmental Conditions at the Site are known to Owner.**
- B. Not Used.**

ARTICLE 6 – BONDS AND INSURANCE

SC-6.03 Contractor's Insurance

SC 6.03 Add the following new paragraph immediately after Paragraph 6.03.J:

K. The limits of liability for the insurance required by Paragraph 6.03 of the General Conditions shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations:

1. Workers' Compensation, and related coverages under Paragraphs 6.03.A.1 and A.2 of the General Conditions:

State:	<u>Statutory</u>
Federal, if applicable (e.g., Longshoreman's):	<u>Statutory</u>
Jones Act coverage, if applicable:	
Bodily injury by accident, each accident	\$ <u>NA</u>
Bodily injury by disease, aggregate	\$ <u>NA</u>
Employer's Liability:	
Bodily injury, each accident	\$ <u>500,000</u>
Bodily injury by disease, each employee	\$ <u>500,000</u>
Bodily injury/disease aggregate	\$ <u>500,000</u>
For work performed in monopolistic states, stop-gap liability coverage shall be endorsed to either the worker's compensation or commercial general liability policy with a minimum limit of:	\$ <u>NA</u>
Foreign voluntary worker compensation	<u>Statutory</u>

2. Contractor's Commercial General Liability under Paragraphs 6.03.B and 6.03.C of the General Conditions:

General Aggregate	\$ <u>2,000,000</u>
Each Occurrence (Bodily Injury and Property Damage)	\$ <u>1,000,000</u>

The aggregate limits under SC-6.03.K.2 (Commercial General Liability) be maintained fully available for this Contract by obtaining and maintaining a Designated Construction Project General Aggregate Limit endorsement, or equivalent.

3. Automobile Liability under Paragraph 6.03.D. of the General Conditions:

Bodily Injury:

Each person	\$ 500,000
Each accident	\$ 1,000,000

Property Damage:

Each accident	\$ 1,000,000
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or

Combined Single Limit of	\$ 2,000,000
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4. Contractor's Pollution Liability:

Each Occurrence	\$ NA
General Aggregate	\$ NA



If box is checked, Contractor is not required to provide Contractor's Pollution Liability insurance under this Contract

5. Additional Insureds: In addition to Owner and Engineer, include as additional insureds the following: Southern Ute Indian Tribe, Ute Mountain Ute Tribe, Lake Durango Water Authority.

6. Contractor's Professional Liability:

Each Claim	\$ NA
Annual Aggregate	\$ NA

ARTICLE 7 – CONTRACTOR'S RESPONSIBILITIES

SC-7.02 Labor; Working Hours

Paragraph 7.02.B of the General Conditions restricts Contractor to working during "regular hours" Monday through Friday, and no work is permitted on "legal holidays."

SC-7.02.B. Add the following new subparagraphs immediately after Paragraph 7.02.B:

- 1. Regular working hours will be 6:00 AM to 7:00 PM; Monday through Friday**
- 2. Legal holidays are New Year's Day, Martin Luther King Jr. Day, President's Day, Good Friday, Memorial Day, Independence Day (July 4th), Labor Day, Veteran's Day, Thanksgiving Day, Christmas Day.**

SC-7.04 *"Or Equals"*

SC-7.04.A.1 Delete Paragraph 7.04.A.1.a.4 in its entirety.

SC-7.06 *Concerning Subcontractors, Suppliers, and Others*

SC-7.06.A Amend Paragraph 7.06.A by adding the following text to the end of the Paragraph:

The Contractor shall not award work valued at more than 50 percent of the Contract Price to Subcontractor(s), without prior written approval of the Owner.

SC-7.16 *Shop Drawings, Samples, and Other Submittals*

SC-7.16 Delete Section 7.16 in its entirety. Procedures and requirements for shop drawings, samples, and other submittals are described in Division 1 of the Specifications.

SC-7.18 *Indemnification*

SC-7.18 Amend Paragraph 7.18.A by striking through the following text: "(other than the Work itself)".

ARTICLE 10 – ENGINEER'S STATUS DURING CONSTRUCTION

SC-10.03 *Project Representative*

SC-10.03 Add the following new paragraphs immediately after Paragraph 10.03.A:

- B.** The Resident Project Representative (RPR) will be Engineer's representative at the Site, will act as directed by and under the supervision of Engineer, and will confer with Engineer regarding RPR's actions.
- 1.** General: RPR's dealings in matters pertaining to the Work in general shall be with Engineer and Contractor. RPR's dealings with Subcontractors shall only be through or with the full knowledge and approval of Contractor. RPR shall generally communicate with Owner only with the knowledge of and under the direction of Engineer.
 - 2.** Schedules: Review the progress schedule, schedule of Shop Drawing and Sample submittals, and Schedule of Values prepared by Contractor and consult with Engineer concerning acceptability.
 - 3.** Conferences and Meetings: Attend meetings with Contractor, such as preconstruction conferences, progress meetings, job conferences, and other Project-related meetings, and prepare and circulate copies of minutes thereof.
 - 4.** Liaison:
 - a.** Serve as Engineer's liaison with Contractor. Working principally through Contractor's authorized representative or designee, assist in providing information regarding the provisions and intent of the Contract Documents.
 - b.** Assist Engineer in serving as Owner's liaison with Contractor when Contractor's operations affect Owner's on-Site operations.

- c. Assist in obtaining from Owner additional details or information, when required for proper execution of the Work.
- 5. Interpretation of Contract Documents: Report to Engineer when clarifications and interpretations of the Contract Documents are needed and transmit to Contractor clarifications and interpretations as issued by Engineer.
- 6. Shop Drawings and Samples:
 - a. Record date of receipt of Samples and Contractor-approved Shop Drawings.
 - b. Receive Samples which are furnished at the Site by Contractor, and notify Engineer of availability of Samples for examination.
 - c. Advise Engineer and Contractor of the commencement of any portion of the Work requiring a Shop Drawing or Sample submittal for which RPR believes that the submittal has not been approved by Engineer.
- 7. Modifications: Consider and evaluate Contractor's suggestions for modifications in Drawings or Specifications and report such suggestions, together with RPR's recommendations, if any, to Engineer. Transmit to Contractor in writing decisions as issued by Engineer.
- 8. Review of Work and Rejection of Defective Work:
 - a. Conduct on-Site observations of Contractor's work in progress to assist Engineer in determining if the Work is in general proceeding in accordance with the Contract Documents.
 - b. Report to Engineer whenever RPR believes that any part of Contractor's work in progress is defective, will not produce a completed Project that conforms generally to the Contract Documents, or will imperil the integrity of the design concept of the completed Project as a functioning whole as indicated in the Contract Documents, or has been damaged, or does not meet the requirements of any inspection, test or approval required to be made; and advise Engineer of that part of work in progress that RPR believes should be corrected or rejected or should be uncovered for observation, or requires special testing, inspection or approval.
- 9. Inspections, Tests, and System Start-ups:
 - a. Verify that tests, equipment, and systems start-ups and operating and maintenance training are conducted in the presence of appropriate Owner's personnel, and that Contractor maintains adequate records thereof.
 - b. Observe, record, and report to Engineer appropriate details relative to the test procedures and systems start-ups.
- 10. Records:
 - a. Prepare a daily report or keep a diary or log book, recording Contractor's hours on the Site, Subcontractors present at the Site, weather conditions, data relative to questions of Change Orders, Field Orders,

Work Change Directives, or changed conditions, Site visitors, deliveries of equipment or materials, daily activities, decisions, observations in general, and specific observations in more detail as in the case of observing test procedures; and send copies to Engineer.

- b. Record names, addresses, fax numbers, e-mail addresses, web site locations, and telephone numbers of all Contractors, Subcontractors, and major Suppliers of materials and equipment.
- c. Maintain records for use in preparing Project documentation.

11. Reports:

- a. Furnish to Engineer periodic reports as required of progress of the Work and of Contractor's compliance with the Progress Schedule and schedule of Shop Drawing and Sample submittals.
- b. Draft and recommend to Engineer proposed Change Orders, Work Change Directives, and Field Orders. Obtain backup material from Contractor.
- c. Immediately notify Engineer of the occurrence of any Site accidents, emergencies, acts of God endangering the Work, force majeure or delay events, damage to property by fire or other causes, or the discovery of any Constituent of Concern or Hazardous Environmental Condition.

12. Payment Requests: Review applications for payment with Contractor for compliance with the established procedure for their submission and forward with recommendations to Engineer, noting particularly the relationship of the payment requested to the Schedule of Values, Work completed, and materials and equipment delivered at the Site but not incorporated in the Work.

13. Certificates, Operation and Maintenance Manuals: During the course of the Work, verify that materials and equipment certificates, operation and maintenance manuals and other data required by the Contract Documents to be assembled and furnished by Contractor are applicable to the items actually installed and in accordance with the Contract Documents, and have these documents delivered to Engineer for review and forwarding to Owner prior to payment for that part of the Work.

14. Completion:

- a. Participate in Engineer's visits to the Site to determine Substantial Completion, assist in the determination of Substantial Completion and the preparation of a punch list of items to be completed or corrected.
- b. Participate in Engineer's final visit to the Site to determine completion of the Work, in the company of Owner and Contractor, and prepare a final punch list of items to be completed and deficiencies to be remedied.
- c. Observe whether all items on the final list have been completed or corrected and make recommendations to Engineer concerning acceptance and issuance of the notice of acceptability of the work.

C. The RPR shall not:

1. Authorize any deviation from the Contract Documents or substitution of materials or equipment (including "or-equal" items).
2. Exceed limitations of Engineer's authority as set forth in the Contract Documents.
3. Undertake any of the responsibilities of Contractor, Subcontractors, or Suppliers.
4. Advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences or procedures of Contractor's work.
5. Advise on, issue directions regarding, or assume control over security or safety practices, precautions, and programs in connection with the activities or operations of Owner or Contractor.
6. Participate in specialized field or laboratory tests or inspections conducted off-site by others except as specifically authorized by Engineer.
7. Accept Shop Drawing or Sample submittals from anyone other than Contractor.
8. Authorize Owner to occupy the Project in whole or in part.

ARTICLE 12 – CLAIMS

SC-12.01 Claims

SC 12.01.D.1 Amend the first sentence of Paragraph 12.01.D.1 to read as follows:

At the conclusion of the Contract, Owner and Contractor may mutually agree to mediation of the underlying dispute.

ARTICLE 13 – COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

SC-13.01 Cost of the Work

SC 13.01.B.5.c Delete Paragraph 13.01.B.5.c in its entirety and insert the following in its place:

c. Construction Equipment and Machinery:

- 1) Rentals of all construction equipment and machinery, and the parts thereof, in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.
- 2) Costs for equipment and machinery owned by Contractor will be paid at a rate shown for such equipment in the FHA Blue Book. An hourly rate will be computed by dividing the monthly rates by 176. These computed rates will include all operating costs. Costs will include the time the equipment or machinery is in use on the changed Work and the costs of transportation,

loading, unloading, assembly, dismantling, and removal when directly attributable to the changed Work. The cost of any such equipment or machinery, or parts thereof, shall cease to accrue when the use thereof is no longer necessary for the changed Work. Equipment or machinery with a value of less than \$1,000 will be considered small tools.

SC-13.02 Allowances

SC 13.02.C Delete Paragraph 13.021.C. in its entirety

ARTICLE 15 – PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

SC-15.01 Progress Payments

SC 15.01.B Amend the second sentence of Paragraph 15.01B.1 by striking out the following text: “a bill of sale, invoice, or other.”

SC-15.01.B.3 Add the following language at the end of paragraph 15.01.B.3:

No payments will be made that would deplete the retainage, place in escrow any funds that are required for retainage, or invest the retainage for the benefit of the Contractor.

SC-15.02 Contractor’s Warranty of Title

SC 15.02.A Amend Paragraph 15.02.A by striking out the following text: “no later than seven days after the time of payment by Owner” and insert “no later than the time of payment by Owner.”

SC-15.03 Substantial Completion

SC 15.03.B Add the following new subparagraph to Paragraph 15.03.B:

1. If some or all of the Work has been determined not to be at a point of Substantial Completion and will require re-inspection or re-testing by Engineer, the cost of such re-inspection or re-testing, including the cost of time, travel and living expenses, shall be paid by Contractor to Owner. If Contractor does not pay, or the parties are unable to agree as to the amount owed, then Owner may impose a reasonable set-off against payments due under Article 15.

SC-15.03 Add the following paragraph immediately after Paragraph 15.03.F:

- G. Manual operation of portions of the project intended to operate automatically shall not constitute substantial completion.

ARTICLE 16 – SUSPENSION OF WORK AND TERMINATION

SC-16.05 Suspension of Work for Historical or Archeological Finds

SC-16.05 Add the following new paragraph after Paragraph 16.04.B

16.05 *Suspension of Work for Historical or Archeological Finds*

If, during the course of construction, evidence of deposits of historical or archeological interest is found, Contractor shall cease operations affecting the immediate area of the

find and notify the Owner. Compensation to Contractor, if any, for lost time or changes in construction to avoid the find, shall be determined in accordance with Article 12 of the General Conditions.

ARTICLE 17 – FINAL RESOLUTION OF DISPUTES

SC-17.02 *Arbitration*

SC-17.02 Add the following new paragraph immediately after Paragraph 17.01.

17.02 Arbitration

- A. All matters subject to final resolution under this Article will be decided by arbitration in accordance with the rules of the Uniform Arbitration Act of the State of Colorado, subject to the conditions and limitations of this paragraph. This agreement to arbitrate and any other agreement or consent to arbitrate entered into will be specifically enforceable under the prevailing law of any court having jurisdiction.**
- B. The demand for arbitration will be filed in writing with the other party to the Contract and with the selected arbitrator or arbitration provider, and a copy will be sent to Engineer for information. The demand for arbitration will be made within the specific time required in this Article, or if no specified time is applicable within a reasonable time after the matter in question has arisen, and in no event shall any such demand be made after the date when institution of legal or equitable proceedings based on such matter in question would be barred by the applicable statute of limitations. The demand for arbitration should include specific reference to Paragraph SC-17.02.D below.**
- C. No arbitration arising out of or relating to the Contract shall include by consolidation, joinder, or in any other manner any other individual or entity (including Engineer, and Engineer's consultants and the officers, directors, partners, agents, employees or consultants of any of them) who is not a party to this Contract unless:**
 - 1. the inclusion of such other individual or entity is necessary if complete relief is to be afforded among those who are already parties to the arbitration; and**
 - 2. such other individual or entity is substantially involved in a question of law or fact which is common to those who are already parties to the arbitration and which will arise in such proceedings.**
- D. The award rendered by the arbitrator(s) shall be consistent with the agreement of the parties, in writing, and include a concise breakdown of the award, and a written explanation of the award specifically citing the Contract provisions deemed applicable and relied on in making the award.**
- E. The award will be final. Judgment may be entered upon it in any court having jurisdiction thereof, and it will not be subject to modification or appeal, subject to provisions of the Laws and Regulations relating to vacating or modifying an arbitral award.**
- F. The fees and expenses of the arbitrators and any arbitration service shall be shared equally by Owner and Contractor.**

SC-17.03 Attorneys' Fees

SC-17.03 Add the following new paragraph, titled "Attorneys' Fees", immediately after Paragraph 17.02.

For any matter subject to final resolution under this Article, the prevailing party shall be entitled to an award of its attorneys' fees incurred in the final resolution proceedings, in an equitable amount to be determined in the discretion of the court, arbitrator, arbitration panel, or other arbiter of the matter subject to final resolution, taking into account the parties' initial demand or defense positions in comparison with the final result.

ARTICLE 18 – MISCELLANEOUS

SC-18.07 Controlling Law

SC-18.07 Add the following sentence to the end of Paragraph 18.07.

Any action, suit, or proceeding arising out of or related to the Contract Documents shall be brought in the District Court of La Plata County, Colorado.

ARTICLE 19 – FEDERAL/STATE REQUIREMENTS

SC-19.01 Conflict of Interest

SC-19.01 Add the following language after Article 19.01 with the title "Conflict of Interest":

- A. Contractor may not knowingly contract with a supplier or manufacturer if the individual or entity who prepared the plans and specifications has a corporate or financial affiliation with the supplier or manufacturer. Owner's officers, employees, or agents shall not engage in the award or administration of this Contract if a conflict of interest, real or apparent, would be involved. Such a conflict would arise when: (i) the employee, officer or agent; (ii) any member of the immediate family; (iii) their partner or (iv) an organization that employs, or is about to employ, any of the above has a financial interest in Contractor. Owner's officers, employees, or agents shall neither solicit nor accept gratuities, favors or anything of monetary value from Contractor or subcontractors.

SC-19.02 Gratuities

SC-19.02 Add the following language after Article 19.02 with the title "Gratuities":

- A. If Owner finds after a notice and hearing that Contractor, or any of Contractor's agents or representatives, offered or gave gratuities (in the form of entertainment, gifts, or otherwise) to any official, employee, or agent of Owner or Agency in an attempt to secure this Contract or favorable treatment in awarding, amending, or making any determinations related to the performance of this Contract, Owner, by written notice to Contractor, terminate this Contract. Owner may also pursue other rights and remedies that the law or this Contract provides. However, the existence of the facts on which Owner bases such findings

shall be an issue and may be reviewed in proceedings under the dispute resolution provisions of this Contract.

- B. In the event this Contract is terminated as provided in paragraph 19.02.A, Owner may pursue the same remedies against Contractor as it could pursue in the event of a breach of this Contract by Contractor. As a penalty, in addition to any other damages to which it may be entitled by law, Owner may pursue exemplary damages in an amount (as determined by Owner) which shall not be less than three nor more than ten times the costs Contractor incurs in providing any such gratuities to any such officer or employee.

SC-19.03 Anti-Kickback

SC-19.03 Add the following after Article 19.03 with the title "Anti-Kickback":

- A. Contractor shall comply with the Copeland Anti-Kickback Act (18 USC 874 and 40 USC 276c) as supplemented by Department of Labor regulations (29 CFR Part 3, "Contractors and Subcontractors on Public Buildings or Public Works Financed in Whole or in Part by Loans or Grants of the United States"). The Act provides that Contractor or subcontractor shall be prohibited from inducing b, by any means, any person employed in the construction, completion, or repair of public facilities, to give up any part of the compensation to which they are otherwise entitled. Owner shall report all suspected or reported violations to Agency.

SC-19.04 Clean Air and Pollution Control Acts

SC-19.04 Add the following after Article 19.04 with the title "Clean Air and Pollution Control Acts":

- A. If this Contract exceeds \$100,000, compliance with all applicable standards, orders, or requirements issued under section 306 of the Clean Air Act (42 U.S.C. 1857(h) and 42 USC 7401et. seq.), section 508 of the Clean Air Act (42 U.S.C. 1368) and Federal Water Pollution Control Act (33 USC 1251 et seq.), Executive Order 11738 and Environmental Protection Agency regulations is required. Contractor will report violations to the Agency and Regional Office of the EPA.

SC-19.05 Environmental Requirements

SC-19.05 Add the following after Article 19.05 with the title "Environmental Requirements":

When constructing a Project involving trenching and/or other related earth excavations, Contractor shall comply with the following environmental conditions:

- A. Wetlands – When disposing of excess, spoil, or other construction materials on public or private property, Contractor shall not fill in or otherwise convert wetlands.
- B. Floodplains – When disposing of excess, spoil, or other construction materials on public or private property, Contractor shall not fill in or otherwise convert 100-year floodplain areas (Standard Flood Hazard Area) delineated on the latest Federal Emergency Management Agency Floodplain Maps, or other appropriate maps, e.g., alluvial soils on NRCS Soil Survey Maps.

- C. **Historical Preservation** – Any excavation by Contractor that uncovers an historical or archaeological artifact or human remains shall be immediately reported to Owner and a representative of agency. Construction shall be temporarily halted pending the notification process and further directions issued by Agency after consultation with the State Historic Preservation Officer (SHPO).
- D. **Endangered Species** – Contractor shall comply with the Endangered Species Act, which provides for the protection of endangered and/or threatened species and critical habitat. Should any evidence of the presence of endangered and/or threatened species or their critical habitat be brought to the attention of Contractor, Contractor will immediately report this evidence to Owner. Construction shall be temporarily halted pending the notification process and further directions issued by Engineer after consultation with appropriate agencies.

SC-19.06 State Revolving Loan Requirements

SC-19.06 Add the following after Article 19.06 with the title “State Revolving Loan Requirements”:

The contract will be subject to the State Revolving Loan requirements included as Exhibit B to these supplementary conditions.

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BARTLETT & WEST

Work Change Directive No.

Date of Issuance:

Effective Date:

Owner:

Owner's Contract No.:

Contractor:

Contractor's Project No.:

Engineer:

Engineer's Project No.:

Project:

Contract Name:

Contractor is directed to proceed promptly with the following change(s):

Description:

Attachments: *[List documents supporting change]*

Purpose for Work Change Directive:

Directive to proceed promptly with the Work described herein, prior to agreeing to changes on Contract Price and Contract Time, is issued due to: *[check one or both of the following]*

- ☐ Non-agreement on pricing of proposed change.
- ☐ Necessity to proceed for schedule or other Project reasons.

Estimated Change in Contract Price and Contract Times (non-binding, preliminary):

Contract Price	\$	[increase] [decrease].
----------------	----	------------------------

Contract Time	days	[increase] [decrease].
---------------	------	------------------------

Basis of estimated change in Contract Price:

- ☐ Lump Sum
 ☐ Unit Price
☐ Cost of the Work
 ☐ Other

RECOMMENDED:

AUTHORIZED BY:

RECEIVED:

By:

Engineer (Authorized Signature)

By:

Owner (Authorized Signature)

By:

Contractor (Authorized Signature)

Title:

Title:

Title:

Date:

Date:

Date:

Approved by Funding Agency (if applicable)

By:

Date:

Title:

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BARTLETT —
— **& WEST**

Change Order No. _____

Date of Issuance:

Effective Date:

Owner:

Owner's Contract No.:

Contractor:

Contractor's Project No.:

Engineer:

Engineer's Project No.:

Project:

Contract Name:

The Contract is modified as follows upon execution of this Change Order:

Description:

Attachments: *[List documents supporting change]*

CHANGE IN CONTRACT PRICE	CHANGE IN CONTRACT TIMES <i>[note changes in Milestones if applicable]</i>
Original Contract Price: \$ _____	Original Contract Times: Substantial Completion: _____ Ready for Final Payment: _____ days or dates
[Increase] [Decrease] from previously approved Change Orders No. ____ to No. ____: \$ _____	[Increase] [Decrease] from previously approved Change Orders No. ____ to No. ____: Substantial Completion: _____ Ready for Final Payment: _____ days
Contract Price prior to this Change Order: \$ _____	Contract Times prior to this Change Order: Substantial Completion: _____ Ready for Final Payment: _____ days or dates
[Increase] [Decrease] of this Change Order: \$ _____	[Increase] [Decrease] of this Change Order: Substantial Completion: _____ Ready for Final Payment: _____ days or dates
Contract Price incorporating this Change Order: \$ _____	Contract Times with all approved Change Orders: Substantial Completion: _____ Ready for Final Payment: _____ days or dates

RECOMMENDED:

ACCEPTED:

ACCEPTED:

By: _____ Engineer (if required)	By: _____ Owner (Authorized Signature)	By: _____ Contractor (Authorized Signature)
Title: _____	Title: _____	Title: _____
Date: _____	Date: _____	Date: _____

Approved by Funding Agency (if applicable)

By: _____ Date: _____
Title: _____

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BARTLETT & WEST

Field Order No. _____

Date of Issuance:

Effective Date:

Owner:

Owner's Contract No.:

Contractor:

Contractor's Project No.:

Engineer:

Engineer's Project No.:

Project:

Contract Name:

Contractor is hereby directed to promptly execute this Field Order, issued in accordance with General Conditions Paragraph 11.01, for minor changes in the Work without changes in Contract Price or Contract Times. If Contractor considers that a change in Contract Price or Contract Times is required, submit a Change Proposal before proceeding with this Work.

Reference:

Specification(s)

Drawing(s) / Detail(s)

Description:

Attachments:

ISSUED:

RECEIVED:

By:

Engineer (Authorized Signature)

By:

Contractor (Authorized Signature)

Title:

Title:

Date:

Date:

Copy to: Owner

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BARTLETT & WEST

SECTION 011100
SUMMARY OF WORK

PART 1 GENERAL

1.01 GENERAL

- A. The work to be performed under this Contract shall consist of furnishing all equipment, materials, supplies, and manufactured articles and for furnishing all transportation and services, including fuel, power, water, and essential communications, and for the performance of all labor, work, or other operations required for the fulfillment of the Contract in strict accordance with the Contract Documents. The Work shall be complete, and all work, materials, and services not expressly shown or called for in the Contract Documents which may be necessary for the complete and proper construction of the Work in good faith shall be performed, furnished, and installed by the Contractor as though originally so specified or shown, at no increase in cost to the Owner.
- B. Wherever the Contract Documents address a third party, i.e. subcontractor, manufacturer, supplier or vendor, it is to be considered as the Contractor through a third party.
- C. Wherever a reference to number of days is noted, it shall be construed to mean calendar days.

1.02 WORK COVERED BY CONTRACT DOCUMENTS

- A. Contract 1 includes the furnishing of all labor, materials, equipment, services and incidentals for the construction of the Raw Water Project for La Plata West Water Authority (LPWWA), with all appurtenant work, complete, tested and ready for operation, including temporary facilities as required, all in conformance with the Contract Documents. The main components include Ductile Iron and PVC pipelines and two Pump stations; the 210 Booster Station and the Intake Pump Station constructed at an existing intake structure on the north shore of Lake Nighthorse West of Durango, Colorado. This will have a present output of 800 gallons per minute (GPM) but portions will be oversized to accommodate future capacity.
- B. Contract 2 includes the furnishing of all labor, materials, equipment, services and incidentals for the installation of cylindrical water intake screens at the Owner's existing intake structure at Lake Nighthorse, with all appurtenant work, complete, tested and ready for operation, in conformance with the Contract Documents. Work for this contract will involve construction of underwater structures performed by an approved commercial dive contractor. The upper screen is located approximately 40 feet below the high water level, and the lower screen approximately 110 feet below high water level. The screens will be constructed with a capacity of 10,000 gpm each. Installation of the upper screen will be the base contract, with an alternate item for installation of the lower screen to be awarded at the Owner's discretion.
- C. Contract 3 includes the furnishing of all labor, materials, equipment, services and incidentals for the construction of approximately 5,500 feet of 4-inch water main, service connections, and appurtenances will be constructed parallel to a portion of the proposed raw water pipeline with Lake Durango Water Authority as the Owner.
- D. The Work is located just southwest of Durango, Colorado, between Lake Nighthorse and Lake Durango, as shown on the Project Drawings.
- E. **Based on the location, all equipment permanently installed shall function as intended at 7,500 feet elevation.**
- F. Contractor's Duties (See also General Conditions):
 - 1. Except as specifically noted, provide and pay for:
 - a. Labor, materials and equipment.

- b. Tools, construction equipment and machinery.
 - c. Water, heat and utilities required for construction.
 - d. Other facilities and services necessary for proper execution and completion of Work.
- 2. Secure and pay for, as necessary for proper execution and completion of work, and as applicable at time of receipt of bids.
 - a. Permits (Excavation, Highway, and Railroad Crossing).
 - b. Government fees.
 - c. Licenses.
- 3. Give required notices.
- 4. Comply with codes, ordinances, rules, regulations orders and other legal requirements of public authorities which bear on performance of work.
- 5. Enforce strict discipline and good order among employees. Contractor's employees, including subcontractors, shall meet the following minimum requirements.
 - a. Superintendent: All work under the Contract shall be performed under the continuous supervision of competent personnel thoroughly experienced in the class of work specified. Prior to beginning the work, the Contractor shall give the Engineer, in writing, the name of the Contractor's official representative or superintendent for the project. The superintendent shall be capable of providing adequate supervision to the project and shall be responsible for receiving instructions, notices, and written orders from the Engineer. A change of the superintendent shall be reported to the Engineer in writing. Failure to provide adequate supervision to the project shall be grounds for the Engineer to require a change in supervision before allowing the work to proceed. The superintendent shall be responsible for reporting to the Engineer any inconsistencies, omissions, or lack of definite detail which is not covered on the plans or in the specification.
 - b. Workers: The Contractor shall employ competent and efficient workers for every kind of work. The Owner reserves the right to suspend or discharge from the work any worker, employee, agent, overseer, foreman, or superintendent in the employ of the Contractor, who in the opinion of the Engineer, shall be considered incompetent, negligent, unfaithful, insubordinate, or disorderly, and any such person shall immediately be suspended or discharged by the Contractor whenever so directed by the Engineer.
- 6. Protect existing pavement, curb and gutter from damage. All equipment used on paved surfaces shall be mounted on rubber. The use of tracked vehicles without rubber lugs is prohibited. The Contractor shall make every effort to use equipment which will not cause damage to any paved areas. Should construction equipment damage any paved surface, the Contractor shall repair it at his expense as directed by the Engineer.

1.03 CONSTRUCTION OPERATION

- A. General. Work under the Contract shall be scheduled and performed in such a manner as to result in the least possible disruption to the operation of the existing facilities and to the public's use of roadways, driveways, and utilities. Utilities shall include but not be limited to water, sewerage, drainage structures, ditches and canals, gas, television and telephone. Prior to commencing with the Work, Contractor shall perform a location investigation of existing underground utilities and facilities in accordance with Section entitled "Protection of Existing Facilities" and shall have obtained all required permits and permissions. Contractor shall also deliver written notice to property occupants (private and public) of all planned disruption to roadways, driveways, and utilities seventy-two hours in advance of disruption.
- B. All work by the Contractor that disrupts utility service shall be shown on the Construction Schedule and specifically scheduled with the Owner. Schedule notification shall consist of a written notice defining the work to be accomplished, the normal function that will be interrupted, the duration of the interruption, and the mitigating effort to be performed by the Contractor to maintain the capacity to operate continuously. The written notice shall be submitted to the Owner fourteen days in advance of the proposed work and

the Owner will respond to the Contractor in writing within 7 days of receipt of the notice regarding the acceptability of the proposed plan.

- C. At no time shall the Contractor undertake to close off any pipelines, or open valves, or take any other action which would affect the operation of the existing system or facilities, except as specifically required by the Drawings and specifications, until authorization is granted by the Owner or Engineer and after proper notification.
- D. This project is not divided into separate operating parts. The Contractor may at his option and depending on his approved schedule, work on more than one task at a time in accordance with the restrictions. The following items are subject to construction sequence and time constraint in order to maintain a fully-operational facility. The Contractor shall note that each item of work is subject to the Engineer's review and acceptance.
 - 1. Both pump stations shall be subject to the 7 day operational test outlined in the section entitled "Starting and Adjusting".
 - 2. The water line shall pass all delineated tests and all pressure relieve valves and pressure sustaining valves shall be adjusted and tested prior to being put into operation.
- E. Temporary installation/connections, may be used where sufficient time is not available to complete a particular aspect of the work. All such subject temporary installations shall be subject to review and acceptance by the Engineer.
- F. Cancellation of Planned Shutdown: A planned shutdown may be cancelled by the Owner upon a 24-hour notification by the Owner/Engineer to the Contractor. Such cancellation shall be expected due to wet weather conditions or other conditions beyond the control of the Owner, Engineer or Contractor. All efforts shall be taken to check weather forecasts and the like prior to scheduling facility shutdowns. However, if a cancellation must occur, the Owner shall not be responsible for any additional costs associated with mobilization and demobilization.

1.04 SEQUENCE OF CONSTRUCTION

- A. General: Within ten (10) days after the "Notice to Proceed" is issued, the Contractor, Owner and Engineer shall meet to coordinate the sequence of construction.
 - 1. The facilities will be maintained in continuous operation by the Owner during the entire construction period of this contract. Work under this Contract shall be so scheduled and coordinated by the Contractor that such work will not impede existing system operation. In performing the work shown and specified, the Contractor shall plan and schedule his work to meet the operating requirements and all additional restrictions.
- B. Coordination with Owner Personnel. Before commencing work involving removing or placing in operation existing or new facilities, the Contractor shall notify the Owner at least thirty (30) days in advance in writing. The Owner shall be responsible for removing facilities from operation.
 - 1. Only the Owner can authorize the shutdown of any portions of the facility or system. The Contractor shall, under no circumstances, interfere with any existing component without the Owner's authorization in writing.

1.05 PROGRESS SCHEDULE AND CONTRACTOR'S SEQUENCE OF WORK

- A. The contractor will develop a definitive sequence of work and estimated progress schedule. The above sequence of work may have to be modified due to weather conditions at the time the notice to proceed is given. The Owner will require that those segments that can be installed during winter months be completed as weather permits during the winter months.
- B. Sequence of work developed by Contractor shall be considered a part of the progress schedule and shall be subject to the requirements stated in Articles 2.07.A.1, 6.04, 6.18, and 15.02.A.1 of the General

Conditions.

1.06 OBSTRUCTIONS

- A. Any street signs, traffic signs, posts, mail boxes, guard fence, standards, yard lights or other similar obstructions shall be removed, properly stored and reset or salvaged to the Owner as directed by the Engineer.
- B. Pipe culverts shall be removed and reset where shown on the plans. Adjustments of this type shall be done in such a manner as to not damage the existing pipe or the existing pipe shall be replaced by new culvert of the same size and material in its entirety.
- C. Trees and shrubs that are encountered in the vicinity of the proposed facilities shall be removed only if deemed necessary by the Engineer.
- D. The Contractor shall protect existing utilities from damage.
- E. All property pins, section corners or other monuments moved and/or destroyed by the Contractor's operations shall be replaced and reset. Replacement and resetting shall be done by a professional Engineer or Surveyor paid by the Contractor at no additional cost to the Owner.

1.07 CONTRACTOR USE OF PROJECT SITE

- A. The Contractor's use of the project site shall be limited to its construction operations, including on-site storage of materials, on-site fabrication facilities, and field offices, as noted on the Contract Drawings.
- B. Do not unreasonably encumber the site with materials or equipment.
- C. The Contractor shall, at his own expense, replace or repair any sod, grass, sidewalk, curb and gutter, pavement, private property or any other improvement damaged by the Contractor's operations that is outside the limits of construction or not listed and denoted as a specific pay item.

1.08 OWNER USE OF THE PROJECT SITE

- A. The Owner may utilize all or part of the existing facilities during the entire period of construction for the conduct of the Owner's normal operations. The Contractor shall cooperate with the Owner to minimize interference with the Contractor's operations and to facilitate the Owner's operations.

1.09 PARTIAL UTILIZATION OF THE WORK BY OWNER.

- A. The Contractor is hereby advised that the Owner may accept the responsibility for the maintenance and protection of a specific portion of the project if utilized prior to completion. However, the Contractor shall retain full responsibility for satisfactory operation of the total project.

1.10 WORK BY OTHERS

- A. The Owner may perform additional work related to the project by himself or he may let other direct contracts which shall contain conditions similar to these. Contractor shall afford the other contractors who are parties to such direct contracts (or Owner, if he is performing the additional work himself), reasonable opportunity for the introduction and storage of materials and equipment and the execution of the work, and shall properly coordinate, schedule and connect his work with theirs.
- B. If any part of Contractor's work depends on proper executions or results upon the work of any such other contractor (or Owner), Contractor shall inspect and promptly report to Engineer, in writing, any defects or deficiencies in such work that render it unsuitable for such proper execution and results. His failure to so report shall constitute an acceptance of the other work as fit and proper for the relationship of his work

except as to defects and deficiencies which may appear in the other work after the execution of his work.

- C. The Contractor shall do all cutting, fitting and patching of his work that may be required to make its several parts come together properly and fit it to receive or to be received by such other work. Contractor shall not endanger any work of others by cutting, excavating or otherwise altering their work and will only cut or alter their work with the written consent of the Engineer and of the other contractors whose work will be affected.
- D. If the performance of additional work by other contractors or Owner is not noted in the Contract Documents prior to the execution of the Contract, written notice thereof shall be given to Contractor prior to starting any such additional work.
- E. The work by others for this Contract involves the construction of the following work:
 - 1. N/A.

1.11 PROJECT MEETINGS

- A. Preconstruction Conference: Prior to the commencement of work at the site, a preconstruction conference will be held at a mutually agreed time and place which shall be attended by the Contractor, its superintendent, and its subcontractors as appropriate. Other attendees will be:
 - 1. Engineer.
 - 2. Representatives of Owner.
 - 3. Governmental representatives as appropriate.
 - 4. Others as requested by Contractor, Owner, or Engineer.
- B. Unless previously submitted to the Engineer, the Contractor shall bring to the conference one copy each of the following:
 - 1. Preliminary schedule.
 - 2. Preliminary Shop Drawing/Sample/Substitute or "Or Equal" submittal schedule.
- C. The purpose of the conference is to designate responsible personnel and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established. The agenda will include:
 - 1. Contractor's tentative schedules.
 - 2. Transmittal, review, and distribution of Contractor's submittals.
 - 3. Processing applications for payment.
 - 4. Maintaining record documents.
 - 5. Critical work sequencing.
 - 6. Field decisions and change orders.
 - 7. Use of project site, office and storage areas, security, housekeeping, the Other's needs.
 - 8. Major equipment deliveries and priorities.
- D. The Engineer will preside at the preconstruction conference and will arrange for keeping the minutes and distributing the minutes to all persons in attendance.
- E. Progress Meetings: The Engineer shall schedule and hold regular on-site progress meetings at least weekly and at other times as requested by Engineer. The Contractor, Engineer, and all subcontractors active on the site shall be represented at each meeting. Contractor may at its discretion request attendance by representatives of its suppliers, manufacturers, and other subcontractors. At a minimum, the Contractor's Superintendent shall be present at each meeting. The Contractor's Project Manager

shall be required to attend the meetings if so requested by the Engineer.

- F. The Engineer shall preside at the meetings and provide for keeping and distribution of the minutes. The purpose of the meetings will be to review the progress of the Work, maintain coordination of efforts, discuss changes in scheduling, and resolve other problems, which may develop.

1.12 PERMITS

- A. It shall be the Contractor's responsibility to secure all permits of every description required to initiate and complete the work under this contract, except permits obtained by the Owner.
- B. Permits obtained by the Owner or his authorized representative are provided in the section entitled "Permits".
- C. No separate or direct payment will be made to the Contractor for permits and inspection requirements, but all such costs shall be included in the applicable items in the Schedule of Payment Items. The Owner will furnish signed and sealed sets of contract documents for permit use as required.
- D. The Contractor shall furnish to the Engineer copies of all permits prior to commencement of work requiring permits.

1.13 SUBSURFACE CONDITIONS

- A. The Contractor acknowledges that he has, prior to executing the Contract, investigated and satisfied himself as to the conditions affecting the Work, including but not restricted to those bearing upon transportation, disposal, handling and storage of materials, availability of labor, water, electric power, roads and uncertainties of weather, river stages, tides, water tables or similar physical conditions at the site, the conformation and conditions of the ground, the character of equipment and facilities needed preliminary to and during prosecution of the Work. The Contractor further acknowledges that he has satisfied himself as to the character, quality and quantity of surface and subsurface materials or obstacles to be encountered insofar as this information is reasonably ascertainable from an inspection of the site, or any contiguous site, as well as from information presented by the Drawings and Specifications made a part of this Contract, or any other information made available to him prior to executing the Contract. Any failure by the Contractor to acquaint himself with the available information will not relieve him from responsibility for estimating properly the difficulty or cost of successfully performing the Work. The Owner assumes no responsibility for any conclusions or interpretations made by the Contractor on the basis of the information made available by the Owner or Engineer.

1.14 DIFFERING SITE CONDITIONS

- A. The Contractor shall promptly and before such conditions are disturbed, notify the Engineer in writing within 48 hours: (1) subsurface or latent physical conditions at the site differing materially from those indicated in this contract, or (2) unknown physical conditions at the site, of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for this contract. The Engineer will promptly investigate the conditions, and if he finds that such conditions do materially so differ and cause an increase or decrease in the Contractor's cost of, or the time required for, performance of any part of the work under this contract, whether or not changed as a result of such conditions, an equitable adjustment shall be made and the contract modified in writing accordingly.
- B. No claim of the Contractor under this clause shall be allowed unless the Contractor has given the notice required in Paragraph A.
- C. No claim by the Contractor for an equitable adjustment hereunder shall be allowed if asserted after final payment under this contract.

1.15 DIMENSIONS OF EXISTING STRUCTURES

- A. Where the dimensions and locations of existing structures are of critical importance in the installation or connection of new work, the Contractor shall verify such dimensions and locations in the field before the fabrication of any materials or equipment which is dependent on the correctness of such information.

1.16 CONSTRUCTION LAYOUT

- A. All work under this Contract shall be constructed in accordance with the lines and grades shown on the Contract Drawings or as directed by the Engineer. Elevation of existing ground, structures and appurtenances are believed to be reasonably correct, but are not guaranteed to be absolute and therefore are presented only as an approximation. Any error or apparent discrepancy in the data shown or omissions of data required for accurately accomplishing the stakeout survey shall be referred immediately to the Engineer for interpretation or correction.
- B. All survey work for construction control purposes shall be made by the Contractor at his expense.
- C. The Contractor shall employ a Land Surveyor registered in the State of Colorado and acceptable to the Engineer. The Contractor shall locate and protect survey control and reference points.
- D. The Contractor shall establish all base lines for the location of the principal component parts of the work, including bench marks. Based upon the information provided by the Contract Drawings, the Contractor shall develop and make all detail surveys necessary for construction.
- E. The Contractor shall have the responsibility to carefully preserve the benchmarks, reference points, stakes, property pins, and all other survey location items. In case of destruction thereof by the Contractor or resulting from his negligence, he shall be held liable for any expense and damage resulting therefrom and shall be responsible for any mistakes that may be caused by the unnecessary loss or disturbance of such bench marks, reference points and stakes.
- F. Existing or new control points, property markers, and monuments that will be established or are destroyed during the normal causes of construction shall be reestablished by the Contractor; and all reference ties recorded therefore shall be furnished to the Engineer. All computations necessary to establish the exact position of the work shall be made and preserved by the Contractor.
- G. Submit a copy of registered site drawings and certificate signed by the Land Surveyor that the elevations and locations of the work are in conformance with the Contract Documents.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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BARTLETT & WEST

SECTION 011419

USE OF SITE

PART 1 GENERAL

1.01 REGULATIONS

- A. Confine operations at site to areas permitted by:
 - 1. Law
 - 2. Ordinances
 - 3. Permits
 - 4. Contract Documents
 - 5. Areas authorized or approved by the Owner.

1.02 LOCATION

- A. Limit use of site for work and storage to within the highway and street right of ways and easements as indicated on the drawings and as directed by the Owner's representative.
- B. The Contractor at his option may negotiate and pay for additional temporary easements from landowners as may be required for his construction operations. Copies of written agreement between the Contractor and landowner shall be provided to the Engineer.

1.03 USE OF PREMISES

- A. Do not unreasonably encumber site with materials or equipment.
- B. Assume full responsibility for protection and safe keeping of products stored on premises. Products stored along the route of the new pipeline shall be stored in such a manner to prevent injury to children and residents that may come in contact with the pipe, manholes or other construction equipment. No materials will be allowed to be stacked on top of one another that could inadvertently be dislodged by children climbing on the materials.
- C. The Contractor shall note the location of water meters and fire hydrants along the route of the pipeline and shall maintain clear access to both at all times. Fire hydrants that are inadvertently damaged during construction shall be reported immediately to the local water utility and the Fire Department.

1.04 DAMAGE TO PREMISES

- A. Contractor shall, at his own expense, replace or repair any sod, sidewalk, curb and gutter or street and private property not called out as a pay item that is damaged by the Contractor's operations. All equipment used on paved surfaces shall be mounted on rubber. The use of tracked vehicles without rubber lugs is prohibited. At locations where use of half of street for construction work is allowed, earth may be spread over that portion of the area to allow the movement of construction equipment.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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BARTLETT & WEST

SECTION 012000
MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.01 METHODS OF MEASUREMENTS AND BASIS FOR PAYMENTS.

- A. All work to be performed under this contract shall be paid for at the lump sum or unit prices stated in the Bid Form. Unit price payments will be based upon the measurement of actual quantities furnished and installed in accordance with the Contract Documents and accepted by the Engineer. Lump sum payments will be based upon completed and accepted items in accordance with its description in this section and as related to the work specified and as shown on the Drawings.
- B. Payment for the items set forth herein, as further specified herein, shall include full compensation to be received by the Contractor for furnishing all tools, equipment, supplies, and manufactured articles, and for all labor, mobilization and demobilization, utilities, coordination, taxes, materials, commissions, transportation and handling, traffic control, barricades, signs, lights, and other traffic control devices, bonds, permit fees, insurance, overhead and profit, incidentals appurtenant to the items of work being described and performing all operations as necessary to complete the various items of the work all in accordance with the requirements of the Contract Documents, including all appurtenances thereto, and including all costs of compliance with the regulations of public agencies having jurisdiction, including Safety and Health Requirements of the Occupational Safety and Health Administration of the U.S. Department of Labor (OSHA). Such compensation shall also include payment for any loss or damages arising directly or indirectly from the work, or from any discrepancies between the actual quantities of work and those shown in the Contract Documents, or from any unforeseen difficulties, which may be encountered during the prosecution of the work until the final acceptance by the Owner. Any material, equipment or operation not specifically mentioned shall be considered to be incidental to the lump sum or unit prices. Final payment will only be made for completed and accepted work.
- C. The Contractor's attention is called to the fact that the contract prices set forth in the bid form establish the total price for completing the work in its entirety. Should the Contractor feel that the cost of any item of work has not been established by the Schedule of Payment Items or this Section he shall include the cost for that work in some other bid item, so that his proposal for the project does reflect his total price for completing the work in its entirety.

1.02 CASH ALLOWANCES

- A. Costs Included in Cash Allowances: Cost of product to Contractor or Subcontractor, less applicable trade discounts.
- B. Costs Not Included in Cash Allowances but Included in Contract Sum/Price: Product, delivery to site and handling at site, including unloading, uncrating, and storage, protection of products from elements and from damage, and labor for installation and finishing and appurtenances and accessories required to properly install the products.

1.03 MEASUREMENT

- A. The quantities for unit price payment under this Contract shall be determined by actual measurement of the completed items, in place, ready for service and accepted by the Engineer. Lump sum item payment under this Contract shall be in accordance with the Schedule of Payment Items as described in the Submittals Section, unless otherwise specified. A representative of the Contractor shall witness all field measurements.

1.04 PAYMENT ITEMS – CONTRACT 1, BID PACKAGE 1 (INTAKE PUMP STATION):

A. Intake Pump Station - Bid Item No. 1:

1. Measurement will be made by the lump sum price for the installation of the raw water pump station at the intake structure, completed and accepted.
2. Payment will be made at the lump sum price bid for completion of the raw water pump station which price shall include the complete furnishing and installation of all materials, labor and equipment for the Pump Station including but not limited to mobilization, bonds, insurance, traffic control, erosion control, pumps, piping, valves, concrete, reinforcement, variable frequency drives, pressure gauges, building, mechanical, electrical and structural work, bridge crane foundation and column pads, earthwork, appurtenances, and all other items of work necessary to complete the work in accordance with the Contract Documents.

B. Sitework and Yard Piping – Bid Item No. 2:

1. Measurement will be made by the lump sum price for the installation of all exterior site work and yard piping at the intake pump station, completed and accepted.
2. Payment will be made at the lump sum price bid for completion of the exterior site work and yard piping at the intake pump station which price shall include the complete furnishing and installation of all materials, labor and equipment for the Pump Station including but not limited to piping up to and including the meter vault, electrical and structural work, fittings, valves and appurtenances, earthwork, gravel surfacing, the meter vault, including excavation and backfill, flow meter, concrete manhole, manhole cover, and all other items of work necessary to complete the work in accordance with the Contract Documents.

C. Instrumentation and Control – Bid Item No. 3:

1. Measurement will be made by the lump sum price for the installation of the instrumentation and control system at the intake structure, completed and accepted.
2. Payment will be made at the lump sum price bid for completion of the instrumentation and control system at the intake pump station which price shall include the complete furnishing and installation of all materials, labor and equipment for the portions of the system as described in Section 409000 that are installed at the Intake Pump Station site, including but not limited to, control panels, programmable logic devices, industrial computers and displays, data radios and antennas, level and pressure sensor systems, software programming and commissioning, software licenses, associated mechanical, electrical and structural work, and all other items of work necessary to complete the work in accordance with the Contract Documents.

D. Air Burst System – Alternate Bid Item No. 1:

1. Measurement will be made by the lump sum price for the installation of intake screen air burst system at the intake structure, completed and accepted.
2. Payment will be made at the lump sum price bid for completion of the instrumentation and control system at the raw water pump station which price shall include the complete furnishing and installation of all materials, labor and equipment for the portions of the system as described in Section 352104 that are installed at the Intake Pump Station site, including but not limited to compressor, air receiver/reservoir, control panels, programmable logic devices, software programming and commissioning, software licenses, interconnection with station instrumentation and control system, associated mechanical, electrical and structural work, and all other items of work necessary to complete the work in accordance with the Contract Documents.

E. Bridge Crane – Alternate Bid Item No. 2:

1. Measurement will be made by the lump sum price for the installation of the bridge crane at the intake structure, completed and accepted.
2. Payment will be made at the lump sum price bid for completion of the bridge crane at the raw water pump station which price shall include the complete furnishing and installation of all materials, labor and equipment for the portions of the system as described in Section 412212 that are installed at

the Intake Pump Station site, including but not limited to structural columns and baseplates, crane girder, trolley and hoist, associated mechanical, electrical and structural work, and all other items of work necessary to complete the work in accordance with the Contract Documents.

1.05 PAYMENT ITEMS – CONTRACT 1, BID PACKAGE 2 (BOOSTER PUMP STATION):

A. Booster Pump Station - Bid Item No. 1:

1. Measurement will be made by the lump sum price for the installation of the booster pump station, completed and accepted.
2. Payment will be made at the lump sum price bid for completion of the booster pump station which price shall include the complete furnishing and installation of all materials, labor and equipment for the Pump Station including but not limited to mobilization, bonds, insurance, traffic control, erosion control, pumps, piping, valves, concrete, reinforcement, variable frequency drives, pressure gauges, building, mechanical, electrical and structural work, earthwork, appurtenances, and all other items of work necessary to complete the work in accordance with the Contract Documents.

B. Sitework and Yard Piping – Bid Item No. 2:

1. Measurement will be made by the lump sum price for the installation of all exterior site work and yard piping at the booster pump station, completed and accepted.
2. Payment will be made at the lump sum price bid for completion of the exterior sitework and yard piping at the booster pump station which price shall include the complete furnishing and installation of all materials, labor and equipment for the Pump Station including but not limited to piping, meter vault, electrical and structural work, fittings, valves and appurtenances, earthwork, gravel surfacing, the meter vault, including excavation and backfill, flow meter, concrete manhole, manhole cover, and all other items of work necessary to complete the work in accordance with the Contract Documents.

C. Instrumentation and Control – Bid Item No. 3:

1. Measurement will be made by the lump sum price for the installation of the instrumentation and control system at the booster pump station, completed and accepted.
2. Payment will be made at the lump sum price bid for completion of the instrumentation and control system at the booster pump station which price shall include the complete furnishing and installation of all materials, labor and equipment for the portions of the system as described in Section 409000 that are installed at the Booster Pump Station site, including but not limited to, control panels, programmable logic devices, industrial computers and displays, data radios and antennas, pressure sensor system, software programming and commissioning, software licenses, associated mechanical, electrical and structural work, and all other items of work necessary to complete the work in accordance with the Contract Documents.

D. Alternate Pump Configurations – Alternate Bid Items No. 1 and No. 2:

1. Measurement will be made by the lump sum price for the installation of alternate pumps and associated equipment at the booster pump station, completed and accepted.
2. Payment will be made at the lump sum price bid for completion of alternate pumps and associated equipment at the booster pump station which price shall include the complete furnishing and installation of all materials, labor and equipment for the portions of the alternate system as described in Section 432115, including but not limited to pumps, alternate variable frequency drives, conduit, conductors, disconnects and circuit breakers, associated mechanical, electrical and structural work, and all other items of work necessary to complete the work in accordance with the Contract Documents.

E. Extended Performance Test – Alternate Bid Item No. 3:

1. Measurement will be made by the lump sum price for the extended performance test of the entire Contract 1 project, completed and accepted.

2. Payment will be made at the lump sum price bid for extension of seven (7) day performance test period as described in Contract Documents to 60 days, which price shall include the complete furnishing and installation of all materials, labor and equipment including but not limited to, portable generators, fuel, regular service and lubrication as required by generator manufacturer, other parts and maintenance as required by manufacturer's recommended service intervals for all installed equipment, all other items of work necessary to complete the work in accordance with the Contract Documents.

1.06 PAYMENT ITEMS – CONTRACT 1, BID PACKAGE 3 (210 PIPELINE AND ACCESS ROAD):

A. Unclassified Excavation – Bid Item No. 1:

1. Measurement will be made to the cubic foot for rock excavated and removed.
2. Payment will be made at the unit price bid per cubic foot of excavation or embankment material. This price shall be deemed full compensation for excavation, backfill, compaction, sheeting, shoring, earthwork, removal of surface boulders, excavation for ditches, and grading to contour and shape the ground surface as proposed. Import of foreign fill or offsite disposal of excess fill shall be included in the payment for this item.

B. Rock Excavation – Bid Item No. 2:

1. Measurement will be made to the cubic foot for rock excavated and removed.
2. Payment will be made at the unit price bid per cubic foot of rock removed. This item shall represent the additional work required to remove rock from the excavation as defined in Section 312317 and shall be paid in addition to Bid Item 1, Unclassified Excavation and Bid Item 8, 30" Ductile Iron Pipe.

C. Roadway Sub-Base: Bid Item No. 3

1. Measurement will be made at the price bid per cubic yard of gravel placed and compacted.
2. This item includes the complete furnishing and installation of all materials and labor for the aggregate/gravel roadway sub-base including but not limited to aggregate, earthwork, subgrade preparation, placing, compaction, removal of existing surfacing and all other items of work necessary to complete the work in accordance with the Contract Documents.

D. Roadway Base: Bid Item No. 4

1. Measurement will be made at the price bid per cubic yard of gravel placed and compacted.
2. This item includes the complete furnishing and installation of all materials and labor for the aggregate/gravel roadway base including but not limited to mobilization, bonds, insurance, traffic control, erosion control, aggregate, earthwork, subgrade preparation, placing, compaction, and all other items of work necessary to complete the work in accordance with the Contract Documents.

E. Storm Sewer Culvert Pipe – Bid Items No. 5 and No. 5:

1. Measurement will be made by the nearest linear foot of pipe furnished and installed at the locations shown on the Drawings.
2. Payment will be made at the unit price bid which price shall include, erosion control trenching, bedding, backfill, compaction, pipe, installation of pipe, pipe end sections (if required), riprap (if required), and all incidental items.

F. 30" Ductile Iron Pipe, In Place - Bid Item No. 7:

1. Measurement shall be made to the nearest linear foot of pipe installed. The length of pipeline to be paid for shall be based upon measurement of the completed and accepted pipelines along the horizontal projections of the centerline of the pipe, less the fitting laying length.
2. Payment shall be made at the contract unit price bid per linear foot of pipe in place, completed and accepted. This price shall be deemed full compensation for mobilization, bonds, insurance, traffic control, erosion control, furnishing and installing all pipe, trenching, backfilling, compaction,

sheeting, shoring, earthwork, grading, joint materials, closure pieces, connection to adjoining pipe, cutting, polyethylene wrap (if required), tracer wire system (if required), bedding, jointing, testing, surface restoration and seeding, and any other incidental items required to complete the pipe installation as detailed and specified.

G. Fittings - Bid Items No. 8-10 Inclusive:

1. Measurement will be made by each fitting of each type and size, completed and accepted.
2. Payment will be made at the unit price bid for each type and size of fitting in place, which price shall include all labor, excavation, backfilling, compaction, sheeting, dewatering, concrete blocking (where required), anchoring, setting, bedding, joint materials, polyethylene wrap (if required), tracer wire system (if required), jointing, strapping, testing and incidental items required to complete the installation.

H. Air /Vacuum Valve – Bid Item No. 11:

1. Measurement will be made for each air/vacuum valve and valve vault setting furnished and installed at the locations shown on the Drawings, completed and accepted.
2. Payment will be made at the unit price bid for each air release/vacuum valve and vault setting which price shall include excavation, backfill, compaction, precast structure, access hatch or manhole ring and cover, pipe saddle, air release/vacuum valve and appurtenances, valve, piping and any other incidental and appurtenant items required to complete the installation as detailed and specified.

I. Pig Retrieval Manhole, In Place – Bid Item No. 12:

1. Measurement will be made for each standard 4' diameter manhole installed.
2. Payment will be made at the lump sum unit price bid for installing each manhole, 0' to 6' deep, which price shall include all excavation, removal, backfill, compaction, shoring, sheeting, dewatering, concrete, pipe, bedding, couplings, end caps, flanged coupling adapters or mechanical restraint systems, ring and cover, surface restoration including pavement replacement in kind, labor and incidentals.

J. Alternate Minimum Bury Depth – Alternate Bid Item No. 1:

1. Measurement shall be made to the nearest linear foot of pipe installed at alternate minimum bury depth. The length of pipeline to be paid for shall be based upon measurement of the completed and accepted pipelines along the horizontal projections of the centerline of the pipe, less the fitting laying length.
2. Payment will be made at the unit price bid per linear foot of pipe installed at alternate minimum bury depth of 60" below finished ground surface. This item shall represent the additional work required to complete trenching, backfilling, compaction, sheeting, shoring, earthwork, grading at the alternate minimum depth and will be paid in addition to Bid Item 8, 30" Ductile Iron Pipe.

1.07 PAYMENT ITEMS – CONTRACT 1, BID PACKAGE 4 (125 PIPELINE):

A. 8" AWWA C-900 PVC Pipe, In Place - Bid Items No. 1-3, Inclusive:

1. Measurement shall be made to the nearest linear foot of pipe or restrained joint pipe installed. The length of pipeline to be paid for shall be based upon measurement of the completed and accepted pipelines along the horizontal projections of the centerline of the pipe, less the fitting laying length.
2. Payment shall be made at the contract unit price bid per linear foot of pipe in place, completed and accepted. This price shall be deemed full compensation for mobilization, bonds, insurance, traffic control, erosion control, furnishing and installing all pipe, trenching, backfilling, compaction, directional drilling (if required), sheeting, shoring, earthwork, grading, joint materials, closure pieces, connection to adjoining pipe, cutting, polyethylene wrap (if required), tracer wire system (if required), bedding, jointing, testing, surface restoration and seeding, and any other incidental items required to complete the pipe installation as detailed and specified.

B. Rock Excavation – Bid Item No. 4:

1. Measurement will be made to the cubic foot for rock excavated and removed.
2. Payment will be made at the unit price bid per cubic foot of rock removed. This item shall represent the additional work required to remove rock from the excavation and shall be paid in addition to Bid Items 1-3, inclusive, AWWA C-900 PVC Pipe.

C. Fittings and Valves - Bid Items No. 5-13, Inclusive:

1. Measurement will be made by each fitting or valve of each type and size, completed and accepted.
2. Payment will be made at the unit price bid for each type and size of fitting in place, which price shall include all labor, excavation, backfilling, compaction, sheeting, dewatering, mechanical joint restraint (where required), concrete blocking (where required), anchoring, setting, bedding, joint materials, polyethylene wrap (if required), tracer wire system (if required), jointing, strapping, valve stem and riser, testing and incidental items required to complete the installation.

D. Type 2 Road Crossing, Bored In Place: Bid Item No. 14

1. Measurement will be made by the linear foot for the installation of each encasement pipe, completed and accepted.
2. Payment will be made at the unit price bid for the encasement pipe, which price shall include excavation of boring pit, tunneling or boring, encasement pipe, restrained joint carrier pipe, casing spacers, end seals, backfill and compaction of boring pit, dewatering, surface restoration and seeding, permitting, and other incidental items.

E. Low Point Drain – Bid Item No. 15:

1. Measurement will be made for each low point drain setting furnished and installed at the locations shown on the Drawings, completed and accepted.
2. Payment will be made at the unit price bid for each low point drain setting which price shall include excavation, backfill, compaction, precast manhole, manhole frame and cover, fittings, gate valves, concrete blocking, piping and any other incidental and appurtenant items required to complete the installation as detailed and specified.

F. Air/Vacuum Valve Vault – Bid Item No. 16:

1. Measurement will be made for each air/vacuum valve and valve vault setting furnished and installed at the locations shown on the Drawings, completed and accepted.
2. Payment will be made at the unit price bid for each air release/vacuum valve and vault setting which price shall include excavation, backfill, compaction, precast structure, access hatch or manhole ring and cover, pipe saddle, air release/vacuum valve and appurtenances, valve, piping and any other incidental and appurtenant items required to complete the installation as detailed and specified.

G. Remove & Replace Gravel Surfacing: Bid Item No. 17:

1. Measurement will be made at the price bid per square yard of gravel removed and replaced.
2. This item includes the complete furnishing and installation of all materials and labor for the aggregate/gravel surfacing including but not limited to aggregate, earthwork, subgrade preparation, placing, compaction, removal of existing surfacing and all other items of work necessary to complete the work in accordance with the Contract Documents.

H. Remove & Replace Asphaltic Concrete Pavement - Bid Item 18:

1. Measurement will be made at the price bid per square yard of asphaltic concrete pavement removed and replaced.
2. This item includes the complete furnishing and installation of all materials and labor for removal and installation asphaltic concrete pavement including but not limited to asphaltic concrete,

concrete, aggregate base, earthwork, subgrade preparation, placing, jointing, compaction, removal of existing surfacing, tack coat, and all other items of work necessary to complete the work in accordance with the Contract Documents.

I. High Pressure Gas Main Crossing: Bid Item No. 19:

1. Measurement will be made by the lump sum price for the installation of the pipeline through the easement and in the area of the high pressure natural gas pipelines identified in the Drawings, completed and accepted.
2. Payment will be made for the completion of the pipeline through the easement and in the area of the high pressure natural gas pipelines identified in the Drawings, which price shall include additional excavation required, additional cost for nitrile gasket pipe, difficulties encountered due to work in and around foreign pipelines, coordination with utility owners, potholing (as required), gravel drive for crossing, permitting, and other incidental items.

J. Storm Sewer Culvert Pipe – Bid Item No. 20:

1. Measurement will be made by the nearest linear foot of pipe furnished and installed at the locations shown on the Drawings.
2. Payment will be made at the unit price bid which price shall include, erosion control trenching, bedding, backfill, compaction, pipe, installation of pipe, pipe end sections (if required), riprap (if required), and all incidental items.

K. 10" PVC Pipe, Fittings, Crossings, and Appurtenances – Alternate Bid Item No. A1.1-A1.20:

1. Measurement shall be identical to complimentary items in base bid.
2. Payment will be identical to complimentary items in base bid, for 10" pipe, fittings, crossings (including increased diameter of boring and associated casing pipe), and appurtenances. Pipe class, bury depth, and restraint requirements will be as specified for 8" base bid. If awarded, this alternate will be awarded with Contract 1, Bid Package 2, Alternate 1 Alternate Pump Configuration.

L. 16" PVC Pipe, Fittings, Crossings, and Appurtenances – Alternate Bid Item No. A2.1-A2.20:

1. Measurement shall be identical to complimentary items in base bid.
2. Payment will be identical to complimentary items in base bid, for 16" pipe, fittings, crossings (including increased diameter of boring and associated casing pipe), and appurtenances. Pipe bury depth and restraint requirements will be as specified for 8" base bid. All buried pipe will be AWWA C-900, Class 235 PVC. If awarded, this alternate will be awarded with Contract 1, Bid Package 2, Alternate 2 Alternate Pump Configuration.

M. Alternate Minimum Bury Depth – Alternate Bid Item No. A2.21:

1. Measurement shall be made to the nearest linear foot of pipe installed at alternate minimum bury depth. The length of pipeline to be paid for shall be based upon measurement of the completed and accepted pipelines along the horizontal projections of the centerline of the pipe, less the fitting laying length.
2. Payment will be made at the unit price bid per linear foot of pipe installed at alternate minimum bury depth of 60" below finished ground surface. This item shall represent the additional work required to complete trenching, backfilling, compaction, sheeting, shoring, earthwork, grading at the alternate minimum depth and will be paid in addition to Bid Items 1-4, 8" AWWA C-900 PVC Pipe or this item as modified by acceptance of alternate bid items above.

1.08 PAYMENT ITEMS – CONTRACT 1, BID PACKAGE 5 (LAKE DURANGO PIPELINE):

A. 8" AWWA C-900 PVC Pipe, In Place - Bid Items No. 1, Inclusive:

1. Measurement shall be made to the nearest linear foot of pipe or restrained joint pipe installed. The length of pipeline to be paid for shall be based upon measurement of the completed and accepted

pipelines along the horizontal projections of the centerline of the pipe, less the fitting laying length.

2. Payment shall be made at the contract unit price bid per linear foot of pipe in place, completed and accepted. This price shall be deemed full compensation for mobilization, bonds, insurance, traffic control, erosion control, furnishing and installing all pipe, trenching, backfilling, compaction, sheeting, shoring, earthwork, grading, joint materials, closure pieces, connection to adjoining pipe, cutting, polyethylene wrap (if required), tracer wire system (if required), bedding, jointing, testing, surface restoration and seeding, and any other incidental items required to complete the pipe installation as detailed and specified.

B. Rock Excavation – Bid Item No. 2:

1. Measurement will be made to the cubic foot for rock excavated and removed.
2. Payment will be made at the unit price bid per cubic foot of rock removed. This item shall represent the additional work required to remove rock from the excavation and shall be paid in addition to Bid Items 1-2, inclusive, AWWA C-900 PVC Pipe.

C. Fittings and Valves - Bid Items No. 3-7, Inclusive:

1. Measurement will be made by each fitting or valve of each type and size, completed and accepted.
2. Payment will be made at the unit price bid for each type and size of fitting in place, which price shall include all labor, excavation, backfilling, compaction, sheeting, dewatering, mechanical joint restraint (where required), concrete blocking (where required), anchoring, setting, bedding, joint materials, polyethylene wrap (if required), tracer wire system (if required), jointing, strapping, valve stem and riser, testing and incidental items required to complete the installation.

D. Type 3 Road Crossing: Bid Item No. 8:

1. Measurement will be made by the linear foot for the installation of each crossing, completed and accepted.
2. Payment will be made at the unit price bid for the crossing pipe, which price shall include excavation, restrained joint pipe, backfill and compaction, dewatering, surface restoration and seeding, permitting, and other incidental items.

E. Low Point Drain – Bid Item No. 9:

1. Measurement will be made for each low point drain setting furnished and installed at the locations shown on the Drawings, completed and accepted.
2. Payment will be made at the unit price bid for each low point drain setting which price shall include excavation, backfill, compaction, precast manhole, manhole frame and cover, fittings, gate valves, concrete blocking, piping and any other incidental and appurtenant items required to complete the installation as detailed and specified.

F. Fire Hydrant Assembly: Bid Item No. 10:

1. Measurement will be made by each hydrant, completed and accepted.
2. Payment will be made at the unit price bid for each hydrant, which price shall include furnishing and installing hydrant, all labor, excavation, backfilling, compaction, sheeting, dewatering, mechanical joint restraint (where required), concrete blocking (where required), anchoring, setting, bedding, joint materials, polyethylene wrap (if required), tracer wire system (if required), jointing, strapping, isolation valve stem and riser, pipe and connection to main, gravel drain, tee fitting, any required barrel extensions, testing and incidental items required to complete the installation.

G. Air/Vacuum Valve Vault – Bid Item No. 11:

1. Measurement will be made for each air/vacuum valve and valve vault setting furnished and installed at the locations shown on the Drawings, completed and accepted.
2. Payment will be made at the unit price bid for each air release/vacuum valve and vault setting which price shall include excavation, backfill, compaction, precast structure, access hatch or manhole

ring and cover, pipe saddle, air release/vacuum valve and appurtenances, valve, piping and any other incidental and appurtenant items required to complete the installation as detailed and specified.

H. Remove & Replace Gravel Surfacing: Bid Item No. 12:

1. Measurement will be made at the price bid per square yard of gravel removed and replaced.
2. This item includes the complete furnishing and installation of all materials and labor for the aggregate/gravel surfacing including but not limited to aggregate, earthwork, subgrade preparation, placing, compaction, removal of existing surfacing and all other items of work necessary to complete the work in accordance with the Contract Documents.

I. Outlet Structure: Bid Item No. 13:

1. Measurement will be made by the lump sum price for the construction of the outlet structure, completed and accepted.
2. Payment will be made at the lump sum price bid for completion of construction of the outlet structure, including all materials and labor including but not limited to concrete outlet structure, riprap, aggregate, earthwork, subgrade preparation, placing, compaction, removal of existing surfacing, flap gate valve and all other items of work necessary to complete the work in accordance with the Contract Documents.

J. Alternate Minimum Bury Depth – Alternate Bid Item No. A1:

1. Measurement shall be made to the nearest linear foot of pipe installed at alternate minimum bury depth. The length of pipeline to be paid for shall be based upon measurement of the completed and accepted pipelines along the horizontal projections of the centerline of the pipe, less the fitting laying length.
2. Payment will be made at the unit price bid per linear foot of pipe installed at alternate minimum bury depth of 60" below finished ground surface. This item shall represent the additional work required to complete trenching, backfilling, compaction, sheeting, shoring, earthwork, grading at the alternate minimum depth and will be paid in addition to Bid Items 1-2, 8" AWWA C-900 PVC Pipe.

1.09 PAYMENT ITEMS – CONTRACT 2 (UNDERWATER INSTALLATION OF INTAKE SCREEN(S)):

A. Upper Portal Screen - Bid Item No. 1:

1. Measurement will be made by the lump sum price for the installation of the upper intake cylindrical water intake screen at the intake structure, completed and accepted.
2. Payment will be made at the lump sum price bid for completion of the upper portal screen which price shall include the complete furnishing and installation of all materials, labor and equipment for the screen including but not limited to furnishing and underwater installation of intake screen, mobilization, bonds, insurance, piping, demolition, removal, and disposal of existing screen or cover, and all other items of work necessary to complete the work in accordance with the Contract Documents.

B. Lower Portal Screen – Alternate Bid Item No. 1:

1. Measurement will be made by the lump sum price for the installation of the lower intake cylindrical water intake screen at the intake structure, completed and accepted.
2. Payment will be made at the lump sum price bid for completion of the lower portal screen which price shall include the complete furnishing and installation of all materials, labor and equipment for the screen including but not limited to furnishing and underwater installation of intake screen, mobilization, bonds, insurance, piping, demolition, removal, and disposal of existing screen or cover, and all other items of work necessary to complete the work in accordance with the Contract Documents.

1.10 PAYMENT ITEMS – CONTRACT 3 (LAKE DURANGO TREATED WATER PIPELINE):

A. 4" AWWA C-900 PVC Pipe, In Place - Bid Item No. 1:

1. Measurement shall be made to the nearest linear foot of pipe or restrained joint pipe installed. The length of pipeline to be paid for shall be based upon measurement of the completed and accepted pipelines along the horizontal projections of the centerline of the pipe, less the fitting laying length.
2. Payment shall be made at the contract unit price bid per linear foot of pipe in place, completed and accepted. This price shall be deemed full compensation for mobilization, bonds, insurance, traffic control, erosion control, furnishing and installing all pipe, trenching, backfilling, compaction, sheeting, shoring, earthwork, grading, joint materials, closure pieces, connection to adjoining pipe, cutting, polyethylene wrap (if required), tracer wire system (if required), bedding, jointing, testing, surface restoration and seeding, and any other incidental items required to complete the pipe installation as detailed and specified.

B. Rock Excavation – Bid Item No. 2:

1. Measurement will be made to the cubic foot for rock excavated and removed.
2. Payment will be made at the unit price bid per cubic foot of rock removed. This item shall represent the additional work required to remove rock from the excavation and shall be paid in addition to Bid Items 1-2, inclusive, AWWA C-900 PVC Pipe.

C. Fittings and Valves - Bid Items No. 3-5, Inclusive:

1. Measurement will be made by each fitting or valve of each type and size, completed and accepted.
2. Payment will be made at the unit price bid for each type and size of fitting in place, which price shall include all labor, excavation, backfilling, compaction, sheeting, dewatering, mechanical joint restraint (where required), concrete blocking (where required), anchoring, setting, bedding, joint materials, polyethylene wrap (if required), tracer wire system (if required), jointing, strapping, valve stem and riser, testing and incidental items required to complete the installation.

D. Connection to Existing – Bid Item No. 6:

1. Measurement will be made by the lump sum for the demolition, modification and connections to existing structures, completed and accepted.
2. Payment will be made at the lump sum price bid for connections to the existing pipeline, which price shall include all excavation, installation, backfill, and compaction, labor, equipment, and incidentals.

E. Air/Vacuum Valve – Bid Item No. 7:

1. Measurement will be made for each air/vacuum valve and valve vault setting furnished and installed at the locations shown on the Drawings, completed and accepted.
2. Payment will be made at the unit price bid for each air release/vacuum valve and vault setting which price shall include excavation, backfill, compaction, precast structure, access hatch or manhole ring and cover, pipe saddle, air release/vacuum valve and appurtenances, valve, piping and any other incidental and appurtenant items required to complete the installation as detailed and specified.

F. New Meter Installation – Bid Item No. 8:

1. Measurement will be made for each meter setting furnished and installed at the locations shown on the Drawings, completed and accepted.
2. Payment will be made at the unit price bid for each meter setting which price shall include excavation, backfill, compaction, meter box, tandem meter setter, installation of Owner-provided positive displacement meter, pressure regulator, saddle tap, corporation stop, service line for connection between mainline and new meter setting (length as required) and for connection between new meter setting and existing household service line, excavation, placement and backfilling.

G. 2 ½" Flush Hydrant: Bid Item No. 9:

1. Measurement will be made by each hydrant, completed and accepted.
2. Payment will be made at the unit price bid for each hydrant, which price shall include furnishing and installing hydrant, all labor, excavation, backfilling, compaction, sheeting, dewatering, mechanical joint restraint (where required), concrete blocking (where required), anchoring, setting, bedding, joint materials, polyethylene wrap (if required), tracer wire system (if required), jointing, strapping, isolation valve stem and riser, pipe and connection to main, gravel drain, testing and incidental items required to complete the installation.

H. Deduct for Concurrent Award of Contract 1 – Alternate Bid Item No. 1:

1. Measurement will be made by the lump sum price for the efficiencies and economies of scale recognized by the Contractor due to concurrent award of Contracts 1 and 3.
2. Payment will be made at the lump sum price bid for the efficiencies and economies of scale recognized by the Contractor due to concurrent award of Contracts 1 and 3. From the beginning of the project, up to 50% of each Application for Payment will utilize credit from this Bid Item until the bid amount is fully consumed by project costs.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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BARTLETT & WEST

SECTION 013300

SUBMITTALS

PART 1 GENERAL

1.01 THE REQUIREMENT

- A. This section specifies the means of all submittals. All submittals, whether their final destination is to the Owner, Engineer, architect, electrical engineer, landscape architect or other representative of the Owner, shall be submitted to the Engineer. A general summary of the types of submittals and the number of copies required is as follows:

<u>Copies to Engineer</u>	<u>Type of Submittal</u>	<u>Submittal Format</u>
1	Construction schedule	Electronic PDF, excel or other readable scheduling file format
1	Schedule of payment items	Electronic PDF or excel file
3	Audio-visual record	DVD
4	Progress estimates	Original Paper
1	Shop drawings	Electronic PDF and 3 paper copies of the final shop drawing
2	Product samples	As specified
1	Record drawings	Original Paper and PDF
2	Certificates of compliance	Original Paper
2	Warranties	Original Paper

1.02 SUBMITTAL PROCEDURES

- A. Transmit each submittal with a form acceptable to the Engineer, clearly identifying the project Contractor, the enclosed material and other pertinent information specified in other parts of this section. Identify variations from Contract Documents and Product or system limitations which may be detrimental to successful performance of the completed Work.
- B. Revise and resubmit submittals as required, identify all changes made since previous submittals. Resubmittals shall be noted as such.
- C. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions.

1.03 CONSTRUCTION SCHEDULE

- A. The construction schedule shall be prepared in the form of a horizontal bar chart showing in detail the proposed sequence of the work and identifying construction activities for each major component, structure or facility. The schedule shall be time scaled, identifying the first day of each week, with the estimated date of starting and completion of each stage of the work in order to complete the project within the Contract time. An electronic copy of the schedule shall be submitted ten calendar days before the date of the Notice to Proceed or Pre-Construction meeting, whichever comes first.
- B. The construction schedule shall be revised to reflect comments by the Owner and Engineer and updated monthly, depicting progress to the last day of the month. Six copies shall be submitted with each request for monthly progress payment.

- C. Changes to the schedule shall be accompanied by a letter of explanation with appropriate reference and revision date on the schedule.
- D. The Contractor shall maintain the work progress in accordance with the accepted schedule and shall take whatever steps necessary to maintain the overall project schedule and unless specifically authorized in writing by the Engineer, any individual component of the schedule.

1.04 SCHEDULE OF PAYMENT ITEMS

- A. The Contractor shall submit a Schedule of Payment Items for review ten calendar days before the date of the Notice to Proceed or Pre-Construction meeting, whichever comes first. The schedule shall contain the installed value of the component parts of Work for the purpose of making progress payments during the construction period.
- B. The schedule shall be given in sufficient detail for the proper identification of Work accomplished. Each item shall include its proportional share of all costs, including the Contractor's overhead, contingencies and profit. The sum of all scheduled items shall equal the total value of the Contract.
- C. No payment will be made for materials stored on the project site.
- D. The Contractor shall expand or modify the above schedule as required by the Engineer's initial or subsequent reviews.

1.05 PROGRESS ESTIMATES

- A. Progress estimates shall be submitted in accordance with the General Conditions and shall be accompanied by the revised Construction Schedule.

1.06 SHOP DRAWINGS

- A. General: The Contractor shall submit for review shop drawings for concrete reinforcement, structural details, piping layout and appurtenances, wiring, color selection charts, all equipment, fabricated items and materials, materials and equipment fabricated especially for this Contract, and materials and equipment for which such Drawings are specified or specifically requested by the Engineer.
- B. Shop drawings shall show performance characteristics, the principal dimensions, weight, structural and operating features, space required, clearances, dimensions needed for installation and correlation with other equipment and materials, external connections, anchorages, supports required, type and/or brand of finish or shop coat, grease fittings, etc. depending on the subject of the Drawings.
- C. When so specified, or if considered by the Engineer to be acceptable, the manufacturer's specifications, catalog data, descriptive matter, illustrations, etc. may be submitted for review in place of shop drawings. In such case, the requirements shall be as specified for shop drawings, insofar as applicable.
- D. The Contractor shall be responsible for the prompt submittal of all shop drawings so that there shall be no delay to the Work due to the absence of such Drawings. The Engineer will review the shop drawings within 21 calendar days of receipt of such Drawings. This review time will commence starting the next working day following receipt of the shop drawing. Reviewed shop drawings will be returned to the Contractor by regular mail, posted no later than 21 days after receipt.
- E. Time delays caused by rejection of submittals are not cause for extra charges to the Owner or time extensions.
- F. Shop drawings received directly from suppliers or subcontractors will be returned without action.
- G. All shop drawings shall be submitted to the Engineer through the Contractor. The Contractor is responsible for obtaining shop drawings from his subcontractors and returning reviewed Drawings to

them. All shop drawings shall be prepared on standard size, 24-inch by 36-inch sheets, or smaller.

- H. Each submittal shall include a statement prepared by the originator of the drawings and data, certifying compliance with the Contract Documents except for deviations which are specifically identified.
- I. All deviations from the Contract Documents shall be identified on each submittal and shall be tabulated in Contractor's letter of transmittal. Such submittals shall, as pertinent to the deviation, indicate essential details of all changes proposed by Contractor (including modifications to other facilities that may be a result of the deviation) and all required piping and wiring diagrams.
- J. Accompany submittals with transmittal letter, in duplicate, containing:
 - 1. Date.
 - 2. Project title and number.
 - 3. Contractor's name and address.
 - 4. The number of each shop drawing, project datum and sample submitted.
 - 5. Notification of deviations from Contract Documents.
 - 6. Other pertinent data.
- K. Submittals shall include:
 - 1. Date and revision dates.
 - 2. Project title and number.
 - 3. The names of:
 - a. Engineer
 - b. Contractor
 - c. Subcontractor
 - d. Supplier
 - e. Manufacturer
 - f. Separate detailer when pertinent.
 - 4. Identification of product or material.
 - 5. Relation to adjacent structure or materials.
 - 6. Field dimensions, clearly identified as such.
 - 7. Specification section number.
 - 8. Applicable standards, such as ASTM number or Federal Specification.
 - 9. A blank space, 4 inch x 3 inch, for the Engineer's stamp.
 - 10. Identification of deviations from Contract Documents.
 - 11. Contractor's stamp, initialed or signed, certifying review of submittal, verification of field measurements and compliance with Contract Documents.
- L. Product Data:
 - 1. Where manufacturer's publications in the form of catalogs, brochures, illustrations, or other data sheets are submitted in lieu of prepared shop drawings, such submission shall specifically indicate the particular item offered. Identification of such items and relative pertinent information shall be made with indelible ink. Submissions showing only general information will not be accepted.
 - 2. Manufacturer's standard schematic drawings:
 - a. Modify drawings to delete information which is not applicable to project.

- b. Supplement standard information to provide additional information applicable to project.
- 3. Manufacturer's catalog sheets, brochures, diagrams, schedules, performance charts, illustrations and other standard descriptive data:
 - a. Clearly mark each copy to identify pertinent materials, products or models.
 - b. Show dimensions and clearances required.
 - c. Show performance characteristics and capacities.
- M. Product data shall include materials of construction, dimensions, performance characteristics, capacities, wiring diagrams, piping and controls, etc.
- N. Sample Warranties: When warranties are called for, a sample of the warranty shall be submitted with the shop drawings. The sample warranty shall be the same form that will be used for the actual warranty.
- O. Work Prior to Review: No material or equipment shall be purchased, fabricated especially for this Contract, or delivered to the project site until the required shop drawings have been submitted, processed and marked either "RESUBMITTAL IS NOT REQUIRED" or "MAKE CORRECTIONS NOTED." All materials and Work involved in the construction shall be as represented by said Drawings.
- P. The Contractor shall not proceed with any portion of the Work (such as the construction of foundations) for which the design and details are dependent upon the design and details of equipment for which submittal review has not been completed.
- Q. Contractor's Review: Only submittals that have been checked and corrected should be submitted to the Contractor by his subcontractors and vendors. Prior to submitting shop drawings to the Engineer, the Contractor shall check thoroughly all such Drawings to satisfy himself that the subject matter thereof conforms to the Drawings and Specifications in all respects. Drawings that are correct shall be marked with the date, checker's name and indications of the Contractor's approval, and then shall be submitted to the Engineer. Other Drawings submitted to the Engineer will be returned to the Contractor unreviewed.
- R. Contractor's Modifications: For submissions containing departures from the Contract Documents, the Contractor shall include proper explanation in his letter of transmittal. Should the Contractor submit for review equipment that requires modifications to the structures, piping, layout, etc. detailed on the Drawings, he shall also submit for review details for the proposed modifications. If such equipment and modifications are accepted, the Contractor, at no additional cost to the Owner, shall do all Work necessary to make such modifications.
- S. Substitutions: Whenever a particular brand or make of material, equipment, or other item is specified, or is indicated on the Drawings, it is for the purpose of establishing a standard of quality, design, and type desired and to supplement the detailed specifications. Any other brand or make which, in the opinion of the Engineer, is equivalent to that specified or indicated may be offered as a substitute subject to the following provisions:
 - 1. Contractor shall submit for each proposed substitution sufficient details, complete descriptive literature, and performance data together with samples of the materials, where feasible, to enable the Engineer to determine if the proposed substitution is equal.
 - 2. Contractor shall submit certified tests, where applicable, by an independent laboratory attesting that the proposed substitution is equal.
 - 3. A list of installations where the proposed substitution is equal.
 - 4. Where the acceptance of a substitution requires revision or redesign of any part of the Work, all such revision and redesign, and all new Drawings and details required therefore, shall be provided by the Contractor at his own cost and expense, and shall be subject to review of the Engineer.
 - 5. In all cases, the Engineer shall be the sole judge as to whether a proposed substitution is to be accepted. The Contractor shall abide by the Engineer's decision when proposed substitute items are judged to be unacceptable and shall in such instances furnish the item, or substitute, as specified. No substitute items shall be used in the Work without written acceptance of the Engineer.

6. Acceptance of any proposed substitution shall in no way release the Contractor from any of the provisions of the Contract Documents.
- T. Complete Submittals: Each submittal shall be complete in all aspects incorporating all information and data required to evaluate the products' compliance with the Contract Documents. Partial or incomplete submissions shall be returned to the Contractor without review.
- U. Shop Drawing Distribution: The Contractor shall electronic copies of all shop drawings to the Engineer for review. Shop drawings will be reviewed, stamped and distributed with the appropriate box checked either "RESUBMITTAL IS NOT REQUIRED," "MAKE CORRECTIONS NOTED" or "REVISE AND RESUBMIT." The Contractor shall distribute the processed shop drawings.
- V. If the Contractor requires additional copies of returned shop drawings, he shall include extra Drawings in his original submittal. The Engineer will process the Drawings and return them to the Contractor.

1.07 PRODUCT SAMPLES

- A. Contractor shall furnish for review all product samples as required by the Contract Documents or requested by the Engineer to determine compliance with the specifications.
- B. Samples shall be of sufficient size or quantity to clearly illustrate the quality, type, range of color, finish or texture and shall be properly labeled to show complete project identification, the nature of the material, trade name of manufacturer and location of the Work where the material represented by the sample will be used.
- C. Samples shall be checked by the Contractor for conformance to the Contract Documents before being submitted to the Engineer and shall bear the Contractor's stamp certifying that they have been so checked. Transportation charges on samples submitted to the Engineer shall be prepaid by the Contractor.
- D. Engineer's review will be for compliance with the Contract Documents, and his comments will be transmitted to the Contractor with reasonable promptness.
- E. Acceptable samples will establish the standards by which the completed Work will be judged.

1.08 CONTRACTOR RESPONSIBILITIES

- A. Contractor responsibilities for submittals are defined in the General and Supplementary Conditions.
- B. Contractor's Responsibility: The review of shop drawings will be general and shall not relieve the Contractor of the responsibility for details of design, dimensions, etc. necessary for proper fitting and construction of the Work required by the Contract and to achieve the specified performance.
- C. Review shop drawings, project data and samples prior to submission. Submittals not bearing the Contractor's certification that he has reviewed, checked and approved the shop drawings and that they are in conformance with the requirements of the Contract Documents will be returned without action by Engineer.
- D. Contractor's stamp or approval is a representation to Owner and Engineer that Contractor accepts full responsibility for determining and verifying all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data, and that he has reviewed or coordinated each submittal with the requirements of the Work and the Contract Documents.
- E. Contractor shall accept full responsibility for the completeness of each submission, including the identification of all deviations from the Contract Documents on each submittal and in the Contractor's letter of transmittal. In addition, in the case of a resubmission, Contractor shall verify that all exceptions previously noted by Engineer have been taken into account. In the event that more than one

resubmission is required because of failure of Contractor to account for exceptions previously noted, Contractor shall reimburse Owner for the charges of Engineer for review of the additional resubmissions.

- F. After Engineer's review, distribute copies.

1.09 CERTIFICATES OF COMPLIANCE

- A. Certificate of Compliance: Prior to the use or installation of any material, appliance or equipment in the work, and if requested by the Engineer, the Contractor shall furnish the Engineer a notarized affidavit certifying that the material, appliance or equipment conforms to the requirements of the specifications for this project. The certificate of compliance shall be accompanied by certified test reports from the manufacturer, mill or an approved commercial testing laboratory. Copies of certificates of compliance and test reports shall be submitted for requested items to the Engineer prior to request for payment.

1.10 WARRANTIES

- A. Original warranties, called for in the Contract Documents, shall be submitted to the Owner through the Engineer. When warranties are required for an item, warranty shall be submitted prior to request for payment of that item.
- B. When warranties are requested, a sample of the warranty to be provided shall be submitted with, and considered part of, the shop drawings.

1.11 RESUBMISSION REQUIREMENTS

- A. Resubmittals shall be made within 30 days of the date of the letter returning the material to be modified or corrected, unless within 14 days Contractor submits an acceptable request for an extension of the stipulated time period, listing the reasons the resubmittal cannot be completed within that time.
- B. Shop Drawings:
 - 1. Revise initial drawings as required and resubmit for initial submittal.
 - 2. Indicate on drawings any changes which have been made other than those requested by Engineer.
- C. Project Data and Samples. Submit new data and samples as required for initial submittal.
- D. Contractor's letter of resubmittal shall list the date of his original submittal letter, the date of the Engineer's letter returning the submittal, and the dates of submission and return of any previous resubmittals.
- E. When the drawings and data are returned marked "REJECTED" or "REVISE AND RESUBMIT", the corrections shall be made as noted thereon and as instructed by Engineer and five corrected copies submitted.
- F. When corrected copies are resubmitted, Contractor shall in writing direct specific attention to all revisions and shall list separately any revisions made other than those called for by Engineer on previous submissions.
- G. The Engineer shall review the initial submittal and one resubmittal or submittal of additional information, if required, of a shop drawing. Subsequent reviews by the Engineer shall be paid for by the Contractor. The Engineer shall invoice the Owner for all costs incurred by providing any and all subsequent shop drawing reviews. The Owner shall deduct these costs from the Contractor's monthly payment request.
- H. Any need for more than one resubmission, or any other delay in obtaining Engineer's review of submittals, will not entitle Contractor to extension on the Contract Time unless delay of the Work is directly caused by a change in the Work authorized by a Change Order or by failure of Engineer to review any submittal within the submittal review period set forth herein and to return this submittal to Contractor.

1.12 ENGINEER'S REVIEW

- A. Engineer's submittal review period shall be 21 consecutive calendar days in length and shall commence on the first work day (Monday through Friday) immediately following the date of arrival of the submittal or resubmittal in Engineer's office. The time required to mail the submittal or resubmittal back to Contractor shall not be considered a part of the submittal review period.
- B. Engineer's review of drawings and data submitted by Contractor will cover only general conformity to the Drawings and Specifications, external connections, and dimensions which affect the layout. Engineer's review does not indicate a thorough review of all dimensions, quantities, and details of the material, equipment, device, or item shown. Engineer's review of submittals shall not relieve Contractor from responsibility for errors, omissions, or deviations, nor responsibility for compliance with the Contract Documents.

1.13 RECORD DRAWINGS

- A. The Contractor shall keep and maintain, at the job site, one record set of Drawings. On these, it shall mark all project conditions, locations, configurations, and any other changes or deviations which may vary from the details represented on the original Contract Drawings, including buried or concealed construction and utility features which are revealed during the course of construction. Special attention shall be given to recording the horizontal and vertical location of all buried utilities that differ from the locations indicated, or which were not indicated on the Drawings. Said record drawings shall be supplemented by detailed sketches as necessary or directed to indicate, fully, the Work as actually constructed. These master record drawings of the Contractor's representation of as-built conditions, including all revisions made necessary by addenda and change orders shall be maintained up-to-date during the progress of the Work.
- B. The record drawings shall be received on the 20th working day of every third month after the month in which the notice to proceed is given as well as on completion of Work. Failure to maintain the record drawings up-to-date shall be grounds of withholding monthly progress payments until such time as the record drawings are brought up-to-date.
- C. In the case of those drawings which depict the detail requirement for equipment to be assembled and wired in the factory, such as motor control centers and the like, the record drawing shall be updated by indicating those portions which are superseded by change order drawings or final shop drawings, and by including appropriate reference information describing the change orders by number and the shop drawings by manufacturer, drawing, and revision numbers.
- D. Record drawings shall be accessible to the Engineer at all times during the construction period.
- E. Final payment will not be acted upon until the Contractor-prepared record drawings have been delivered to the Engineer. Said up-to-date record drawings shall be in the form of a set of prints with carefully plotted information overlaid in pencil.
- F. Upon substantial completion of the Work and prior to final acceptance, the Contractor shall finalize the deliver a complete set of record drawings to the Engineer for transmittal to the Owner, conforming to the construction records of the Contractor. This set of drawings shall consist of corrected drawings showing the reported location of the Work. The information submitted by the Contractor and incorporated in the Record Drawings will be assumed to be correct, and the Engineer will not be responsible for the accuracy of such information, and for any errors or omissions which may appear on the Record Drawings as a result.
- G. The information submitted by the Contractor in the record drawings shall be certified by a land surveyor registered in the State of Colorado.
- H. The record drawings shall show the exact location of all structures and all mains within the right-of-way or easement, size and type of material of mains, all deflection points (vertical and horizontal), top pipe elevations and stationing at 100-foot increments, and exact dimensions and locations of all fittings and

valves.

1.14 PRECONSTRUCTION SURVEY

- A. Prior to start of any on-site construction activities, the Contractor and the Owner or his authorized representative shall make a joint condition survey after which the Contractor shall prepare 3 copies of a report indicating on a layout plan the condition of any damaged property adjacent to the site of work and any variances from the drawings. The report shall also contain color photographs, 3-1/2 x 5 inches or larger, of all damaged areas in eight different directions noted along with a sufficient number of photos showing the physical features of the existing route before construction begins. The photos shall be organized in a photo album and identified by location and direction of view.
- B. The report shall be signed by both the Contractor and the Owner or his authorized representative upon mutual agreement as to its accuracy and completeness. One set shall be delivered to the Owner, one to the Engineer and the final set shall be retained by the Contractor.

1.15 AUDIO-VISUAL PRECONSTRUCTION RECORD

- A. General: Prior to the start of any on-site construction activities, the Contractor shall have a continuous color audio-video DVD recording taken 50 feet both sides of the pipe route or right of way, whichever is greater along the entire length of the Project to serve as a record of preconstruction conditions. Items to be specifically included but not limited to all damaged areas, traffic signs, pedestrian signs, equestrian signs, milepost markers, drainage structures and culverts, trails, walkways and pathways, curbs and gutters, driveways and approaches, intersections in all directions, utility poles and guy lines, utility pedestals, utility markers, survey markers, road turnouts and all other above grade improvements. Particular attention shall be paid to the existing drainage swales and ditches. No construction shall begin prior to review and acceptance of the DVD recording covering the construction area by the Engineer. The Engineer shall have the authority to reject all or any portion of the video DVD not conforming to the specifications and order that it be redone at no additional charge. The Contractor shall reschedule unacceptable coverage within five days after being notified. The Engineer shall designate those areas, if any, to be omitted from or added to the audio-video coverage. Tape recordings shall not be more than ninety days prior to construction in any area. All DVDs and written records shall become property of the Owner.
- B. The Contractor shall engage the services of a professional electrographer. A responsible commercial firm known to be skilled and regularly engaged in the business of preconstruction color audio-video documentation shall prepare the color audio-video tapes. The electrographer shall furnish to the Engineer a list of all equipment to be used for the audio-video recording, i.e., manufacturer's name, model number, specifications and other pertinent information. Additional information to be furnished by the electrographer is the names and addresses of two references that the electrographer has performed color audio-video recording for on projects of a similar nature within the last twelve months.
- C. Audio-video DVDs: Audio-video DVDs shall be new. Reprocessed DVDs will not be acceptable. The DVDs shall be high energy, extended still frame capable, video disc, shall be interchangeable with the color video DVD player and shall be compatible for playback with a standard player-receiver, DVD format.
- D. Equipment: All equipment, accessories, materials and labor to perform this service shall be furnished by the Contractor and shall be DVD format.
- E. The total audio-video system shall reproduce bright, sharp, clear pictures with accurate colors and shall be free from distortion, tearing, rolls or any other form of imperfection. The audio portion of the recording shall reproduce the commentary of the camera operator with proper volume, clarity and be free from distortion and interruptions.
- F. When conventional wheeled vehicles are used, the distance from the camera lens to the ground shall not be less than twelve feet. In some instances, audio-video tape coverage may be required in areas not accessible by conventional wheeled vehicles. Such coverage shall be obtained by walking or special conveyance acceptable to the Engineer.

- G. The color video camera used in the recording system shall have a horizontal resolution of 500 lines at center, a luminance signal to noise ratio of 45 dB and a minimum illumination requirement of twenty-five foot-candles.
- H. Recorded Information - Audio: Each DVD shall begin with the current date, project number and municipality and be followed by the general location; i.e., name of street, house address, viewing side and direction of progress. The audio track shall consist of an original live recording. The recording shall contain the narrative commentary of the electrographer, recorded simultaneously with his fixed elevation video record of the zone of influence of construction.
- I. Recorded Information - Video: All video recordings must, by electronic means, display continuously and simultaneously, generated with the actual videoing, transparent digital information to include the date and time of recording. The date information shall contain the month, day, and year. The time information shall contain the hours and minutes. Additional information shall be displayed or verbally provided periodically. Such information shall include, but not be limited to, the project name and contract number. Supplemental information including, but not be limited to, the name of street, house address, direction of travel and the viewing side shall be verbally indicated at the beginning of that section of tape.
- J. All recording shall be done during times of good visibility. No recording shall be done during precipitation, mist, or fog or more than 10% snow coverage on the ground. The recording shall only be done when sufficient sunlight is present to properly illuminate the subjects or recordings and to produce bright, sharp video recordings of those subjects.
- K. The rate of speed in the general direction of travel of the vehicle used during taping shall not exceed forty-four feet per minute (approx. 0.5 mph). Panning, zoom-in and zoom-out rates shall be sufficiently controlled to maintain a clear view of the object.
- L. DVD coverage shall include all surface features located within the zone of influence of construction supported by appropriate audio coverage. Such coverage shall include, but not be limited to, existing driveways, sidewalks, curbs, pavements, ditches, mailboxes, landscaping, culverts, fences, signs and headwalls within the area covered.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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BARTLETT  **WEST**

SECTION 014126

PERMITS

PART 1 GENERAL

1.01 REQUIREMENTS

- A. It shall be the Contractor's responsibility to secure all permits of every description required to initiate and complete the work under this contract, except permits obtained by the Owner. The Contractor shall be responsible for complying with all permit and approval requirements including Owner obtained.
 - 1. The contractor shall obtain a Utility/Special Use Permit from the Colorado Department of Transportation. As part of that permit the contractor shall conform to the insurance requirements listed in the Insurance Requirements for CDOT Utility and Special Use Permits document that is provided after this section.
- B. No separate or direct payment will be made to the Contractor for permits and inspection requirements, but all such costs shall be included in the applicable items in the Schedule of Prices. The Owner will furnish signed and sealed sets of Contract Documents for permit use as required.
- C. The Contractor shall furnish to the Engineer copies of all permits and/or agreements prior to commencement of work requiring permits.
- D. Permits/approval obtained by the Owner or his authorized representative, include the following:
 - 1. Colorado Department of Public Health and Environment. The Owner has applied for and received approval for this work. The Contractor shall be responsible for complying with all permit conditions as well as CDPHE requirements.
 - 2. USACOE Nationwide 12 – Copy provided at the end of this section.
 - 3. La Plata County ROW permit – Copy provided at the end of this section.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 014219
REFERENCE STANDARDS

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Titles of Sections and Paragraphs: Captions accompanying specification sections and paragraphs are for convenience of reference only, and do not form a part of the Specifications.
- B. Applicable Publications: Whenever in these Specifications references are made to published specifications, codes, standards, or other requirements, it shall be understood that wherever no date is specified, only the latest specifications, standards, or requirements of the respective issuing agencies which have been published as of the date of the Notice to Proceed, shall apply; except to the extent that said standards or requirements may be in conflict with applicable laws, ordinances, or governing codes. No requirements set forth herein or shown on the Drawings shall be waived because of any provision of, or omission from, said standards or requirements.
- C. Specialists, Assignments: In certain instances, Specification text requires (or implies) that specific work is to be assigned to specialists or expert entities, who must be engaged for the performance of that work. Such assignments shall be recognized as special requirements over which the Contractor has no choice or option. These requirements shall not be interpreted so as to conflict with the enforcement of building codes and similar regulations governing the Work; also they are not intended to interfere with local union jurisdiction settlements and similar conventions. Such assignments are intended to establish which party or entity involved in a specific unit of work is recognized as "expert" for the indicated construction processes or operations. Nevertheless, the final responsibility for fulfillment of the entire set of contract requirements remains with the Contractor.

1.02 1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of other requirements of the specifications, all work specified herein shall conform to or exceed the requirements of all applicable codes and the applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of these Specifications nor the applicable codes.
- B. References herein to "Building Code" or UBC shall mean the Uniform Building Code. The latest edition of the code as approved and used by the local agency as of the date of award, as adopted by the agency having jurisdiction, shall apply to the Work herein, including all addenda, modifications, amendment, or other lawful changes thereto.
- C. In case of conflict between codes, reference standards, Drawings and the other Contract Documents, the most stringent requirements shall govern. All conflicts shall be brought to the attention of the Engineer for clarification and directions prior to ordering or providing any materials or labor. The Contractor shall follow the most stringent requirements.
- D. Applicable Standard Specifications: The Contractor shall construct the Work specified herein in accordance with the requirements of the Contract Documents and the referenced portion of those referenced codes, standards, and Specifications listed herein.
- E. References herein to "OSHA Regulations for Construction" shall mean Title 29, Part 1926, Construction Safety and Health Regulations, Code of Federal Regulations (OSHA), including all changes and amendments thereto.
- F. References herein to "OSHA Standards" shall mean Title 29, Part 1910, Occupational Safety and Health Standards, Code of Federal Regulations (OSHA), including all changes and amendments thereto.

1.03 ABBREVIATIONS AND SYMBOLS

A. Abbreviations used in the Contract Documents are defined as follows:

AABC	Associated Air Balance Council
AAMA	Architectural Aluminum Manufacturers Assoc.
ASSHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
AFBMA	Antifriction Bearing Manufacturers Assoc.
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AHDGA	American Hot Dip Galvanizers Association
AI	Asphalt Institute
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute
APA	American Plywood Association
API	American Petroleum Institute
APHA	American Public Health Association
APWA	American Public Works Association
ARI	Air Conditioning and Refrigeration Institute
ASA	Acoustical Society of America
ASAE	American Society of Agriculture Engineers
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASLE	American Society of Lubricating Engineers
ASME	American Society of Mechanical Engineers
ASMM	Architectural Sheet Metal Manual
ASSE	American Society of Sanitary Engineering
ASTM	American Society for Testing and Materials
AWG	American Wire Gage
AWPA	American Wood Preservers Association
APWI	American Wood Preservers Institute
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturers Association

CDOT	Colorado Department of Transportation
CEMA	Conveyor Equipment Manufacturers Association
CISPI	Cast Iron Soil Pipe Institute
CMA	Concrete Masonry Association
CRSI	Concrete Reinforcing Steel Institute
CS	Commercial Standard
DHI	Door and Hardware Institute
DIPRA	Ductile Iron Pipe Research Association
EIA	Electronic Industries Association
ETL	Electronic Test Laboratories
FS	Federal Specifications
FGMA	Flat Glass Marketing Association
FM	Factory Mutual
IBBM	Iron Body, Bronze Mounted
IEEE	Institute Electrical and Electronics Engineers
IES	Illuminating Engineering Society
IFI	Industrial Fasteners Institute
IPCEA	Insulated Power Cable Engineers Association
IPS	Iron Pipe Size
ISA	Instrument Society of America
ISO	International Organization for Standardization
MBMA	Metal Building Manufacturer's Association
MIL	Military Specification
MTI	Marine Testing Institute
NAAMM	National Association of Architectural Metals Manufacturers
NACE	National Association of Corrosion Engineers
NBHA	National Builder's Hardware Association
NBS	National Bureau of Standards
NEBB	National Environmental Balancing Bureau
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
NPT	National Pipe Thread
NRCA	National Roofing Contractors Association
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PCI	Prestressed Concrete Institute
PS	Product Standard

SAE	Society of Automotive Engineers
SCPRF	Structural Clay Products Research Foundation
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SPI	Society of the Plastics Industry
SSPC	Steel Structures Painting Council
SSPWC	Standard Specifications for Public Works Construction
UBC	Uniform Building Code
UL	Underwriters' Laboratories
USBR	U.S. Bureau of Reclamation
WRI	Manual of Standard Practice for Welded Wire Fabric

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 014500
QUALITY CONTROL

PART 1 GENERAL

1.01 QUALITY ASSURANCE

- A. Quality: All materials and equipment shall be new and correctly designed and shall conform to the requirements of Sections entitled "Reference Standards" and "Product Requirements". They shall be standard first-grade quality produced by expert workmen and be intended for the use for which they are offered. Materials or equipment which, in the opinion of the Engineer, are inferior or of a lower grade than indicated, specified or required will not be acceptable.
- B. Source Limitations: To the greatest extent possible for each unit of Work, the Contractor shall provide products, materials, or equipment of a singular generic kind from a single source.
- C. Compatibility of Options: Where more than one choice is available as options for Contractor's selection of a product, material, or equipment, the Contractor shall select an option which is compatible with other products, materials, or equipment already selected. Compatibility is a basic general requirement of product/material selections.
- D. Uniform Finish: A uniform finish shall be used for all hardware, metallic nameplates and similar exposed metal parts used on any equipment or group of equipment and, as far as possible, the same finish shall be used for all such equipment items.

1.02 PRODUCT EVALUATION

- A. At the Owner's discretion, the Owner will employ and pay for the services of an independent testing laboratory for testing. Testing shall be as specified by the Engineer.
- B. The work or actions of the testing laboratory shall in no way relieve the Contractor of his obligations under the Contract. The laboratory testing work will include such inspections and testing required by the Contract Documents, existing laws, codes, ordinances, etc. The testing laboratory will have no authority to change the requirements of the Contract Documents, nor perform, accept or approve any of the Contractor's Work.
- C. The Contractor shall allow the Engineer ample time and opportunity for evaluation and testing of materials and equipment to be used in the Work. The Contractor shall advise the Engineer promptly upon placing orders for materials and equipment so that arrangements may be made, if desired, for evaluation before shipment from the place of manufacture. The Contractor shall at all times furnish the Engineer and his representatives, facilities including labor, and allow proper time for evaluation and testing materials, equipment, and workmanship. The Contractor must anticipate that possible delays may occur in the execution of its work due to the necessity of materials and equipment being inspected and accepted for use. The Contractor shall furnish, at his own expense, all samples of materials required by the Engineer for testing, and shall make his own arrangements for providing water, electric power, or fuel for the various evaluation and tests of structures and equipment.
- D. The Contractor shall furnish the services of representatives of the manufacturers of certain equipment, as specified in other sections of these Contract Documents, as required. The Contractor shall also place its orders for such equipment on the basis that, after the equipment has been tested prior to final acceptance of the work, the manufacturer will furnish the Engineer with certified statements that the equipment has been installed properly and is ready to be placed in functional operation. Tests and analyses required for equipment shall be paid for by the Contractor, unless specified otherwise in the section which covers a particular piece of equipment.
- E. The Owner will bear the cost of all tests, evaluation, or investigations undertaken by the order of the

Engineer for the purpose of determining conformance with the Contract Documents if such tests, evaluation, or investigations are not specifically required by the Contract Documents, and if conformance is ascertained thereby. Whenever nonconformance is determined by the Engineer as a result of such tests, evaluation, or investigations, the Contractor shall bear the full cost of any additional tests, evaluations and investigations, which are ordered by the Engineer to ascertain subsequent conformance with the Contract Documents.

1.03 EVALUATION AT PLACE OF MANUFACTURE

- A. Unless otherwise specified, all products, materials, and time and equipment shall be subject to evaluation by the Engineer at the place of manufacture.
- B. The presence of the Engineer at the place of manufacture however, shall not relieve the Contractor of the responsibility for furnishing products, materials, and equipment that comply with all requirements of the Contract Documents. Compliance is a duty of the Contractor, and said duty shall not be avoided by any act or omission on the part of the Engineer.

1.04 SAMPLING AND TESTING

- A. Unless otherwise specified, all sampling and testing shall be in accordance with the methods prescribed in the current standards of the ASTM, as applicable to the class and nature of the article or materials considered; however, the Engineer reserves the right to use any generally-accepted system of sampling and testing which, in the opinion of the Engineer will insure the Owner that the quality of the workmanship is in full accord with the Contract Documents.
- B. Any waiver by the Owner of any specific testing or other quality assurance measures, whether or not such waiver is accompanied by a guarantee of substantial performance as a relief from the specified testing or other quality assurance requirements as originally specified, and whether or not such guarantee is accompanied by a performance bond to assure execution of any necessary corrective or remedial Work, shall not be construed as a waiver of any requirements of the Contract Documents.
- C. Notwithstanding the existence of such waiver, the Engineer reserves the right to make independent investigations and tests and failure of any portion of the Work to meet any of the requirements of the Contract Documents, shall be reasonable cause for the Engineer to require the removal or correction and reconstruction of any such work in accordance with the General Conditions.
- D. In addition to any other evaluation, observation or quality assurance provisions that may be specified, the Engineer shall have the right to independently select, test, and analyze, at the expense of the Owner, additional test specimens or any or all of the materials to be used. Results of such tests and analyses shall be considered along with the tests or analyses made by the Contractor to determine compliance with the applicable specifications for the materials so tested or analyzed; provided, that testing or investigation by the Engineer, which fails to meet the requirements of the Contract Documents, all costs of such independent inspection and investigation, and all costs of removal, correction, and reconstruction or repair of any such Work shall be borne by the Contractor.

1.05 TESTING SERVICES FURNISHED BY CONTRACTOR

- A. Unless otherwise specified, Contractor shall provide all testing services in connection with the following:
 - 1. Concrete.
 - 2. Asphaltic concrete materials and mix designs.
 - 3. Moisture-density and relative density tests on fill and backfill materials.
 - 4. In-place field density tests on fills and backfill.
 - 5. Fill and backfill materials.
 - 6. All other tests and engineering data required for Engineer's review of materials and equipment

proposed to be used in the Work.

- B. Contractor shall obtain Engineer's acceptance of the testing firm before having services performed, and shall pay all costs for these testing services.

1.06 TESTING SERVICES FURNISHED BY OWNER.

- A. Unless otherwise specified, Owner shall provide for tests made on the following materials and equipment:
 - 1. Other material and equipment at the discretion of Owner.
- B. Testing, including sampling, will be performed by Engineer or the testing firm's laboratory personnel, in the general manner indicated in the Specifications. Engineer shall determine the exact time, location, and number of tests, including samples.
- C. Arrangements for delivery of samples and test specimens to the testing firm's laboratory will be made by the Contractor. The testing firm's laboratory shall perform all laboratory tests within a reasonable time consistent with the specified standards and shall furnish a written report of each test.
- D. Contractor shall furnish all sample materials and cooperate in the testing activities, including sampling. Contractor shall interrupt the Work when necessary to allow testing, including sampling, to be performed. Contractor shall have no claim for an increase in Contract Price or Contract times due to such interruption. When testing activities, including sampling, are performed in the field by Engineer or the testing firm's laboratory personnel, Contractor shall furnish personnel and facilities to assist in the activities.

1.07 SITE INVESTIGATION AND CONTROL

- A. The Contractor shall verify all dimensions in the field and shall check field conditions continuously during construction. The Contractor shall be solely responsible for any inaccuracies built into the Work due to its failure to comply with this requirement.
- B. The Contractor shall inspect related and appurtenant Work and shall report in writing to the Engineer any conditions that will prevent proper completion of the Work. Failure to report any such conditions shall constitute acceptance of all site conditions, and any required removal, repair, or replacement caused by unsuitable conditions shall be performed by the Contractor at its sole cost and expense.

1.08 DIMENSIONS OF EXISTING STRUCTURES

- A. Where the dimensions and locations of existing structures are of critical importance in the installation or connection of new work, the Contractor shall verify such dimensions and locations in the field before the fabrication of any materials or equipment which is dependent on the correctness of such information.

1.09 FIELD SURVEYING AND ENGINEERING

- A. The Contractor shall employ a Land Surveyor registered in the State of Colorado and acceptable to the Owner. The Contractor shall locate and protect survey control and reference points.
- B. Contractor shall provide field engineering services to establish elevations, lines, and levels, utilizing recognized engineering survey practices based upon the construction staking.
- C. Submit a copy of registered site drawing and certificate signed by the Land Surveyor that the elevations and locations of the Work are in conformance with the Contract Documents.

1.10 RIGHT OF REJECTION

- A. The Engineer, acting for the Owner, shall have the right, at all times and places, to reject any articles or

materials to be furnished hereunder which, in any respect, fail to meet the requirements of the Contract Documents, regardless of whether the defects in such articles or materials are detected at the point of manufacture or after completion of the Work at the site. If the Engineer, through an oversight or otherwise, has accepted materials or Work which is defective or which is contrary to the Contract Documents, such materials, no matter in what stage or condition of manufacture, delivery, or erection, may be subsequently rejected by the Engineer for the Owner.

- B. The Contractor shall promptly remove rejected articles or materials from the site of the Work after notification of rejection. All costs of removal and replacement of rejected articles or materials as specified herein shall be borne by the Contractor.

1.11 PROTECTION

- A. Weather Conditions: Work that may be affected by inclement weather shall be suspended until proper conditions prevail. In the event of impending storms, the Contractor shall take necessary precautions to protect all work, materials and equipment from exposure.
- B. Fire Protection: The Contractor shall take all necessary precautions to prevent fires at or adjacent to the Work, including its own buildings and trailers. Adequate fire extinguisher and hose line stations shall be provided throughout the work area.

1.12 CUTTING AND PATCHING

- A. The Contractor shall perform all cutting and patching of the Work that may be required to make its several parts come together properly and fit it to receive or be received by such other work. The Contractor shall not endanger any work of others by cutting, excavating or otherwise altering their work and shall only cut or alter work with the written consent of the Owner and of the other Contractors whose work will be affected.

1.13 SLEEVES AND OPENINGS

- A. The Contractor shall provide all openings, chases, etc., to fit its own work and that of any other subcontractors and Contractors. All such openings or chases shown on the Contract Drawings, or reasonably implied thereby, or as confirmed or modified by acceptable shop, setting or erecting drawings, shall be provided by the Contractor.
- B. Where pipes or conduits are to pass through slabs or walls, or where equipment frames or supports are to be installed as integral part of an opening, the sleeves, openings, forms or frames shall be furnished by the installer of the pipes, conduits or equipment, but shall be placed by the Contractor. Where hanger inserts, anchor bolts and similar items are to be embedded in concrete as an integral part of a slab or wall they shall be furnished by the installer of the pipe or other equipment requiring the hanger, etc, but shall be placed by the Contractor.
- C. Any cost resulting from correction of defective, ill-timed, or mislocated work or for subsequent work which becomes necessary because of omitted openings, chases, sleeves, frames, inserts, etc., shall be borne by the Contractor or subcontractor responsible therefor. The Contractor shall not arbitrarily cut, drill, alter, damage, or otherwise endanger the work of another Contractor. In no case shall beams, lintels, or other structural members be cut without the proper authorization of the Engineer. The nature and extent of any corrective or additional work shall be subject to the acceptance of the Engineer following consultation with the affected parties.

1.14 ABANDONMENT AND SALVAGE OF EXISTING FACILITIES

- A. General: The scope of work requires the Contractor to interface with existing structures, mechanical equipment, electrical facilities and piping which will be abandoned or otherwise removed and/or relocated as part of the work. Prior to beginning any work associated with existing facilities to be abandoned,

salvaged, or otherwise removed or relocated, the Contractor shall inform the Owner and the Engineer of his intent so that all arrangements can be made with the Owner for disconnecting electrical service (where appropriate), isolating pipelines (where possible) or otherwise removing existing facilities from service to the extent possible. The Contractor shall not proceed without written authorization from the Owner.

- B. Pipelines: The Contractor shall abandon, salvage or otherwise remove existing pipelines or segments of existing pipelines shown to be abandoned in place, salvaged, or removed as part of the contract work. Unless otherwise indicated in the Contract Documents, all piping shown on the Drawings to be abandoned shall be abandoned in place. Pipe shown to be abandoned need only be removed a minimum three feet clear of new utilities to be installed. Abandon-in-place shall be defined as installing plugs, or other permanent closure, as reviewed and accepted by the Owner, on all terminations, open ends or ends of pipe designated as being cut, capped, and anchored in an acceptable manner. The pipe will remain buried unless otherwise noted.
- C. Piping indicated on the Drawings as being removed, or any piping to be abandoned which interferes with new structures or piping, shall be excavated and removed using methods which will not disturb adjacent piping or other facilities. All pipe materials shall be subject to salvage by the Owner as defined below. Any remaining piping on both ends of pipe segments removed shall be abandoned in-place, per the above definition. After piping has been removed, the Contractor shall backfill the evacuated area in accordance with requirements set forth in other sections of these specifications.
- D. Equipment: The Contractor shall abandon, salvage or otherwise remove existing equipment or other facilities as shown on the Contract Drawings or indicated herein. In all cases, the Contractor shall exercise caution when handling the existing equipment so as not to disturb or damage adjacent facilities. The Contractor shall make all repairs to adjacent facilities which may be damaged as a result of the Contractor's efforts in abandoning, salvaging or otherwise removing existing facilities, at no additional cost to the Owner.
- E. Salvage: The Owner may desire to salvage certain items of existing equipment which are to be dismantled and removed during the course of construction. Prior to removal of any existing equipment or piping from the site of work, the Contractor shall ascertain from the Owner whether or not the particular item or items are to be salvaged. Items to be salvaged shall be stockpiled on the site, in a location as designated by the Owner. All other items of equipment shall be disposed of off-site by the Contractor at his own expense in accordance with applicable laws, ordinances and regulations.

1.15 REHABILITATION

- A. Certain areas of existing structures, piping, conduits, and the like will be affected by work necessary to complete modifications under this Contract. The Contractor shall be responsible to rehabilitate those areas affected by its construction activities.
- B. Where new rectangular openings are to be installed in concrete or concrete masonry walls or floors, the Contractor shall score the edges of each opening (both sides of wall or elevated slab) by saw cutting clean, straight lines to a minimum depth of one inch and then chipping out the concrete. Alternately, the opening can be formed by saw cutting completely through the slab or wall. Saw cuts deeper than one inch (or the depth of cover over existing reinforcing steel, whichever is less) shall not be allowed to extend beyond the limits of the opening. Corners shall be made square and true by a combination of core drilling, chipping, or grinding. All necessary precautions shall be taken during removal of concrete to prevent debris from falling and damaging adjacent equipment or piping. Saw cuts allowed to extend beyond the opening shall be repaired by filling with nonshrink grout. The concrete around any exposed reinforcement steel shall be chipped back and exposed reinforcement steel cut a minimum of 1½ inches from the finished face of the new opening. The inside face of the new opening shall be grouted to fill any voids and cover the exposed aggregate and shall be trowel-finished to provide a plumb and square opening.
- C. Where new conduit or piping is to be installed through existing concrete walls, the Contractor shall accurately position and core-drill openings. Openings shall be adequately sized to allow alignment of piping or conduit and fittings without deflection and to provide adequate clearance for satisfactory packing in the annular space between the piping or conduit and the core drilling opening as shown on the

Drawings.

- D. Where new piping is to be connected to existing piping, the existing piping shall be cut square and the ends properly prepared for the connection shown on the drawings. Any damage to the lining and coating of the existing piping shall be repaired by the Contractor.
- E. Where existing equipment, equipment pads and bases, piping, piping supports, electrical panels and devices, conduits, and associated appurtenances are removed, the Contractor shall rehabilitate the affected area such that little or no evidence of the previous installation remains. Openings in concrete floors, walls, and ceiling from piping, conduit, and fastener penetrations shall be filled with nonshrink grout and finished to match the adjacent area. Concrete pads and bases for equipment and supports shall be removed by chipping away concrete and cutting any exposed reinforced steel and anchor bolts a minimum of 1-½ inches below finished grade. The area of concrete to be rehabilitated shall be scored by saw cutting clean, straight lines to a minimum depth of 1-½ inches, and all concrete within the scored lines removed to a minimum depth of 1-½ inches. The area within the scored lines shall be patched with nonshrink grout to match the adjacent grade and finish. Abandoned connections to piping and conduits shall be terminated with blind flanges, caps, and plugs suited for the material, type, and service of the pipe or conduit. Walls shall be painted in accordance with requirements set forth in Section entitled "Painting".
- F. Where existing structural steel members are removed or modified, the surface of the remaining existing steel members damaged by construction activities shall be repaired. The affected areas shall be surface prepared and coated in accordance with Section entitled "Painting."
- G. Architecturally finished surfaces of walls, floors, ceilings, or other areas which are exposed by any of the removals specified herein and which have bolt holes, scars, chipped or other damaged surfaces revealed by the removal, shall be repaired by the Contractor with the same or matching materials as the existing surface or as approved by the Engineer.
- H. Disposal of Debris: All debris, materials, piping, and miscellaneous waste products from the work described in this section shall be removed from the project as soon as possible. They shall be disposed of in accordance with applicable federal, state, and local regulations. The Contractor is responsible for determining these regulations and shall bear all costs or retain any profit associated with disposal of these items.

1.16 INSTALLATION OF EQUIPMENT

- A. Contractor shall have on hand sufficient personnel, proper equipment, and machinery of ample capacity to facilitate the work.
- B. Contractor shall be responsible for locating, aligning and leveling all equipment and shall employ a licensed surveyor to set all lines and levels of equipment to the accuracy required.
- C. Complete manufacturer's installation instructions, including permissible tolerances, shall be furnished in duplicate with each unit of equipment or set of identical units.
- D. All equipment shall be installed in accordance with the shop drawings; inclusive of manufacturer's specifications, drawings and tolerances; under the direct supervision of the required manufacturer's engineer. In no instance shall the directions of the manufacturer's engineer contravene the Engineer's direction.
- E. Equipment shall be erected in a neat and workmanlike manner on the foundations at the locations and elevations shown on the drawings unless otherwise indicated by the Engineer during installation.
- F. Erection equipment shall meet the approval of the Engineer. Motor operated handling equipment shall be maintained in a condition such that no oil or grease will be dropped on the finished floors. Materials to be dragged within the building shall be skidded in such a manner, and by such methods, that will not gouge or mar finished floors. Erection equipment shall not be allowed on or operated over any concrete

floor slabs until approval is given by the Engineer. The Contractor shall be responsible for the correction and repair of any damage to the buildings caused by his operations.

- G. If the Contractor uses the floor in any structure to support equipment, he shall protect, brace, and shore up the floor so as to avoid damage to the floor itself or to the floor supporting beams, columns, or structure. Any and all damage to the floor itself or to the floor supporting beams, columns or structure shall be repaired as directed by the Engineer, and the Contractor shall pay for all costs of the repairs.

1.17. SUPERVISION BY MANUFACTURER'S REPRESENTATIVES

- A. The Contractor shall provide the services of qualified equipment manufacturer's technical representatives who shall adequately supervise the installation and testing of all equipment furnished under this Contract and instruct the Contractor's personnel and Owner's operating personnel in its maintenance and operation. The manufacturers' representatives shall devote, as a minimum, the full time specified under the detailed Specifications. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor. The manufacturer's representatives shall sign in and out in a book kept by the Resident Project Representative on every occasion they are on the project site and shall indicate time of arrival and departure.

1.18. EQUIPMENT MANUFACTURERS CERTIFICATION

- A. As a condition precedent to acceptance of equipment installed and operating, the Contractor will provide the Owner with written certification, obtained from each company manufacturing equipment for the Project, that the equipment is installed and does operate in accordance with the specifications and manufacturer's recommendations.

1.19. OBSERVATION OF THE WORK

- A. The Work shall be conducted under the general observation of the Engineer and shall be subject to observation by representatives of the Engineer acting on behalf of the Owner to ensure strict compliance with the requirements of the Contract Documents. Such observation may include mill, plant, shop or field observation, as required. The Engineer shall be permitted access to all parts of the Work, including plants where materials or equipment are manufactured or fabricated.
- B. The presence of the Engineer or any observer, however, shall not relieve the Contractor of the responsibility for the proper execution of the Work in accordance with all requirements of the Contract Documents. Compliance is a duty of the Contractor, and said duty shall not be avoided by any act or omission on the part of the Engineer or any observer.
- C. All materials and articles furnished by the Contractor shall be subject to rigid inspection, and no materials or articles shall be used in the Work until they have been inspected and accepted by the Engineer or its representative. No Work shall be backfilled, buried, cast in concrete, hidden or otherwise covered until it has been inspected by the Engineer or its authorized representative. Any Work so covered in the absence of inspection shall be subject to uncovering. Where uninspected Work cannot be uncovered, such as in concrete cast over reinforcing steel, all such Work shall be subject to demolition, removal, and reconstruction under proper inspection, and no additional payment will be allowed therefore.

1.20. TIME OF OBSERVATION AND TESTS

- A. Samples and test specimens required under these Specifications shall be furnished and prepared for testing in ample time for the completion of the necessary tests and analyses before said articles or materials are to be used. The Contractor shall furnish and prepare all required test specimens within the scope of the Contract. The costs of all retests due to any test which shows unsatisfactory results shall be borne by the Contractor. Whenever the Contractor is ready to backfill, bury, cast in concrete, hide, or otherwise cover any Work under the Contract, the Engineer shall be notified not less than twenty four hours in advance to request inspection before beginning any such Work of covering. Failure of the

Contractor to notify the Engineer at least twenty-four hours in advance of any such inspections shall be reasonable cause for the Engineer to order a sufficient delay in the Contractor's schedule to allow time for such inspections and any remedial or corrective Work required, and all costs of such delays, including its effect upon other portions of the Work, shall be borne by the Contractor.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 015100
TEMPORARY UTILITIES

PART 1 GENERAL

1.01 WORK INCLUDED

- A. It shall be the Contractor's responsibility to provide equipment that is adequate for the performance of the Work under this Contract within the time specified. All equipment shall be kept in satisfactory operating condition, shall be capable of safely and efficiently performing the required Work, and shall be subject to inspection and review by the Owner's representative at any time within the duration of the Contract.
- B. The Contractor shall provide for utilities and services for its own operations. The Contractor shall furnish, install, maintain and provide all necessary supplies for all temporary utilities during the contract period including removal upon completion of the Work.

1.02 REQUIREMENTS OF REGULATORY AGENCIES

- A. All Work hereunder shall conform to the applicable requirements of the OSHA Standards for Construction, all Federal, State and local codes, permit conditions, regulations, and utility requirements.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Materials may be new or used, but must be adequate in capacity for the required usage, must not create unsafe conditions, and must not violate requirements of applicable codes and standards.

2.02 POWER AND LIGHTING

- A. Power: The Contractor shall provide all necessary power required for its operations under the Contract, and shall provide and maintain all temporary power lines required to perform the Work in a safe and satisfactory manner.
- B. Construction Lighting: All Work conducted at night or under conditions of deficient daylight shall be suitably lighted to insure proper Work and to afford adequate facilities for inspection and safe working conditions. Temporary lighting shall be maintained during nonworking periods if the area is subject to access by the public.
- C. Electrical Connections: All temporary connections for electricity shall be subject to review by the Owner and the power company representative, and shall be removed in like manner at the Contractor's expense prior to final acceptance of the Work.
- D. Separation of Circuits: Circuits separate from lighting circuits shall be used for all power purposes, unless otherwise permitted by the Owner.
- E. Construction Wiring: All wiring for temporary electric light and power shall be properly installed and maintained and shall be securely fastened in place. All electrical facilities shall conform to the requirements of Subpart K of the OSHA Safety and Health Standards for Construction.

2.03 WATER SUPPLY

- A. General: The Contractor shall supply, and pay for all costs for all water used for construction, flushing, disinfection, and testing. The Contractor shall provide and maintain all meters, piping, fittings, adapters,

and valving required.

- B. Water used for testing, disinfection and flushing will be provided by the Owner. If metering of water used is not practical, the quantity of water used for flushing will be estimated at 5 times the volume of the pipeline. Contractor shall exercise measures to conserve water.
- C. Potable Water: All drinking water on the site during construction shall be furnished by the Contractor and shall be bottled water or water furnished in suitable dispensers. Notices shall be posted conspicuously throughout the site warning the Contractor's personnel that piped water may be contaminated.
- D. Water Connections: The Contractor shall not make connection to, or draw water from, any fire hydrant or pipeline without first obtaining permission of the authority having jurisdiction over the use of said fire hydrant or pipeline and from the agency owning the affected water system. For each such connection made, the Contractor shall first attach to the fire hydrant or pipeline a valve and a meter, if required by the said authority, of a size and type acceptable to said authority and agency.
- E. Removal of Water Connections: Before final acceptance of the Work on the project, all temporary connections and piping installed by the Contractor shall be entirely removed, and all affected improvements shall be restored to their original condition, or better, to the satisfaction of the Owner and to the agency owning the affected utility.
- F. Fire Protection: The construction, and all other parts of the Work shall be adequately protected against damage by fire. Hose connections and hose, water casks, chemical equipment, or other sufficient means shall be provided for fighting fires in the temporary structures and other portions of the Work, and responsible persons shall be designated and instructed in the operation of such fire apparatus so as to prevent or minimize the hazard of fire. The Contractor's fire protection program shall conform to the requirements of Subpart F of the OSHA Standards for Construction.
- G. Coordinate the use of water for any construction-related purpose with the water utility and Engineer. Provide 24-hour notice prior to withdrawing water from any source.

2.04 SANITATION

- A. Toilet Facilities: Fixed or portable chemical toilets shall be provided wherever needed for the use of employees. Toilets at construction job sites shall conform to the requirements of Part 1926 of the OSHA Standards for Construction.
- B. Such facilities shall be made available when the first employees arrive on the Work, shall be properly secluded from public observation, and shall be constructed and maintained in suitable numbers and at such points and in such manner as may be required.
- C. The Contractor shall maintain the sanitary facilities in a satisfactory and sanitary condition at all times and shall enforce their use. He shall rigorously prohibit the committing of nuisances on the site of the Work, on the lands of the Owner, or an adjacent property.
- D. The Owner shall have the right to inspect any building or other facility erected, maintained, or used by the Contractor, to determine whether or not the sanitary regulations have been complied with.
- E. Sanitary and Other Organic Wastes: The Contractor shall establish a regular daily collection of all sanitary and organic wastes. All wastes and refuse from sanitary facilities provided by the Contractor or organic material wastes from any other source related to the Contractor's operations shall be disposed of away from the site in a manner satisfactory to the Owner and in accordance with all laws and regulations pertaining thereto.

2.05 TEMPORARY VENTILATION

- A. The Contractor shall provide and maintain adequate ventilation for a safe working environment. In addition, forced air ventilation shall be provided for the curing of installed materials, humidity control and the prevention of hazardous accumulations of dust, gases or vapors.

PART 3 EXECUTION

3.01 GENERAL

- A. On-going Clean-up. The Contractor and his Sub-contractors shall, during the course of the construction, keep all areas reasonably free of debris and miscellaneous materials. Clean-up shall be an on-going process and, as a minimum, all areas within the construction limits shall be policed daily.

3.02 REMOVAL

- A. Completely remove temporary materials and equipment when their use is no longer required.
- B. Clean and repair damage caused by temporary installations or use of temporary facilities.
- C. Restore existing facilities used for temporary services to specified, or to original, condition.

END OF SECTION

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SECTION 015210

FIELD OFFICE

PART 1 GENERAL

1.01 GENERAL

- A. The Contractor shall provide field office, equipment, and services specified herein, for his own use at the project site, during the entire time of construction beginning at the commencement date stated in the Notice to Proceed until the date of final acceptance of the Work by the Owner.
- B. The Contractor shall locate his field office in the location designated as the staging area. The field office shall remain the property of the Contractor and shall be removed from the site upon completion of the Work.

1.02 CONTRACTOR'S FIELD OFFICE REQUIREMENTS

- A. The trailer shall conform to HUD requirements with a minimum ceiling height of 7 feet, 6-inches.
- B. The Contractor shall provide steps and platforms with handrails to permit entry to the offices. This work shall conform to the Uniform Building Code and OSHA requirements.
- C. The trailer shall be blocked up and hurricane straps installed conforming to the applicable building codes.
- D. Necessary sanitary, water and telephone service connections shall be provided by the Contractor as specified elsewhere in this Document.
- E. Bottled drinking water shall be provided in suitable dispensers.
- F. Provide two 4 lb. minimum, portable ABC type fire extinguishers.

1.03 ENGINEER'S OFFICE

- A. The Engineer's field office, equipped as specified herein, shall be provided in the staging area, ready for use by the Engineer within 14 days after the commencement date stated in the Notice to Proceed. The Contractor's attention is directed to the condition that no payments for mobilization will be recommended for payment for any such work done under the Contract until all field office facilities specified herein, have been provided.
- B. The Contractor shall furnish a field office for the use of the Resident Engineer and Inspectors. The field office shall be less than 3 years old, in acceptable condition and consist of a nominal 40 foot by 14 foot single wide (or equivalent) trailer with two offices, conference room, record storage and work areas. The field office shall be located in the staging area shown on the Drawings.
- C. The structure shall be watertight with suitable windows and doors with substantial locks. All windows shall have venetian blinds and aluminum screens. Adequate ceiling lighting fixtures, 75 foot candles at desk height, shall be furnished and provided with wall switches.
- D. The trailer shall conform to HUD requirements. Minimum ceiling height shall be 7'6", the interior shall have vinyl tile floor covering on all floors, wall paneling, 100 amp electrical service, copper wiring, six cubic foot refrigerator, and two 4 lb. minimum, portable ABC type wall mounted fire extinguishers. Washroom shall be equipped with a flush toilet, cabinet mounted wash basin and medicine cabinet complete with supplies. Plumbing fixtures shall be acceptable house type, trapped and vented.
- E. Air conditioning shall be provided which is capable of lowering the temperature to 72 in hot weather. Heating shall be provided which is capable of raising the temperature to 78 in cold weather.

- F. The Contractor shall install the Engineers field office trailer and provide services as follows:
1. The Contractor shall provide steps and platforms with handrails to permit entry to the offices. This work shall conform to the Uniform Building Code and OSHA requirements.
 2. The trailer shall be blocked up at the location shown on the Drawings and hurricane straps installed conforming to the applicable building codes.
 3. Necessary sanitary, water and telephone service connections shall be provided to the trailer. Three telephone lines shall be provided. The trailer shall be provided with two telephones. The third telephone line shall be furnished with RJ-1 1 type jacks for connection of facsimile or other similar equipment.
 4. The Contractor shall provide and pay all costs for power, water, internet access and regular weekly (minimum) janitor service. Rooms shall be swept and dusted, and waste receptacles emptied daily. The Contractor shall furnish and replace electric bulbs and/or florescent tubes, toilet paper, towels and soap and maintain the office copiers, telecopiers and other equipment in first-class condition, including all repairs until final acceptance of the work under this Contract.
 5. The Contractor shall provide fire insurance, extended coverage and vandalism, malicious mischief and burglary and theft insurance coverage for the Engineer's field office trailer in the amount of \$50,000 and for field office equipment in the amount of \$25,000.
 6. Bottled drinking water shall be furnished with electronic water cooler to dispense hot and cold water and continuous supply of paper cups.
- G. The field office shall remain the property of the Contractor and shall be removed upon completion of the work.
- H. The Contractor shall furnish new or good, clean used office furniture in acceptable condition for the Engineer's field office. Model numbers listed below are to establish minimum product quality. Office furniture shall consist of the following:
1. Two: Double Pedestal Desks Hon Metro Classic series stock model 3262/WP with 60" x 30" top size, or equal.
 2. Two: Conventional Office Chairs Hon 2021 Executive Swivel, United Chair Co. SV11 or equal.
 3. One: Conference Room Table 8' x 4'.
 4. Eight: Office Chairs, Hon Model No. W52, or equal.
 5. Two: 4 drawer (52" high) filing cabinets. Hon model 514P with lock, Steelmaster, or equal.
 6. Three: Wastepaper baskets.
 7. Two: Bookcases - 41" high x 34" wide x 18" deep with three shelves and metal doors. Hon Model 542E, Tiffany or equal.
 8. One: Dry erase "white board" 4ft x 6 ft wall mount type, with aluminum frame, full length marker rail, two erasers and two boxes of four color dry erase markers.
 9. One: Aluminum framed cork faced bulletin board 36-inch x 60-inch wall mount type.
 10. One: Dry electrostatic process copy machine, capable of up to 11" by 17" reproductions on ordinary paper stock of variable weight and sizes at a rate of approximately 4 copies per minute, internet capable connection, complete with stand and necessary accessories.
 11. One: Table 30-inch x 60-inch Hon UTM3060, or equal.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 015510
SITE ACCESS AND STORAGE

PART 1 GENERAL

1.01 REGULATIONS

- A. Confine operations at site to areas permitted by:
 - 1. Law
 - 2. Ordinances
 - 3. Permits
 - 4. Contract Documents
 - 5. Areas authorized or approved by the Owner

1.02 HIGHWAY LIMITATIONS

- A. The Contractor shall make its own investigation of the condition of available public and private roads and of clearances, restrictions, bridge load limits, and other limitations affecting transportation and ingress and egress to the site of the Work. It shall be the Contractor's responsibility to construct and maintain any haul roads required for its construction operations.

1.03 TEMPORARY CROSSINGS

- A. General: Wherever necessary or required for the convenience of the public or individual residents at street or highway crossings, private driveways, or elsewhere, the Contractor shall provide suitable temporary bridges over unfilled excavations, except in such cases as the Contractor shall secure the written consent of the individuals or authorities concerned to omit such temporary bridges, which written consent shall be delivered to the Owner prior to excavation. All such bridges shall be maintained in service until access is provided across the backfilled excavation. Temporary bridges for street and highway crossing shall conform to the requirements of the authority having jurisdiction in each case, and the Contractor shall adopt designs furnished by said authority for such bridges, or shall submit designs to said authority for approval, as may be required.
- B. The Contractor shall maintain traffic and protect the public from all damage to persons and property within the contract limits, in accordance with all applicable state, local, and city regulations. The Contractor shall conduct its operations so as to maintain and protect access for vehicular and pedestrian traffic to and from all properties and business establishments adjoining or adjacent to those streets affected by its operations, and to subject the public to a minimum of delay and inconvenience. Suitable signs, barricades, railing, etc. shall be erected and the work outlined by adequate lighting at night. Danger lights shall be provided as required. Watchmen and flagmen shall be provided as may be necessary for the protection of traffic.
- C. Street Use: Nothing herein shall be construed to entitle the Contractor to the exclusive use of any public street, alleyway, or parking area during the performance of the Work hereunder, and it shall so conduct its operation as not to interfere unnecessarily with the authorized work of utility companies or other agencies in such streets, alleys, ways, or parking areas. No street shall be closed to the public without first obtaining permission of the Owner and proper government authority. Where excavation is being performed in primary streets or highways, one lane in each direction shall be kept open to traffic at all times unless otherwise provided or shown. Toe boards shall be provided to retain excavated material if required by the Owner or the agency having jurisdiction over the street or highway. Fire hydrants on or adjacent to the Work shall be kept accessible to fire-fighting equipment at all times. Temporary provisions shall be made by the Contractor to assure the use of sidewalks and the proper functioning of all gutters, sewer inlets, and other drainage facilities.

- D. **Traffic Control:** The Contractor shall provide, place, and maintain all necessary barricades, traffic cones, warning signs, lights, flaggers, and other safety devices in accordance with the requirements of the "Manual of Uniform Traffic Control Devices, Part VI - Traffic Controls for Street and Highway Construction and Maintenance Operations", published by U.S. Department of Transportation, Federal Highway Administration (ANSI D6.1). All barricades and obstructions shall be illuminated at night, and all lights shall be kept burning from sunset until sunrise. The Contractor shall provide guards or flaggers and shall conform to such special safety regulations relating to traffic control as may be required by the public authorities within their respective jurisdictions. All signs, signals, and barricades shall conform to the requirements of Subpart G, Part 1926, of the OSHA Safety and Health Standards for Construction.
- E. The Contractor shall submit three copies of a traffic control plan to the authority having jurisdiction for approval a minimum of two weeks prior to construction. The authority reserves the right to observe these traffic control plans in use and to make any changes as field conditions warrant. Any changes shall supersede these plans and be done solely at the Contractor's expense.
- F. The Contractor shall remove traffic control devices when no longer needed, repair all damage caused by installation of the devices, and shall remove post settings and backfill the resulting holes to match grade.
- G. **Street Closure:** If closure of any street is required during construction, a formal temporary application for a street closure shall be made to the authority having jurisdiction at least 7 days prior to the required street closure in order to determine necessary sign and detour requirements.
- H. **Temporary Driveway Closure:** The Contractor shall notify the owner or occupant (if not owner-occupied) of the closure of the driveways to be closed more than one eight-hour work day, at least three working days prior to the closure. The Contractor shall minimize the inconvenience and minimize the time period that the driveways will be closed. The Contractor shall fully explain to the owner/occupant how long the work will take and when closure is to start.
- I. All dirt, debris and construction materials deposited on existing streets and right of ways shall be immediately removed by the Contractor.

1.04 CONTRACTOR'S SITE ACCESS

- A. Unless otherwise required by the Contractor, site access shall be from applicable public roads. Additional access deemed necessary by the Contractor shall be investigated and procured. Written consent of the Owner or governmental agency shall be submitted. Access to the School District easement shall only have one access in and out.

1.05 CONTRACTOR'S WORK AND STORAGE AREA

- A. The staging area for this project shall be as shown on the Drawings. Storage areas shall be provided within the designated staging area. The staging area is general and does not indicate limits of construction. Responsibility for protection and safekeeping of equipment and materials at or near the sites will be solely that of the Contractor and no claim shall be made against the Owner by reasons of any act of an employee or trespasser. Should an occasion arise necessitating access to an area occupied by stored equipment and/or materials, the Contractor shall immediately move them. No equipment or materials shall be placed upon the Owner's property until it is acceptable to the Owner.
- B. If the Contractor requires additional staging area other than shown on the Drawings, the Contractor shall obtain such areas from off site sources. The Contractor shall pay for any off site area required.
- C. Upon completion of the Contract, the Contractor shall remove from the storage areas all of their equipment, temporary fencing, surplus materials, rubbish, and restore the areas as designated on the Drawings.

1.06 SECURITY

- A. The Contractor shall employ watchmen and security guards to protect the job site against vandalism, burglary, theft, trespassing at the Contractors discretion. The Contractor shall care for and protect against loss or damage of all material to be incorporated in the construction for the duration of the project and shall repair or replace damaged or lost materials and damage to structures. The Contractor shall be responsible for providing, maintaining and securing gates used for construction purposes for the duration of the project.
- B. Provide barriers to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from damage due to construction operations.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 015719
TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 GENERAL

1.01 DUST ABATEMENT

- A. The Contractor shall furnish all labor, equipment, and means required and shall carry out effective measures wherever and as often as necessary to prevent its operation from producing dust in amounts damaging to property, cultivated vegetation, or domestic animals, or causing a nuisance to persons living in or occupying buildings in the vicinity. The Contractor shall be responsible for any damage resulting from any dust originating from its operations. The dust abatement measures shall be continued until the Contractor is relieved of further responsibility by the Engineer. No separate payment will be allowed for dust abatement measures and all costs thereof shall be included in the Schedule of Prices.

1.02 RUBBISH CONTROL

- A. During the progress of the Work, the Contractor shall keep the site of the Work and other areas used by it in a neat and clean condition, and free from any accumulation of rubbish. The Contractor shall dispose of all rubbish and waste materials of any nature occurring at the Work site, and shall establish regular intervals of collection and disposal of such materials and waste. The Contractor shall also keep its haul roads free from dirt, rubbish, and unnecessary obstructions resulting from its operations. Disposal of all rubbish and surplus materials shall be off the site of construction in accordance with local codes and ordinances governing locations and methods of disposal, and in conformance with all applicable safety laws, and to the particular requirements of Part 1926 of the OSHA Safety and Health Standards for Construction.

1.03 CHEMICALS

- A. All chemicals used during project construction or furnished for project operation, whether defoliant, soil sterilant, herbicide, pesticide, disinfectant, polymer, paint, fuel, solvent or reactant of other classification, shall show approval of either the U.S. Environmental Protection Agency or the U.S. Department of Agriculture. The handling, storage, use and disposal of all such chemicals and disposal of residues shall be in strict accordance with all applicable rules and regulations of Federal, State and local jurisdictional agencies, the printed instructions of the manufacturer and all regulatory requirements. Copies of antidote literature shall be kept at the storage site and at the Contractor's job site office. A supply of antidotes shall be kept at the Contractor's office.

1.04 NOISE CONTROL

- A. Noise resulting from the Contractor's work shall not exceed the noise levels and other requirements stated in local ordinances. The Contractor shall be responsible for curtailing noise resulting from his operation. He shall, upon written notification from the Engineer or the noise control officers, make any repairs, replacements, adjustments, additions and furnish mufflers when necessary to fulfill requirements.

1.05 EROSION ABATEMENT AND WATER POLLUTION

- A. It is imperative that any Contractor dewatering operation not contaminate or disturb the environment of the properties adjacent to the work. The Contractor shall be responsible for obtaining a stormwater discharge permit and provide an erosion abatement plan in accordance with CDPHE and the City of Pagosa Springs. The Contractor be responsible for complying with all requirements of stormwater discharge permit and provide an erosion abatement plan in accordance with EPA/CDPHE requirements. The Contractor shall schedule and control his operations to confine all runoff water from disturbed surfaces, water from dewatering operations that becomes contaminated with lime silt, muck and other deleterious matter, fuels, oils, bitumens, calcium chloride, chemicals and other polluting materials.

- B. Contractor shall prevent erosion of soil on the site and adjacent property resulting from his construction activities. Effective measures shall be initiated prior to the commencement of clearing, grading, excavation, or other operation that will disturb the natural protection.
- C. Work shall be scheduled to expose areas subject to erosion for the shortest possible time, and natural vegetation preserved to the greatest extent practicable. Temporary storage and construction buildings shall be located, and construction traffic routed, to minimize erosion. Temporary fast-growing vegetation or other suitable ground cover shall be provided as necessary to control runoff.
- D. The Contractor shall construct temporary silting basin(s) of adequate size and provide all necessary temporary materials, operations and controls including, but not limited to, filters, coagulants, screens, and other means necessary to attain the required discharge water quality.
- E. The Contractor shall be responsible for providing, operating and maintaining materials and equipment used for conveying the clear water to the point of discharge. All pollution prevention procedures, materials, equipment and related items shall be operated and maintained as required until project completion. Upon the removal of the materials, equipment and related items, the Contractor shall restore the area to the condition prior to its commencing work.

1.06 NPDES STORMWATER PERMIT

- A. This project is subject to Section 402 of the Clean Water Act which established the National Pollutant Discharge Elimination System (NPDES) to regulate the discharge of pollutants from point sources and requires issuance of an NPDES General Permit No. 2, or an individual NPDES Permit for Stormwater Discharge Associated with Industrial activity for Construction Activities. The Colorado Department of Public Health and Environment (CDPHE) has been given the authority to issue a General NPDES Permit for this project.
- B. The Contractor shall obtain this permit by submitting a Notice of Intent (NOI) and all other documentation and information to CDPHE as necessary.
- C. The Contractor shall be the responsible party for applying for implementing and complying with a NPDES Stormwater discharge permit for the construction activities with this project. The Contractor shall be the permittee and solely responsible for compliance and costs associated therewith, including those specifically referenced herein. The Contractor shall be responsible for preparation of a Storm Water Pollution Prevention Plan and shall be responsible to retain or engage persons knowledgeable in the preparation of said plan. The Storm Water Pollution Prevention Plan shall be prepared in a manner that complies with all applicable requirements.
- D. The Contractor shall be the responsible party for publishing Notice of Intent as required for the NPDES Storm Water permit as well as for paying for fees associated with said Notice.
- E. The Contractor shall pay all fees and costs associated with preparation of and implementation of the Storm Water Pollution Prevention Plan. Payment of all fines and penalties associated with the permit and any permit violations shall be the responsibility of the Contractor.
- F. Prior to Notice to Proceed by the Owner, the Contractor shall furnish to Owner a copy of the Notice of Intent, as well as the CDPHE NPDES Storm Water Permit number issued by the CDPHE.
- G. All subcontractors must sign the NPDES certification statement before conducting any work at the site. The certifications must be signed in accordance with the signatory requirements found in the permit and must be incorporated in the Storm Water Pollution Prevention Plan.
- H. In the event that the CDPHE considers the Owner to be a co-permittee, the Contractor agrees to indemnify and hold harmless the Owner for all issues and activities relating to the Storm Water Pollution Prevention Plan and permit including, but not limited to, fines and penalties.
- I. References to silt fences and other erosion control devices or measures, if any, in the specifications or

on the plans are intended to illustrate typical erosion control measures to be implemented by the Contractor. References in the plans or specifications shall not be considered a part of the Storm Water Pollution Prevention Plan. The omission that erosion control measures or devices are not indicated on the plans or in the specifications does not waive the Contractor's responsibilities associated with the NPDES Storm Water permit nor the Storm Water Pollution Prevention Plan.

- J. The Contractor shall be responsible for maintenance and inspection, and all associated costs thereof, of all erosion control facilities or other activities or devices identified under the Storm Water Pollution Prevention Plan.
- K. The Contractor shall be responsible for making any revisions to the SWPPP document and for updating same to comply with CDPHE requirements as well as to reflect changes or revisions in Contractor's work.
- L. Include all costs associated with applying for and obtaining the necessary NPDES permit(s) as well as for preparation, implementation and monitoring of the Storm Water Pollution Prevention Plan and all necessary pollution control measures to be constructed and maintained by the Contractor, including indemnification of the Owner, in the lump sum price for erosion control.
- M. Contractor shall file an NOD (Notice of Discontinuation) with CDPHE upon completion and acceptance of the project by the Owner. The Contractor shall provide a copy of the NOD to the Owner as part of project close-out and prerequisite to receiving final payment.

1.07 WETLAND BEST MANAGEMENT PRACTICES

- A. The Contractor shall be responsible for all aspects of the following BMPs which shall be followed for all construction within wetlands delineated on the Drawings:
 - 1. The proposed construction activities within the ordinary high water mark of the intermittent drainages will be reclaimed to original surface topography immediately following construction activities. In addition, all areas of disturbance within floodplain areas will be reclaimed as soon as possible following construction activities.
 - 2. A professional biologist must be onsite during the construction within waters of the US.
 - 3. Wetland areas will be clearly marked with blue lathe prior to the start of construction.
 - 4. Timber mats or equipment pads will be utilized in wetlands to prevent rutting and damage to root systems by equipment or vehicles when rutting is greater than 4 inches.
 - 5. Should groundwater be encountered during excavation for pipeline, dewatering discharges will be discharged to an upland site with no return flows to the wetland and covered within the Stormwater Management Plan.
 - 6. All heavy equipment and vehicles entering wetland areas will be thoroughly washed at upland sites to minimize the potential for fuel and oil residues or weeds from reaching receiving waters.
 - 7. All equipment/vehicle refueling activities will be conducted on upland areas >150 feet from wetland areas.
 - 8. All potential spill material (i.e. fuel and concrete) will be stored on upland areas >150 feet from the wetland areas.
 - 9. The top foot of sod/soil above the pipeline trench will be stockpiled separately on top of the trench in the temporary disturbance area to function as a native seed base.
 - 10. Disturbance to wetland areas will be kept to the minimum needed for construction and installation.
 - 11. Construction areas will be reclaimed as soon as practical.
 - 12. All seed, mulching material, and straw used in the project shall be state-certified weed-free.
 - 13. Structural BMPs (i.e. erosion control logs) will be maintained until successful reclamation of disturbed areas has been completed.
 - 14. Trench plugs will be placed within trench at entry and exit to wetland areas.

1.08 MITIGATION OF ADVERSE IMPACTS

- A. The Contractor shall be responsible for all aspects of the following mitigation measures which shall be implemented for the proposed project.
 - 1. A project specific Stormwater Management Plan will be prepared for the project and will be used when completing construction activities. A General Permit Application will be filed with the CDPHE WQCD – Storm Water Program at least 10 days prior to initiation of construction. The SWMP includes Best Management Practices (BMPs) that will protect surface and ground water quality prior to, during, and following construction activities.
 - 2. Any construction activities occurring during the breeding bird season (April 1 – August 15) would have clearance surveys completed prior to construction activities in the spring of each breeding season. Brush clearing activities will be completed outside of the breeding season.
 - 3. Surveys for bald eagle active winter night roosts and nesting activity will be completed prior to construction.
 - 4. Major construction activities will be planned between March 15 and December 15 to minimize impact and disturbance to deer and elk. If winter weather patterns present construction opportunities, the Owner will consult with CPW regarding measures to minimize impact and disturbance to deer and elk.
 - 5. Should unidentified archaeological resources be discovered in the course of the project, work must be interrupted until the resources have been evaluated in terms of the National Register of Historic Places eligibility criteria (36 CFR § 60.4) in consultation with the State Historic Preservation Office.
 - 6. Disturbed areas will be reclaimed and dirt roads would be watered during periods of high use in order to reduce fugitive dust emissions.

1.09 TEMPORARY DRAINAGE PROVISIONS

- A. Contractor shall provide for the drainage of storm water and such water as may be applied or discharged on the site in performance of the Work. Drainage facilities shall be adequate to prevent damage to the Work, the site, and adjacent property.
- B. Existing drainage channels and conduits shall be cleaned, enlarged, or supplemented as necessary to carry all increased runoff attributable to Contractor's operations. Dikes shall be constructed as necessary to divert increased runoff from entering adjacent property (except in natural channels), to protect Owner's facilities and the Work, and to direct water to drainage channels or conduits. Ponding shall be provided as necessary to prevent downstream flooding.
- C. Contractor shall obtain the necessary stormwater discharge construction permits, and comply with all applicable provisions.
- D. Contractor shall grade the site to drain both during and after construction.

1.10 POLLUTION CONTROL

- A. Contractor shall prevent the pollution of drains and watercourses by sanitary wastes, sediment, debris, and other substances resulting from construction activities. No sanitary wastes will be permitted to enter any drain or watercourse other than sanitary sewers. No sediment, debris, or other substance will be permitted to enter sanitary sewers and reasonable measures will be taken to prevent such materials from entering any drain or watercourse.
- B. The Contractor shall be responsible for preparing, obtaining approval, maintaining and complying with all applicable provisions of the Spill Control and Containment Plan

1.11 PRECAUTIONS DURING ADVERSE WEATHER

- A. During adverse weather, and against the possibility thereof, the Contractor shall take all necessary precautions so that the work may be properly done and satisfactory in all respects. When required, protection shall be provided by use of tarpaulins, wood and building paper shelters, or other acceptable means. The Contractor shall be responsible for all changes caused by adverse weather.
- B. The Engineer may suspend construction operations at any time when, in his judgment, the conditions are unsuitable or the proper precautions are not being taken, whatever the weather conditions may be, in any season. The suspension of construction operations by the Engineer shall not be cause for additional compensation or cost by the Contractor.

1.12 PERIODIC CLEANUP AND SITE RESTORATION

- A. During the progress of the Work, the Contractor shall keep the site of the Work and other areas used by it in a neat and clean condition, and free from any accumulation of rubbish. The Contractor shall dispose of all rubbish and waste materials of any nature occurring at the Work site, and shall establish regular intervals of collection and disposal of such materials and waste. The Contractor shall also keep its haul roads free from dirt, rubbish, and unnecessary obstructions resulting from its operations. Disposal of all rubbish and surplus materials shall be off the site of construction in accordance with local codes and ordinances governing locations and methods of disposal, and in conformance with all applicable safety laws, and to the particular requirements of Part 1926 of the OSHA Safety and Health Standards for Construction.
- B. The Contractor shall perform the cleanup work on a regular basis and as frequently as ordered by the Engineer. Basic site restoration in a particular area shall be accomplished immediately following the installation or completion of the required facilities in that area. Furthermore, such work shall also be accomplished, when ordered by the Engineer, if partially completed facilities must remain incomplete for some time period due to unforeseen circumstances.
- C. Unused equipment and tools shall be stored at the Contractor's yard or base of operations for the project.
- D. Upon failure of the Contractor to perform periodic clean-up and basic restoration of the site to the Engineer's satisfaction, the Engineer may, upon 5 days prior written notice to the Contractor, employ such labor and equipment as it deems necessary for the purpose, and all costs resulting therefrom shall be charged to the Contractor and deducted from amounts of money that it may be due.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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BARTLETT & WEST

SECTION 016000
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 GENERAL

- A. The word "Products", as used herein, is defined to include purchased items for incorporation into the Work, regardless of whether specifically purchased for project or taken from Contractor's stock of previously purchased products. The word "Materials", is defined as products which must be substantially cut, shaped, worked, mixed, finished, refined, or otherwise fabricated, processed, installed, or applied to form units of work. The word "Equipment" is defined as products with operational parts, regardless of whether motorized or manually operated, and particularly including products with service connections (wiring, piping, and other like items). Definitions in this paragraph are not intended to negate the meaning of other terms used in Contract Documents, including "specialties", "systems", "structure", "finishes", "accessories", "furnishings", "special construction", and similar terms, which are self-explanatory and have recognized meanings in the construction industry.

1.02 QUALITY ASSURANCE

- A. All materials and equipment shall conform to the Section entitled "Quality Control."
- B. Source Limitations: To the greatest extent possible for each unit of Work, the Contractor shall provide products, materials, or equipment of a singular generic kind from a single source.
- C. Compatibility of Options: Where more than one choice is available as options for Contractor's selection of a product, material, or equipment, the Contractor shall select an option which is compatible with other products, materials, or equipment already selected. Compatibility is a basic general requirement of product/material selections.

1.03 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Products or manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

1.04 SUBSTITUTIONS

- A. Engineer will consider requests for Substitutions only within 15 days after date of Notice to Proceed.
- B. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.
- C. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.
- D. A request constitutes a representation that Contractor:
 - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
 - 2. Will provide the same warranty for the Substitution as for the specified product.

3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
 4. Waives claims for additional costs or time extension which may subsequently become apparent.
 5. Will reimburse Owner for review or redesign services associated with re-approval by authorities.
- E. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.
- F. Substitution Submittal Procedure:
1. Submit three copies of request for Substitution for consideration. Limit each request to one proposed Substitution.
 2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence.
 3. The Engineer will notify Contractor, in writing, of decision to accept or reject request.

1.05 DESIGN

- A. Equipment and appurtenances shall be designed in conformity with the ASME, AIEE, NEMA and other generally accepted applicable standards and shall be rugged construction and of sufficient strength to withstand all stresses which may occur during fabrication, testing, transportation, installation and all conditions of operation. All bearings and moving parts shall be adequately protected by bushings or other acceptable means against wear, and provision shall be made for adequate lubrication by readily accessible devices. Details shall be designed for appearance as well as utility. Protruding members, joints, corners, gear covers, etc., shall be finished in appearance.
- B. All exposed welds on machinery shall be ground smooth and the corners of structural shapes shall be rounded or chamfered, as required to ensure satisfactory paint adhesion.

1.06 PRODUCT DELIVERY-STORAGE-HANDLING

- A. The Contractor shall deliver, handle, and store products in accordance with supplier's written recommendations and by methods and means which will prevent damage, deterioration, and loss including theft. Delivery schedules shall be controlled to minimize long-term storage of products at site and overcrowding of construction spaces. In particular, the Contractor shall provide delivery/ installation coordination to ensure minimum holding or storage times for products recognized to be flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other sources of loss.

1.07 TRANSPORTATION AND HANDLING

- A. Products shall be transported by methods to avoid product damage and shall be delivered in undamaged condition in supplier's unopened containers or packaging, dry.
- B. The Contractor shall provide equipment and personnel to handle products, materials, and equipment including those provided by Owner, by methods to prevent soiling and damage.
- C. The Contractor shall provide additional protection during handling to prevent marring and otherwise damaging products, packaging, and surrounding surfaces.

1.08 STORAGE AND PROTECTION

- A. Products shall be stored in accordance with supplier's written instructions, with seals and labels intact and legible. Sensitive products shall be stored in weather-tight enclosures and temperature and humidity ranges shall be maintained within tolerances required by supplier's written instructions.

- B. For exterior storage of fabricated products, they shall be placed on sloped supports above ground. Products subject to deterioration shall be covered with impervious sheet covering; ventilation shall be provided to avoid condensation.
- C. Loose granular materials shall be stored on solid surfaces in a well drained area and shall be prevented from mixing with foreign matter.
- D. Storage shall be arranged to provide access for inspection. The Contractor shall periodically inspect to assure products are undamaged and are maintained under required conditions.
- E. Storage shall be arranged in a manner to provide access for maintenance of stored items and for inspection.

1.09 MAINTENANCE OF STORAGE

- A. Stored products shall be periodically inspected on a scheduled basis. The Contractor shall maintain a log of inspections and shall make said log available to the Engineer on request.
- B. The Contractor shall verify that storage facilities comply with supplier's product storage requirements.
- C. The Contractor shall verify that supplier required environmental conditions are maintained continually.
- D. The Contractor shall verify that surfaces of products exposed to the elements are not adversely affected and that any weathering of finishes is acceptable under requirements of Contract Documents.
- E. Weather Conditions: Work that may be affected by inclement weather shall be suspended until proper conditions prevail. In the event of impending storms, the Contractor shall take necessary precautions to protect all work, materials and equipment from exposure.
- F. Fire Protection: The Contractor shall take all necessary precautions to prevent fires at or adjacent to the Work, including its own buildings and trailers. Adequate fire extinguisher and hose line stations shall be provided throughout the work area.

1.10 MAINTENANCE OF EQUIPMENT STORAGE

- A. For mechanical and electrical equipment in long-term storage, the Contractor shall provide a copy of the supplier's service instructions to accompany each item, with notice on enclosed instruction shown on exterior of package.
- B. Equipment shall be serviced on a regular basis, and a log of services shall be maintained and submitted as a record document to the Engineer.

1.11 NAMEPLATES

- A. Each unit of equipment shall have the manufacturer's name or trademark on a corrosion-resistant nameplate securely affixed in a conspicuous place. The manufacturer's name or trademark may be cast integrally, stamped, or otherwise permanently marked upon the item of equipment.
- B. Such information as year of manufacture, serial number, rating data and any other information the manufacturer may consider necessary to complete identification, or as specified, shall be shown on the nameplate.

1.12 PAINTING

- A. Except as otherwise specified or required, equipment shall be primed and finish painted at the factory, in accordance with the recommendations of the manufacturer.

- B. Necessary field painting shall be in accordance with Section entitled, "Painting". Any damage to shop coatings shall be corrected to the satisfaction of the Engineer.

1.13 LUBRICANTS

- A. During testing and prior to acceptance, the Contractor shall furnish all lubricants necessary for the proper lubrication of all equipment furnished under this Contract.

1.14 SPECIAL TOOLS

- A. For each type of equipment furnished by him the Contractor shall provide a complete set of all special tools (including calibration and test equipment) which may be necessary for the adjustment, operation, maintenance and disassembly of such equipment.
- B. Special tools shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such special tools until completion of the Work, at which time they shall be delivered to the Owner.

1.15 PROTECTION AGAINST GALVANIC CORROSION

- A. Where dissimilar metals are in direct contact with each other, suitable insulation shall be provided between adjoining surfaces so as to eliminate direct contact. The insulation shall be heavy bituminous coatings, nonmetallic separators or washers, or other acceptable materials.

1.16 FASTENERS

- A. All necessary bolts, anchor bolts, nuts, washers, plates and bolt sleeves shall be furnished by the Contractor in accordance herewith. Bolts shall have suitable washers and, where so required, their nuts shall be hexagonal.
- B. All bolts, anchor bolts, nuts, washers, plates, and bolt sleeves shall be Type 304 stainless steel unless otherwise specifically indicated or specified.
- C. Unless otherwise specified, stud, tap, and machine bolts shall be Grade 5, plain, carbon steel. Hexagonal nuts of the same quality of metal as the bolts shall be used.

1.17 SALVAGED MATERIALS

- A. In the absence of special provisions in other Sections of the Specifications, salvage materials, equipment or other supplies that occur are the property of the Owner and shall be cleaned and stored as directed by the Engineer.
- B. All excavated materials needed for backfilling operation shall be stored on site. Where additional area is needed for stockpiling, it shall be obtained by the Contractor.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 017500
STARTING AND ADJUSTING

PART 1 GENERAL

1.01 GENERAL

- A. Equipment testing and startup are requisite to satisfactory completion of the contract and, therefore, shall be completed within the contract time.
- B. As construction of the project enters the final stages of completion, the Contractor shall, in accordance with the requirements set forth in the Contract Documents, attend to the following items:
 - 1. Schedule equipment manufacturer's visits to site.
 - 2. Calibration of instruments and controls.
 - 3. Perform required testing adjusting and balancing of project components.
 - 4. Set up and adjust all electrical and mechanical equipment's operation, control and monitoring systems and parameters.
 - 5. Perform complete and successful system operation and controls check including all alarm, status and control features and functions prior to scheduling start up and initial operation.
 - 6. Schedule start-up and initial operation.
 - 7. Furnish skilled personnel during initiation operation.
 - 8. Owner operation and maintenance training.

1.02 EQUIPMENT TESTING

- A. The Contractor shall provide the services of an experienced and authorized representative of the supplier of each item of equipment (excluding minor items of equipment specifically exempted by the Engineer in writing), who shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. In each case, the Contractor shall arrange to have the supplier's representative revisit the job site as often as necessary until any and all trouble is corrected and the equipment installation and operation are satisfactory to the Engineer.
- B. The Contractor shall require that each supplier's representative furnish to the Engineer a written report addressed to the Owner, and copied to the Engineer, certifying that the equipment has been properly installed and lubricated, is in accurate alignment, is free from any undue stress imposed by connecting piping or anchor bolts, and has been operated satisfactorily under full-load conditions, is ready for operation, and the Owner's operating personnel have been instructed in the operation, maintenance and lubrication of the equipment.
- C. The Contractor shall be responsible for scheduling all operations testing. The Contractor is advised that the Engineer and the Owner's operating personnel will witness operations testing.
- D. The supplier's representative shall instruct the Owner's operating personnel in correct operation and maintenance procedures. The instruction shall demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment. Such instruction shall be scheduled at a time arranged with the Owner at least 2 weeks in advance and shall be provided while the respective representative's equipment is fully operational. On-site instruction shall be given by qualified persons who have been made familiar in advance with the equipment and systems in the plant. The Contractor shall have submitted, and had accepted by the Engineer, the O&M Manuals (specified in the Operation and Maintenance Data Section) prior to commencement of training.
- E. The Contractor shall notify the Engineer at least 14 days in advance of each equipment test or Owner

training session.

- F. Training shall be provided to three separate shifts of the Owner's personnel between the hours of 8:00 A.M. and 5:00 P.M. as necessary.
- G. The Contractor shall furnish all personnel, power, water, chemicals, fuel, oil, grease, and all other necessary equipment, facilities, and services required for conducting the tests.

1.03 SYSTEM STARTUP

- A. The startup of a pump station and pipeline system is a highly complex operation requiring the combined technical expertise of the Contractor, suppliers, subcontractors, the Engineer, and the Owner. The Contractor shall provide the effective coordination of all parties necessary for successful startup.
- B. It is not the intent of the Engineer to instruct the Contractor in the startup of the system; however, the Engineer will be available prior to and during startup to provide technical support to the Contractor.
- C. The Contractor shall startup each applicable portion of the system, including both pump stations and pipeline, and, after a successful and Owner approved startup, the Contractor shall operate it for a continuous 7-day (24 hours per day) period. Alternate bid items may extend the duration of this operation period. The Contractor shall be available at all times during this period to provide necessary maintenance support as may be deemed necessary by the Owner and/or Engineer.
- D. Not less than 2 months prior to startup, the Contractor shall submit to the Engineer for review, a detailed schedule of operations which will be necessary to effect a successful initial operation and sustained period of operation for the duration of the required startup period.
- E. The startup shall not be commenced until all required leakage tests, disinfection, and equipment tests have been completed to the satisfaction of the Engineer.
- F. All defects in materials or workmanship which appear during this test period shall be immediately corrected by the Contractor. Time lost for equipment repairs, wiring corrections, control point settings, or other reasons which actually interrupt the startup may, at the discretion of the Engineer, be justifiable cause for extending the startup test duration.
- G. During the startup, the Contractor shall provide the services of authorized representatives of the suppliers, in addition to those services required under operations testing, as necessary, to correct faulty equipment operation.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 017610
PROTECTION OF EXISTING FACILITIES

PART 1 GENERAL

1.01 WORK INCLUDED

- A. The Contractor shall protect all existing utilities and improvements not designated for removal and shall restore damaged or temporarily relocated utilities and improvements to a condition equal to or better than they were prior to such damage or temporary relocation, all in accordance with requirements of the Contract Documents. All property that is damaged by the Contractor during the construction of the proposed facilities shall be repaired or replaced as directed by the Owner or the Engineer to a like new condition regardless of its physical condition prior to the start of construction.
- B. The Contractor shall verify the exact locations and depths of all utilities shown and the Contractor shall make exploratory excavations of all utilities that may interfere with the Work. All such exploratory excavations shall be performed as soon as practicable after award of Contract and, in any event, a sufficient time in advance of construction to avoid possible delays to the Contractor's Work. When such exploratory excavations show the utility location to differ materially from the location shown or specified, the Contractor shall so notify the Engineer.
- C. The number of exploratory excavations required shall be that number which is sufficient to determine the alignment and grade of the utility.

1.02 RIGHTS-OF-WAY

- A. The Contractor shall not do any Work that would affect any oil, gas, sewer, or water pipeline; any telephone, telegraph, or electric transmission line; any fence; or any other structure, nor shall the Contractor enter upon the rights-of-way involved until notified by the Engineer that the Owner has secured authority therefor from the proper party. After authority has been obtained, the Contractor shall give said party due notice of its intention to begin Work, and shall give said party convenient access and every facility for removing, shoring, supporting, or otherwise protecting such pipeline, transmission line, ditch, fence, or structure, and for replacing same. When two or more contracts are being executed at one time on the same or adjacent land in such manner that work on one contract may interfere with that on another, the Owner shall determine the sequence and order of the Work. When the territory of one contract is the necessary or convenient means of access for the execution of another contract, such privilege of access or any other reasonable privilege may be granted by the Owner to the Contractor so desiring, to the extent, amount, in the manner, and at the times permitted. No such decision as to the method or time of conducting the work or the use of territory shall be made the basis of any claim for delay or damage, except as provided for temporary suspension of the work in accordance with Article 16 of the General Conditions of the Contract Documents.

1.03 PROTECTION OF STREET OR ROADWAY MARKERS

- A. The Contractor shall not destroy, remove, or otherwise disturb any existing survey markers or other existing street or roadway markers without proper authorization. No pavement breaking or excavation shall be started until all survey or other permanent marker points that will be disturbed by the construction operations have been properly referenced for easy and accurate restoration. It shall be the Contractor's responsibility to notify the proper representatives of the Owner of the time and location that Work will be done. Such notification shall be sufficiently in advance of construction so that there will be no delay due to waiting for survey points to be satisfactorily referenced for restoration. All survey markers or points disturbed by the Contractor without proper authorization by the Engineer, will be accurately restored by the Owner at the Contractor's expense after all street or roadway resurfacing has been completed.

1.04 RESTORATION OF PAVEMENT

- A. General: All paved areas including asphaltic concrete berms cut or damaged during construction or damaged as a result of the overall construction activities such as hauling or transportation activities shall be replaced with similar materials and of equal thickness to match the existing adjacent undisturbed areas, except where specific resurfacing requirements have been called for in the Contract Documents or in the requirements of the agency issuing the permit. All temporary and permanent pavement shall conform to the requirements of the affected pavement owner. All pavements which are subject to partial removal shall be neatly saw cut in straight lines.
- B. Within five working days of the pipe installation, temporary restoration shall be completed. All paved areas, including asphaltic concrete berms cut or damaged during construction, shall be replaced with similar materials and of equal thickness to match the existing adjacent undisturbed areas, except where specific restoration requirements have been called for in the Contract Documents or in the requirements of the agency issuing the permit.
- C. Temporary Restoration: Temporary restoration includes repair to all driveways, sidewalks and roadways. They shall be swept clean and be maintained free of dirt and dust. All areas disturbed by the construction activities shall be restored to proper grade, cleaned up, including the removal of debris, trash, and deleterious materials. All construction materials, supplies, or equipment, including piles of debris shall be removed from the area. All temporarily restored areas shall be maintained by the Contractor. These areas shall be kept clean and neat, free of dust and dirt, until final restoration operations are completed. The Contractor is responsible to utilize dust abatement operations in the temporarily restored areas as required, to the satisfaction of the Engineer.
- D. Temporary Resurfacing: Wherever required by the public authorities having jurisdiction, the Contractor shall place temporary surfacing promptly after backfilling and shall maintain such surfacing for the period of time fixed by said authorities before proceeding with the final restoration of improvements.
- E. Permanent Resurfacing: In order to obtain a satisfactory junction with adjacent surfaces, the Contractor shall saw cut back and trim the edge so as to provide a clean, sound, vertical joint before permanent replacement of an excavated or damaged portion of pavement. Damaged edges of pavement along excavations and elsewhere shall be trimmed back by saw cutting in straight lines. All pavement restoration and other facilities restoration shall be constructed to finish grades compatible with adjacent undisturbed pavement.
- F. Restoration of Sidewalks or Private Driveways: Wherever sidewalks or private roads have been removed for purposes of construction, the Contractor shall place suitable temporary sidewalks or roadways promptly after backfilling and shall maintain them in satisfactory condition for the period of time fixed by the authorities having jurisdiction over the affected portions before proceeding with the final restoration or, if no such period of time is so fixed, the Contractor shall maintain said temporary sidewalks or roadways until the final restoration thereof has been made.
- G. Timely Restoration of Existing Facilities: The Contractor shall test an installed section of pipeline within five calendar days from completion of the pipeline. A section of pipe is defined as a pipe section which can be isolated such as by manholes or valves for testing. Within five calendar days after testing of the pipelines and pipeline appurtenances is satisfactorily completed, the Contractor shall provide the Engineer with a "Schedule of Existing Facilities Restoration" which will be reviewed and be acceptable to the Engineer. The schedule shall show the existing facilities to be restored and schedule of beginning and completion dates for each item of restoration. The work for completing the final restoration of existing facilities for a tested section of work shall be completed within 30 days of acceptance of the pipeline testing.
- H. All temporary restoration/resurfacing work and maintenance is subsidiary to the project.

1.05 EXISTING UTILITIES AND IMPROVEMENTS

- A. General: The Contractor shall protect all underground utilities and other improvements which may be

impaired during construction operations. It shall be the Contractor's responsibility to ascertain the actual location of all existing utilities and other improvements that will be encountered in its construction operations, and to see that such utilities or other improvements are adequately protected from damage due to such operations. The Contractor shall take all possible precautions for the protection of unforeseen utility lines to provide for uninterrupted service and to provide such special protection as may be necessary.

- B. **Utilities to be Moved:** In case it shall be necessary to move the property of any public utility or franchise holder, such utility company or franchise holder will, upon request of the Contractor, be notified by the Owner to move such property within a specified reasonable time. When utility lines that are to be removed are encountered within the area of operations, the Contractor shall notify the Engineer a sufficient time in advance for the necessary measures to be taken to prevent interruption of service.
- C. **Where the proper completion of the Work requires the temporary or permanent removal and/or relocation of an existing utility or other improvement which is shown, the Contractor shall remove and, without unnecessary delay, temporarily replace or relocate such utility or improvement in a manner satisfactory to the Owner and the owner of the facility. In all cases of such temporary removal or relocation, restoration to former location shall be accomplished by the Contractor in a manner that will restore or replace the utility or improvement as nearly as possible to its former locations and to as good or better condition than found prior to removal. This includes temporarily supporting and bracing for line and power poles.**
- D. **Owner's Right of Access:** The right is reserved to the Owner and to the owners of public utilities and franchises to enter at any time upon any public street, alley, right-of-way, or easement for the purpose of making changes in their property made necessary by the Work of this Contract.
- E. **Utilities Shown or Indicated:** Existing utility lines that are shown or the locations of which are made known to the Contractor prior to excavation and that are to be retained, and all utility lines that are constructed during excavation operations shall be protected from damage during excavation and backfilling. The appropriate utility owner or franchise holder shall be immediately notified of any and all damage to their facilities and they shall have jurisdiction and approval over the means and methods of repair of same.
- F. **Underground Utilities Not Shown or Indicated:** In the event that the Contractor damages any existing utility lines that are not shown or the locations of which are not made known to the Contractor prior to excavation, a written report thereof shall be made immediately to the Owner. If directed by the Owner, repairs shall be made by the Contractor under the provisions for changes and extra Work contained in the General Conditions.
- G. **All costs of locating, and repairing damage not due to failure of the Contractor to exercise reasonable care, and removing or relocating such utility facilities not shown in the Contract Documents with reasonable accuracy, and for equipment on the project which was actually working on that portion of the Work which was interrupted or idled by removal or relocation of such utility facilities, and which was necessary idled during such Work will be paid for as extra Work in accordance with the provisions of the General Conditions. Compensation shall not include Contractor's costs for the coordination of his activities with the utility company affected. Contractor shall schedule his work in such a manner that he is not delayed by the utilities companies relocating or supporting their facilities. No compensation will be paid the Contractor for any loss of time or delay.**
- H. **Approval of Repairs:** All repairs to a damaged improvement are subject to inspection and approval by an authorized representative of the improvement owner before being concealed by backfill or other work.
- I. **Maintaining in Service:** All oil and gasoline pipelines, power, and telephone or other communication cable ducts, gas and water mains, irrigation lines, sewer lines, storm drain lines, poles, and overhead power and communication wires and cables encountered along the line of the Work shall remain continuously in service during all the operations under the Contract, unless other arrangements satisfactory to the Owner are made with the owner of said pipelines, duct, main, irrigation line, sewer, storm drain, pole, or wire or cable. The Contractor shall be responsible for and shall repair all damage due to its operations and the provisions of this Section shall not be abated even in the event such damage occurs after backfilling or is not discovered until after completion of the backfilling.

- J. Septic Tank Lateral Lines: Septic tank lateral lines and drain fields may be encountered during construction operations. The Contractor shall be responsible to locate and take all possible precautions for protecting the lateral lines and drain fields. Any damage shall be repaired and/or replaced by the Contractor, at no additional cost to the Owner, in a manner satisfactory to the Engineer.

1.06 ELECTRICAL POWER POLES

- A. All work on power poles needing to be temporarily supported, braced, or relocated, shall be done by the owner of the utility, (i.e. La Plata Electric, or other), at no charge to the Owner and paid for by the Contractor. The Contractor shall coordinate the work with utility owner.
- B. Underground power lines damaged by the Contractor shall be repaired by utility owner at no cost to the Owner and paid for by the Contractor.

1.07 GAS COMPANY LINES

- A. Gas Company lines damaged by the Contractor shall be repaired by the owner of the utility (i.e. Source Gas, or other), at no cost to the Owner and paid for by the Contractor.
- B. Gas lines needing to be relocated shall be moved by the Source Gas and paid for by the Contractor. The Contractor shall coordinate the relocation with Source Gas to eliminate the relocation delays in the interceptor sewer construction.
- C. High pressure gas pipelines will be encountered on this project. Care should be taken to coordinate proper crossing procedures with

1.08 LINES FOR STREET LIGHTS

- A. Lines and poles for street lights needing to be temporarily supported/braced, or which are damaged by the Contractor shall be repaired by the owner of the utility, (i.e. La Plata Electric or other), and paid for by the Contractor.

1.09 BURIED TELECOMMUNICATIONS LINES AND/OR CONDUIT

- A. Buried telecommunications lines and/or conduit damaged by the Contractor shall be repaired by the owner of the utility, (i.e. Century Telephone Company or other), at no additional cost to the Owner and paid for by the Contractor.

1.10 CABLE TELEVISION BURIED CABLE AND/OR CONDUIT.

- A. Cable Television buried lines and/or Conduit damaged by the Contractor shall be repaired by the appropriate Cable Television Company and paid for by the Contractor.

1.11 WATER MAINS

- A. Water mains damaged by the Contractor shall be repaired by the owner of the utility or upon written permission by the utility owner, by the Contractor in accordance with the requirements of the utility owner; both to be fully paid for by the Contractor.
- B. The opening and closing of distribution system valves shall be performed only by the utility owner. This includes existing valves and Contractor installed valves that control the flow of potable or non-potable water.

1.12 TREES WITHIN STREET RIGHTS-OF-WAY AND PROJECT LIMITS

- A. General: The Contractor shall exercise all necessary precautions so as not to damage or destroy any trees or shrubs, including those lying within street rights-of-way and project limits and shall not trim or remove any trees unless such trees have been approved for trimming or removal by the jurisdictional agency or Owner. All existing trees and shrubs which are damaged during construction shall be trimmed or replaced by the Contractor to the satisfaction of the Owner. Tree trimming and replacement shall be accomplished in accordance with the following paragraphs.
- B. Trimming: The symmetry of the tree shall be preserved; no stubs or splits or torn branches shall remain. Clean cuts shall be made close to trunk or large branch. Spikes shall not be used for climbing live trees. All cuts over 1½ inches in diameter shall be coated with an asphaltic emulsion material.
- C. Replacement: The Contractor shall immediately notify the Owner if any tree is damaged by the Contractor's operation. If, in the opinion of the Owner, the damage is such that replacement is necessary, the Contractor shall replace the tree at its own expense. The tree shall be of a like size and variety as the tree damaged, or, if of a smaller size, the Contractor shall pay to the Owner of said tree compensatory payment acceptable to the tree owner, subject to the approval of the Owner.

1.13 NOTIFICATION BY THE CONTRACTOR

- A. Prior to any excavation in the vicinity of any existing underground facilities, including all water, sewer, storm drain, gas, petroleum products, or other pipelines; all buried electric power, communications, or television cables; all traffic signal and street lighting facilities; and all roadway and state highway rights-of-way, the Contractor shall notify the respective authorities representing the owners or agencies responsible for such facilities not less than 3 days nor more than 7 days prior to excavation so that a representative of said owners or agencies can be present during such Work if they so desire.
- B. The Contractor shall prepare a written notice to property owners adjacent to the project work site notifying them of the schedule of work affecting them and anticipated inconveniences they may expect. The notice shall list the company name and phone numbers of responsible personnel, both local and out of town if non-local contractor, where the property owner, Engineer or Owner, including police, fire and public works can contact him during normal business hours, after hours and on weekends. The notice shall meet the approval of the Engineer and be delivered to property owners at least 72 hours prior to construction adjacent to their property.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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BARTLETT & WEST

SECTION 017700
CLOSEOUT PROCEDURES

PART 1 GENERAL

1.01 FINAL CLEANUP

- A. The Contractor shall promptly remove from the vicinity of the completed Work, all rubbish, unused materials, concrete forms, construction equipment, and temporary structures and facilities used during construction. Final acceptance of the Work by the Owner will be withheld until the Contractor has satisfactorily complied with the foregoing requirements for final cleanup of the project site.
- B. Contractor shall thoroughly clean all materials, equipment and structures; all marred surfaces shall be touched up to match adjacent surfaces, all glass surfaces cleaned and floors cleaned.
- C. Contractor shall remove spatter, grease, stains, fingerprints, dirt, dust, labels, tags, packing materials and other foreign items or substances from interior and exterior surfaces, equipment, signs and lettering.
- D. Contractor shall remove paint, clean and restore all equipment and material nameplates, labels and other identification markings.
- E. Contractor shall maintain cleaning until project, or portion thereof, is occupied by the Owner.
- F. The Contractor shall:
 - 1. Use only cleaning materials recommended by manufacturer of surface to be cleaned.
 - 2. Use each type of cleaning material on only those surfaces recommended by the cleaning material manufacturer.
 - 3. Use only materials which will not create hazards to health or property.

1.02 CLOSEOUT TIMETABLE

- A. The Contractor shall establish dates for equipment testing, acceptance periods, and on-site instructional periods (as required under the Contract). Such dates shall be established not less than two weeks prior to beginning any of the foregoing items, to allow the Owner, the Engineer, and their authorized representatives sufficient time to schedule attendance at such activities.

1.03 FINAL SUBMITTALS

- A. Before the final acceptance of the project, the Contractor shall submit to the Engineer (or to the Owner if indicated) certain records, certifications, etc., which are specified elsewhere in the Contract Documents. Missing, incomplete or unacceptable items, as determined by the Engineer or the Owner, shall constitute grounds for withholding final payment to the Contractor. A partial list of such items appears below, but it shall be the Contractor's responsibility to submit any other items which are required in the Contract Documents:
 - 1. Written test results of project components, where required.
 - 2. Performance affidavits for equipment, where required.
 - 3. Operation and maintenance manuals for all equipment.
 - 4. During the entire construction operation, the Contractor shall maintain records of all deviations from the Drawings and Specifications and shall prepare therefrom record drawings showing correctly and accurately all changes and deviations from the Work made during construction to reflect the Work as it was actually constructed. These drawings shall conform to recognized standards of drafting, shall be neat, legible and on reproducible material acceptable to the Engineer.

5. Written guarantees, where required.
6. Certificates of inspection and acceptance by local governing agencies having jurisdiction.
7. Releases from all parties who are entitled to claims against the subject project, property, or improvement pursuant to the provisions of law including the fully executed Affidavit of Contractor, Document No. 860.
8. Keying Schedule.
9. Bonds for roofing, maintenance, etc. as required.

1.04 SUBSTANTIAL COMPLETION

- A. When Contractor considers the Work is substantially complete, he shall submit to Engineer:
 1. A written notice that the Work is substantially complete.
 2. A list of items to be completed or corrected.
- B. Within a reasonable time after receipt of such notice, Engineer will make an inspection to determine the status of completion.
- C. Should Engineer determine that the Work is not substantially complete:
 1. Engineer will promptly notify the Contractor in writing, giving the reasons therefore.
 2. Contractor shall correct the deficiencies in the Work, and send a second written notice of substantial completion to the Engineer.
 3. Engineer will reinspect the Work.
- D. When the Engineer finds that the Work is substantially complete, he will:
 1. Prepare and deliver to Owner a tentative Certificate of Substantial Completion on document C-625 from the project manual, with a tentative list of items to be completed or corrected before final payment.
 2. After consideration of any objections made by the Owner as provided in Conditions of the Contract, and when Engineer considers the Work substantially complete, he will execute and deliver to the Owner and the Contractor a definite Certificate of Substantial Completion with a revised tentative list of items to be completed or corrected.

1.05 FINAL INSPECTION

- A. When Contractor considers the Work is complete, he shall submit written certification that:
 1. Contract Documents have been reviewed.
 2. Work has been inspected for compliance with Contract Documents.
 3. Work has been completed in accordance with Contract Documents.
 4. Equipment and systems have been tested in the presence of the Owner's representative and are operational.
 5. Work is completed and ready for final inspection.
- B. Engineer will make an inspection to verify the status of completion with reasonable promptness after receipt of such certification.
- C. Should Engineer consider that the Work is incomplete or defective:
 1. Engineer will promptly notify the Contractor in writing, listing the incomplete or defective work.
 2. Contractor shall take immediate steps to correct deficiencies, and send a second written

certification to Engineer that the Work is complete.

3. Engineer will reinspect the Work.
4. This procedure will continue until the entire project has been accepted by the Engineer.

- D. The "Final Payment" will not be processed until the entire project has been accepted by the Owner and all of the requirements in sub-section 1.03 "Final Submittals" have been satisfied.
- E. When the Engineer finds that the Work is acceptable under the Contract Documents, he shall request the Contractor to make closeout submittals.

1.06 REINSPECTION FEES

- A. Should Engineer perform reinspections due to failure of the Work to comply with the claims of status of completion made by the Contractor:
 1. Owner will compensate Engineer for such additional services.
 2. Owner will deduct the amount of such compensation from the final payment to the Contractor.

1.07 TOUCH UP AND REPAIR

- A. The Contractor shall touch up and repair damage to all field painted and factory finished equipment. Touch up painting shall match as nearly as possible the original finish. If in the opinion of the Engineer the touch up work is not satisfactory, the Contractor shall repaint the item.

1.08 CLEANING

- A. Before the final acceptance of the project, the Contractor shall accomplish the cleaning and final adjustments of the various building components as follows:
 1. Clean all glass and adjust all windows and doors for proper operation.
 2. Clean and lubricate all finish hardware after adjustment for proper operation.
 3. Touch up marks of defects in painted surfaces and touch up any similar defects in factory finished surfaces.
 4. Wax all resilient flooring materials.
 5. Remove bitumen from gravel stops, fascias, and other exposed surfaces.
 6. Remove all stains, marks, fingerprints, soil, spots, and blemishes from all finish surfaces, tile, stone, brick and similar surfaces.

1.09 MAINTENANCE AND GUARANTEE

- A. The Contractor shall comply with all maintenance and guarantee requirements of the Contract Documents.
- B. Replacement of earth fill or backfill, where it has settled below the required finish elevations, shall be considered as a part of such required repair work, and any repair or resurfacing constructed by the Contractor which becomes necessary by reason of such settlement shall likewise be considered as a part of such required repair work unless the Contractor shall have obtained a statement in writing from the affected private owner or public agency releasing the Owner from further responsibility in connection with such repair or resurfacing.
- C. The Contractor shall make all repairs and replacements promptly upon receipt of written order from the Owner. If the Contractor fails to make such repairs or replacements promptly, the Owner reserves the right to do the Work and the Contractor and his surety shall be liable to the Owner for the cost thereof.

1.10 GREASE, OIL AND FUEL

- A. All grease, oil and fuel required for testing of equipment shall be furnished by the Contractor. The Contractor shall also furnish a one year's supply of lubricants including grease and oil of the type recommended by the manufacturer for each item of equipment supplied.

1.11 TOOLS

- A. Any special tools (including grease guns or other lubricating devices) which may be necessary for the adjustment, operation, and maintenance of any equipment shall be furnished with the respective equipment. The Contractor shall furnish a complete list of tools and instructions for their use, recommended by the manufacturer or supplier with the Shop Drawing Submittal.

1.12 SPARE PARTS

- A. Spare parts for equipment shall be furnished where indicated in the equipment specifications and/or as recommended by the equipment manufacturer. Spare parts shall be identical and interchangeable with original parts. Parts shall be supplied, prepared for storage, in clearly identified containers, except large or bulk items which may be wrapped in polyethylene.
- B. The parts shall be stored separately in a locked area, maintained by the Contractor, and shall be delivered to the Owner at a location designated by the Owner. The Contractor shall furnish an inventory listing of all spare parts for each piece of equipment using the form included at the end of this section.

1.13 FINAL ADJUSTMENT OF ACCOUNTS.

- A. Submit a final statement of accounting to Engineer.
- B. Statement shall reflect all adjustments to the Contract Sum:
 - 1. The original Contract Price.
 - 2. Additions and deductions resulting from:
 - a. Previous change orders.
 - b. Unit prices.
 - c. Deductions for uncorrected work.
 - d. Adjustments to Quantities.
 - e. Deductions for liquidated damages.
 - f. Deductions for reinspection payments.
 - g. Other adjustments.
 - 3. Total Contract Price, as adjusted.
 - 4. Previous payments.
 - 5. Sum remaining due.
- C. Engineer will prepare a final change order, reflecting approved adjustments to the Contract price which were not previously made by change orders.

1.14 FINAL APPLICATION FOR PAYMENT

- A. Contractor shall submit the final application for payment in accordance with procedures and requirements stated in the General Conditions.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

PHONE _____ () _____

SPARE PARTS INVENTORY:

[illegible]

NOTE: Use additional sheets as required.

SECTION 017823
OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Compile product data and related information appropriate for Owner's maintenance and operation of all products furnished under this Contract.
 - 1. Prepare operating and maintenance data as specified in this section and as referenced in other pertinent sections of specifications.
- B. Instruct Owner's personnel in the maintenance of products and in the operation of equipment and systems.

1.02 SUBMITTAL REQUIREMENTS - GENERAL

- A. Prepare data in a form suitable for insertion by the Engineer in an instructional manual for use by the Owner's personnel.
 - 1. Five originals of each item shall be submitted. Photocopies will not be accepted.
 - 2. One electronic copy in adobe pdf format, indexed and searchable, of each item shall be submitted.
- B. Format:
 - 1. Size: 8-1/2 in. x 11 in.
 - 2. Paper: 20 pound minimum, white, for typed pages.
 - 3. Drawings: Suitable for folding and binding into manual.
 - a. Supplement product data with drawings as necessary to clearly illustrate:
Relations of component parts of equipment and systems.
Control and flow diagrams.
 - b. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
 - c. Do not use Project Record Documents as maintenance drawings.
 - d. Provide for each separate product, or each piece of operating equipment:
 - e. Typed description of product, and major component parts of equipment.
- C. List, with each product, the name, address and telephone number of:
 - 1. Subcontractor or installer.
 - 2. Maintenance contractor, as appropriate.
 - 3. Identify the area of responsibility of each.
 - 4. Local source of supply for parts and replacement.
- D. Identify each product by product name and other identifying symbols as set forth in Contract Documents.
- E. Product Data:
 - 1. Include only those sheets which are pertinent to the specific product. Catalogues which contain data for an entire line or series will not be accepted.
 - 2. Annotate each sheet to:

- a. Clearly identify the specific product or part installed.
 - b. Clearly identify the data applicable to the installation
 - c. Delete references to inapplicable information.
- F. Copy of each warranty, bond and service contract issued:
- 1. Provide information sheet for Owner's personnel, give:
 - a. Proper procedures in the event of failure.
 - b. Instances which might affect the validity of warranties or bonds.

1.03 SUBMITTALS REQUIREMENTS FOR EQUIPMENT AND SYSTEMS

- A. Content, for each unit of equipment and system, as appropriate:
- 1. Description of unit and component parts:
 - a. Function, normal operating characteristics, and limiting conditions.
 - b. Performance curves, engineering data and tests.
 - c. Complete nomenclature and commercial number of all replaceable parts.
 - 2. Operating Procedures:
 - a. Start-up, break-in, routine and normal operating instructions.
 - b. Regulation, control, stopping, shut-down and emergency instructions.
 - c. Summer and winter operating instructions.
 - d. Special operating instructions.
 - 3. Maintenance Procedures:
 - a. Routine operations.
 - b. Guide to "trouble-shooting".
 - c. Disassembly, repair and reassembly.
 - d. Alignment, adjusting and checking.
 - 4. Servicing and Lubrication Schedule:
 - a. List of lubricants required.
 - 5. Manufacturer's printed operating and maintenance instructions.
 - 6. Description of sequence of operation by control manufacturer.
 - 7. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
 - a. Predicted life of parts subject to wear.
 - b. Items recommended to be stocked as spare parts.
 - c. Lists, illustrations and drawings shall show and identify each and every part and fastener. Include an exploded view of assembly drawing.
 - 8. As-installed control diagrams by controls manufacturer.
 - 9. Each contractor's coordination drawings:
 - a. As-installed color coded piping diagrams.
 - 10. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.
 - 11. Other data as required under pertinent sections of specifications.

B. Content, for each electric and electronic system, as appropriate:

1. Description of system and component parts:
 - a. Function, normal operating characteristics, and limiting conditions.
 - b. Performance curves, engineering data and tests.
 - c. Complete nomenclature and commercial number of replaceable parts.
2. Circuit directories of panelboards:
 - a. Electrical service.
 - b. Controls.
 - c. Communications.
3. As-installed color coded wiring diagrams.
4. Operating procedures:
 - a. Routine and normal operating instructions.
 - b. Sequences required.
 - c. Special operating instructions.
5. Maintenance procedures:
 - a. Routine operations.
 - b. Guide to "trouble-shooting."
 - c. Disassembly, repair and reassembly.
 - d. Adjustment and checking.
6. Manufacturer's printed operating and maintenance instructions.
7. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.
8. Other data as required under pertinent sections of specifications.

C. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.

D. Additional requirements for operating and maintenance data: The respective sections of Specifications.

1.04 INSTRUCTIONS OF OWNER'S PERSONNEL

- A. Prior to final inspection or acceptance, fully instruct Owner's designated operating and maintenance personnel in the operation, adjustment and maintenance of all products, equipment and systems.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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BARTLETT — *&* — **WEST**

SECTION 023033
SUBSURFACE INVESTIGATION

PART 1 GENERAL

1.01 DESCRIPTION

- A. Reference is made to the Geological Report prepared by Trautner Geotech, LLC. for the identification of those reports of investigations and tests of subsurface and latent physical conditions at the site or otherwise affecting cost, progress or performance of the Work which have been relied upon by the Engineer in preparing the Drawings and Specifications. Engineer will make copies of such reports available to any Bidder requesting them. **These reports are not guaranteed as to accuracy or completeness, nor are they part of the Contract Documents.**
- B. Before submitting his Bid, each Bidder shall, at his own expense, make such additional investigations and tests as the Bidder may deem necessary to determine his Bid for performance of the Work in accordance with the time, price and other terms and conditions of the Contract Documents.
- C. On request, Owner will provide each Bidder access to the site to conduct such investigations and tests as each Bidder deems necessary for submission of his Bid.
- D. The lands upon which the Work is to be performed, rights-of-way for access thereto, and other lands designated for use by contractor in performing the Work are identified in the Specifications or Drawings.

1.02 REQUIREMENTS

- A. Contractor shall carefully study all reports of explorations and tests of subsurface conditions at or contiguous to the site and all drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the site which have been identified in the Contract Documents.
- B. Contractor acknowledges that such reports and drawings are not Contract Documents and may not be complete for Contractor's purposes.
- C. Contractor acknowledges that Owner and Engineer do not assume responsibility for the accuracy or completeness of information and data shown or indicated in the Contract Documents with respect to the performance of the work at or contiguous to the site.
- D. Contractor has obtained and carefully studied (or assumes responsibility for having done so) all such additional supplementary examinations, investigations, explorations, tests, studies and data concerning conditions (surface, subsurface and Underground Facilities) at or contiguous to the site or otherwise which may affect cost, progress, performance or furnishing of the Work or which relate to any aspect of the means, methods, techniques, sequences or procedures of construction to be employed by Contractor and safety precautions and programs incident thereto. Contractor does not consider that any additional examinations, investigations, explorations, tests, studies or data are necessary for the performance and furnishing of the Work at the contract price, within the contract times and in accordance with the other terms and conditions of the Contract Documents.
- E. The submission of a bid shall constitute an incontrovertible representation by the Bidder that he has complied with every requirement of this section and that the Contract Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performance of the work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 024100

DEMOLITION

PART 1 GENERAL

1.01 WORK INCLUDED

- A. The removal and or reuse, salvage and disposal of materials and equipment necessary for the work to be performed as shown on the Drawings and as specified herein.
- B. The Owner shall have the right of first refusal on all items associated with this project.

1.02 PROCEDURES

- A. Procedures to be used for the removal of all types of materials shall provide for safe conduct of the work, careful removal and disposition of materials specified to be salvaged, protection of property which is to remain undisturbed, coordination with other work in progress, and timely disconnection of utility services. Existing property which is damaged by the Contractor's operations shall be repaired or replaced in kind by the Contractor at no additional cost to the Owner.
- B. Existing Utilities: The Contractor shall notify the Owner and other proper authorities concerned not less than seven days before starting work in any area. He shall furnish all necessary information as to the nature and extent of the work and shall obtain their cooperation and instructions in locating and protecting all underground pipes, cables, and other utilities. All utility line locations shown on the Drawings are approximate.
- C. Explosives: The use of explosives will not be permitted for demolition of structures.

1.03 SUBMITTALS

- A. Shop Drawings: Indicate demolition and removal sequence and location of salvageable items. Include proposed method of demolition and provisions for erosion, dust, and noise control.
- B. Project Record Documents: Accurately record actual locations of capped utilities and subsurface obstructions. Indicate what fill materials were used in backfilling. Information is to be recorded in drawing form.
- C. Salvaged Material Data: Submit description of all savaged materials, inspection data, and parts lists.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Materials noted to be removed and not relocated, salvaged or reused in the project shall be removed from the construction site and disposed of by the Contractor. Salvaged materials shall be delivered to the Owner.

PART 3 EXECUTION

3.01 GENERAL

- A. During removal operations all persons and property shall be protected from injury or damage. The work shall proceed in a manner that will minimize the generation and spread of dust, flying particles and objectionable odors.

3.02 PROTECTION

- A. Before beginning any cutting or demolition work, the Contractor shall carefully survey the existing work and examine the drawings and specifications to determine the extent of the work. The Contractor shall take all necessary precautions to insure against damage to existing work to remain in place, to be reused, or to remain the property of the Owner, and any damage to such work shall be repaired or replaced as approved by the Engineer at no additional cost to the Owner. The Contractor shall carefully coordinate the work of this section with all other work and construct and maintain shoring, bracing and supports, as required.
- B. Erect, and maintain temporary barriers and security devices, including warning signs and lights, and similar measures, for protection of the public, Owner, Contractor's employees and existing improvements to remain.
- C. Mark location of utilities.

3.03 DEPRESSIONS MADE BY EXCAVATIONS

- A. Depressions made by excavations shall be filled with suitable material and compacted to make the surface conform with the final grades. Fill material and degree of compaction shall conform to the requirements of the sections entitled "Earthwork" and or "Excavation and Backfill for Structures".

3.04 DISPOSITION BY CLASSIFICATION

- A. Reinstalled: Items of material or equipment shown on the drawings or specified to be reinstalled in the work shall be carefully removed from the existing location, shall be cleaned and otherwise readied for reuse, and shall be protected from damage and abuse. Such items shall be reinstalled in accordance with applicable sections of these specifications covering new items of similar categories.
- B. Salvaged: Materials and equipment noted on the drawings or specified to be salvaged shall be carefully removed, cleaned and delivered to a location on Owner's premises as designated by the Engineer or Owner. Final list of items to be salvaged is subject to the Owners review.
- C. Scrapped: All removed materials and equipment with the exception of removed concrete not noted on the drawings or specified to be reinstalled or salvaged shall be considered as scrap and shall be disposed of by the Contractor off of the Owner's property. Removed concrete shall be disposed of off site unless otherwise directed by the Owner or his representative. Final list of items to be scrapped is subject to the Owners review.

3.05 REMOVALS - GENERAL

- A. All mechanical and electrical materials indicated to be salvaged shall be removed prior to initiating the scraping/removal of the existing pump station.
- B. All removed concrete shall be scrapped. Edges of the existing concrete indicated to be removed, and which adjoin portions of retained slabs, shall first be outlined by scoring the surface with a concrete saw. Existing pavement shall be removed only to the maximum allowable trench width, as detailed. Pavement removal in excess of the maximum width will be at the Contractor's expense. In removing the existing pavement, Contractor shall prevent the breaking and cracking of adjacent pavement beyond the limits of trench and final pavement replacement, as detailed by the saw cutting of pavement (full depth second cut) prior to removal.
- C. Rocks produced by blasting and excavation may be used by the Owner. The salvage and transportation of those rocks shall be coordinated with the Owner.
- D. All removed structural steel, supports, grating, etc. shall be scrapped unless otherwise noted on the Drawings.

- E. Structures, Walls and Partitions: Structure and finish shall be removed to the minimum required to remove and install piping. The Contractor shall limit the size of openings for removal. At locations where pipes are removed and not reinstalled, the openings or holes shall be completely filled in to match the surrounding area. At locations where pipes are removed and reinstalled, the openings or holes shall be filled in as shown on the drawings or specified.
- F. All sanitary sewer lines to be abandoned in place shall be pressure filled with flowable concrete fill as specified in the section entitled "Cast in Place Concrete".
- G. Underground structures to be abandoned in place shall be filled with concrete of flowable concrete fill to a depth not less than the crown elevation of the uppermost connecting sewer line. The remaining volume of the structures shall be filled with flowable concrete fill of sand and compacted to Type A compaction.
- H. The uppermost section of underground structures to be abandoned in place shall be removed to a minimum depth of five feet below ground. The excavation shall then be backfilled and compacted in accordance with the section entitled "Earthwork".

3.06 REMOVALS - MECHANICAL

- A. All removed mechanical materials (pumps, valves, fittings) shall be scrapped unless noted to be salvaged on the drawings. Items shall be delivered to the location designated by the Owner or Engineer.
- B. Prior to performing any removal work hereunder, the Contractor shall determine the location of all appropriate shutoff valves so that the work to be modified can be isolated during construction. In the event that no shutoff valve can be found, the Contractor shall make provision to isolate the work by means of plugs, caps or other effective sealing devices.
- C. During the performance of the removal work, the Contractor shall drain the contents of any affected pipes containing liquid in a manner that will prevent such contents from spilling. Extreme care shall be taken in releasing pressurized gas or liquid lines.
- D. Mechanical items to be removed and salvaged to the Owner include, but are not limited to, the following:
 - 1. All process pipe fittings 4 inches and larger.
 - 2. All process valves 4 inches and larger.
 - 3. All pumps including drive shafts, bases, motors, bearing support angles, and appurtenances.

3.07 REMOVALS - ELECTRICAL

- A. Electrical wiring, raceway, and panel boards noted to be removed shall be scrapped.
- B. Fixtures not called out or specified to be re-used shall be salvaged. Remove lens, lamps and hangers and separate in boxes. Label as to contents.
- C. Apparatus and equipment not re-used shall be scrapped. Separate into standard components, box and label as to contents.

3.08 REMOVALS – STRUCTURAL

- A. Structural items to be removed and salvaged to the Owner include, but are not limited to, the following:
 - 1. N/A.

3.09 CLEAN-UP

- A. Debris and rubbish: Remove debris and rubbish from the site daily.

- B. Debris Control: Remove and transport debris in a manner as to prevent spillage on streets or adjacent areas.
- C. Regulations: Local regulations regarding hauling and disposal apply.

END OF SECTION

SECTION 033000
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Footings.
 - 2. Foundation walls.
 - 3. Slabs-on-grade.
 - 4. Concrete toppings.
 - 5. Building and basin walls.

1.03 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. The proposed mix designs shall be submitted by the contractor for review to the engineer of record. Mix design is the responsibility of the Contractor subject to the limitations of the Specifications. Review processing of this submission will be required only as evidence that the mix has been designed by qualified persons and that the minimum requirements of the Specifications have been met. Such review will in no way alter the responsibility of the Contractor to furnish concrete meeting the requirements of the Specifications relative to all criteria listed in the specification. Concrete mix design quantities and test results shall be submitted for review and shall be accepted before concrete work is started. Reports covering the source, quality, and proportions of the concrete materials used in the design mix should include the following information:
 - 1. Slump, determined in accordance with ASTM C143
 - 2. Gallons of water per cubic yard
 - 3. Water-Cementitious materials ratio
 - 4. Air content, determined in accordance with ASTM C231
 - 5. Quantity of cement
 - 6. Quantity of fly ash
 - 7. Specific gravity and gradation of each aggregate in accordance with ASTM C127 and ASTM C128
 - 8. Compressive strength based on 7-day and 28-day compression tests in accordance with ASTM C39

9. Times of initial set, determined in accordance with ASTM C403
 10. Water-soluble chloride ion for the mix and aggregate, determined in accordance with ASTM C1218
 11. Unit weight, determined in accordance with ASTM C138
 12. Type and quantity of each admixture
 13. Mass of each aggregate per cubic yard
 14. Shrinkage test in accordance with ASTM C157
- C. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- D. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- E. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.
1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.
- F. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
1. Location of construction joints is subject to approval of the Architect.
- G. Samples: For waterstops and vapor retarder.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, manufacturer, and testing agency.
- B. Welding certificates.
- C. Material Certificates: For each of the following, signed by manufacturers:
1. Cementitious materials.
 2. Admixtures.
 3. Form materials and form-release agents.
 4. Steel reinforcement and accessories.
 5. Fiber reinforcement.
 6. Waterstops.
 7. Curing compounds.
 8. Floor and slab treatments.
 9. Bonding agents.
 10. Adhesives.
 11. Vapor retarders.
 12. Semirigid joint filler.
 13. Joint-filler strips.
 14. Repair materials.

- D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
 - 1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity. Provide certificates that aggregate comply with ASTM C 33. State weathering region limits of coarse aggregates: severe, moderate, or negligible. State basis of determining that alkali reactivity potential is negligible. Identify certifications and tests to actual materials to be used in the work. Provide additional tests and certifications for each change in material source. Provide an alternate materials source of aggregate if tests indicate that aggregates are reactive or possess severe weathering potential. Submit gradation analysis for fine and course aggregate with concrete mix designs. If deleterious substances are present, state the amount.
- E. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.
- F. Field quality-control reports.
- G. Minutes of preinstallation conference.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
 - 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."
- F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
 - 3. ACI 318, "Building Code requirements for Structural Concrete"
 - 4. ACI 350, "Code Requirements for Environmental Engineering Concrete Structures"
- G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- H. Mockups: Cast concrete slab-on-grade and formed-surface panels to demonstrate typical joints, surface finish, texture, tolerances, floor treatments, and standard of workmanship.

1. Build panel approximately 200 sq. ft for slab-on-grade and 100 sq. ft. for formed surface in the location indicated or, if not indicated, as directed by Architect.
2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

I. Preinstallation Conference: Conduct conference at Project site.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete subcontractor.
 - e. Special concrete finish subcontractor.
2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

J. Evaluation and Acceptance of Concrete

1. Evaluation and acceptance of the compressive strength of concrete shall be according to the requirements of ACI 318, Chapter 5 "Concrete Quality, Mixing, and Placing", and as specified herein.
2. If any concrete fails to meet these requirements, immediate corrective action shall be taken to increase the compressive strength for all subsequent batches of the type of concrete affected.
3. All concrete which fails to meet ACI requirements and these specifications, is subject to removal and replacement at the cost of the Contractor.

- K. In the event tests on control specimens of concrete fall below the specified requirements, the Engineer may permit check tests for strengths to be made by means of typical cores drilled from the related part of the structure in accordance with ASTM C 42 and C 39. All costs associated with the failure to meet the specification requirements, including this type of testing and removal and replacement shall be borne by the Contractor.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 PRODUCTS

2.01 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 1. Plywood, metal, or other approved panel materials.

2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. High-density overlay, Class 1 or better.
 - b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
 - c. Structural 1, B-B or better; mill oiled and edge sealed.
 - d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- E. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- F. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- G. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.
 4. Bolts and rods that are to be completely withdrawn shall be coated with a nonstaining bond breaker.
 5. The Contractor shall be responsible for the water tightness of the form ties and any repairs needed.

2.02 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
- C. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60 ASTM A 706/A 706M, deformed bars, assembled with clips.
- D. Plain-Steel Wire: ASTM A 82/A 82M.
- E. Deformed-Steel Wire: ASTM A 496/A 496M.
- F. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.
- G. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

2.03 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Zinc Repair Material: ASTM A 780, zinc-based solder, paint containing zinc dust, or sprayed zinc.
- C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
 - 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
 - 3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.
- D. Bar Couplers: Reinforcing steel bar splicing couplers shall be a mechanical type as manufactured by Dayton Barsplice Inc., DYWIDAG, or equal. Use couplers which develop 125% of the specified yield strength of the reinforcing bars. Make field demonstrations and sample splicing prior to splicing bars being included into the work.

2.04 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type I/II, gray. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class F.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
 - c. The Portland cement shall contain not more than 0.60% alkalis. The term "alkalies" referred to herein is defined as the sum of the percentage of sodium oxide and 0.658 times the percentage of potassium oxide ($\text{Na}_2\text{O} + 0.658 \text{ K}_2\text{O}$). These oxides shall be determined in accordance with ASTM C 114.
 - d. The Portland cement shall contain not more than 8% tricalcium aluminate.
 - e. A single brand of cement shall be used throughout the Work, and prior to its use, the brand shall be acceptable to the Engineer.
 - f. The cement shall be suitably protected from exposure to moisture until used. Cement that has become lumpy shall not be used. Sacked cement shall be stored in such a manner so as to permit access for inspection and sampling.
 - g. Certified mill test reports for each shipment of cement to be used shall be submitted to the Engineer if requested regarding compliance with these Specifications.
 - h. Fly ash shall have a carbon content of less than 4% as measured by the loss on ignition. 75% of the fly ash shall have a fineness of 45 μm or less.
- B. Silica Fume: ASTM C 1240, amorphous silica.
- C. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source[with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
 - 1. Maximum Coarse-Aggregate Size: 1 inch nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

3. Coarse aggregates shall consist of well-graded, clean, hard, durable gravel, crushed gravel, crushed rock or a combination thereof. Coarse aggregates shall not contain any materials that are reactive with the alkalis in the cement when exposed to moisture. Where aggregate reactivity has not been established or tested, low-alkali cement shall be used.
4. Fine aggregates shall be natural sand or a combination of natural and manufactured sand that are hard and durable.
5. Combined aggregates shall be well graded from coarse to fine sizes, and shall be uniformly graded between screen sizes to produce a concrete that has optimum workability and consolidation characteristics. Where a trial batch is required for a mix design, the final combined aggregate gradations will be established during the trial batch process.
6. When tested in accordance with "Potential Reactivity of Aggregates (Chemical Method)" (ASTM C 289), the ratio of silica released to reduction in alkalinity shall not exceed 1.0.
7. When tested in accordance with "Organic Impurities in Sands for Concrete" (ASTM C 40), the fine aggregate shall produce a color in the supernatant liquid no darker than the reference standard color solution.
8. When tested in accordance with "Resistance to Abrasion of Small size Coarse Aggregate by Use of the Los Angeles Machine (ASTM C 131), the coarse aggregate shall show a loss not exceeding 42% after 500 revolutions, or 10.5% after 100 revolutions.
9. When tested in accordance with "Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate" (ASTM C 88), the loss resulting after five cycles shall not exceed 15% for fine or coarse aggregate when using sodium sulfate.

D. Water: ASTM C 94 and potable.

2.05 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: Use where the air temperature at the time of placement is expected to be consistently over 80° F. ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 - a. If the high range water reducing agent is added to the concrete at the batch plant, it shall be second generation type, [W.R. Grace & Co. Daracem 100], [BASF Pozzoloth 430R], or equal. High range water reducer shall be added to the concrete after all other ingredients have been mixed and initial slump has been verified.
 - b. If the high range water reducer is added to the concrete at the job site, it shall be used in conjunction with a low range water reducer and shall be [BASF Pozzoloth 400N and Pozzoloth MBL82], [W.R. Grace & Co. WRDA 19 and WRDA 79], or equal. Concrete shall have a slump of 3 inches \pm ½-inch prior to adding the high range water reducing admixture at the job site. The high range water reducing admixture shall be accurately measured and pressure injected into the mixer as a single dose by an experienced technician. A standby system shall be provided and tested prior to each day's operation of the job site system.
 - c. Concrete shall be mixed at mixing speed for a minimum of 30 mixer revolutions after the addition of the high range water reducer.

5. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

- C. Set-Accelerating Corrosion-Inhibiting Admixture: Use where the air temperature at the time of placement is expected to be consistently under 40° F. Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494/C 494M, Type C.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Axim Italcementi Group, Inc.; CATEXOL CN-CI.
 - b. BASF Construction Chemicals - Building Systems; Rheocrete CNI.
 - c. Euclid Chemical Company (The), an RPM company.
 - d. Grace Construction Products, W. R. Grace & Co.; DCI.
 - e. Sika Corporation; Sika CNI.
- D. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Construction Chemicals - Building Systems; Rheocrete 222+.
 - b. Cortec Corporation.
 - c. Grace Construction Products, W. R. Grace & Co.; DCI-S.
 - d. Sika Corporation; FerroGard 901.

2.06 VAPOR RETARDERS

- A. Sheet Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Carlisle Coatings & Waterproofing, Inc.; Blackline 400.
 - b. Fortifiber Building Systems Group; Moistop Ultra 15.
 - c. Grace Construction Products, W. R. Grace & Co.; Florprufe 120.
 - d. Insulation Solutions, Inc.; Viper VaporCheck 16.
 - e. Meadows, W. R., Inc.; Perminator 15 mil.
 - f. Raven Industries Inc.; Vapor Block 15.
 - g. Reef Industries, Inc.; Griffolyn 15 mil Green.
 - h. Stego Industries, LLC; Stego Wrap 15 mil Class A.
- B. Sheet Vapor Retarder: Polyethylene sheet, ASTM D 4397, not less than 10 mils thick.
- C. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.
- D. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D 448, Size 10, with 100 percent passing a 3/8-inch sieve, 10 to 30 percent passing a No. 100 sieve, and at least 5 percent passing No. 200 sieve; complying with deleterious substance limits of ASTM C 33 for fine aggregates.

2.07 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Axim Italcementi Group, Inc.; CATEXOL CimFilm.
 - b. BASF Construction Chemicals - Building Systems; Confilm.
 - c. ChemMasters; SprayFilm.
 - d. Conspec by Dayton Superior; Aquafilm.
 - e. Dayton Superior Corporation; Sure Film (J-74).
 - f. Edoco by Dayton Superior; BurkeFilm.
 - g. Euclid Chemical Company (The), an RPM company; Eucobar.
 - h. Kaufman Products, Inc.; Vapor-Aid.
 - i. Lambert Corporation; LAMBCO Skin.
 - j. L&M Construction Chemicals, Inc.; E-CON.
 - k. Meadows, W. R., Inc.; EVAPRE.
 - l. Metalcrete Industries; Waterhold.
 - m. Nox-Crete Products Group; MONOFILM.
 - n. Sika Corporation; SikaFilm.
 - o. SpecChem, LLC; Spec Film.
 - p. Symons by Dayton Superior; Finishing Aid.
 - q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
 - r. Unitex; PRO-FILM.
 - s. Vexcon Chemicals, Inc.; Certi-Vex Envio Set.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
 - b. BASF Construction Chemicals - Building Systems; Kure 200.
 - c. ChemMasters; Safe-Cure Clear.
 - d. Conspec by Dayton Superior; W.B. Resin Cure.
 - e. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
 - f. Edoco by Dayton Superior; Res X Cure WB.
 - g. Euclid Chemical Company (The), an RPM company; Kurez W VOX; TAMMSCURE WB 30C.
 - h. Kaufman Products, Inc.; Thinfil 420.

- i. Lambert Corporation; AQUA KURE - CLEAR.
- j. L&M Construction Chemicals, Inc.; L&M Cure R.
- k. Meadows, W. R., Inc.; 1100-CLEAR.
- l. Nox-Crete Products Group; Resin Cure E.
- m. Right Pointe; Clear Water Resin.
- n. SpecChem, LLC; Spec Rez Clear.
- o. Symons by Dayton Superior; Resi-Chem Clear.
- p. TK Products, Division of Sierra Corporation; TK-2519 DC WB.
- q. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.

F. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Construction Chemicals - Building Systems; Kure-N-Seal 25 LV.
 - b. ChemMasters; Spray-Cure & Seal Plus.
 - c. Conspec by Dayton Superior; Sealcure 1315.
 - d. Dayton Superior Corporation; Day-Chem Cure and Seal (J-22UV).
 - e. Edoco by Dayton Superior; Cureseal 1315.
 - f. Euclid Chemical Company (The), an RPM company; Super Diamond Clear; LusterSeal 300.
 - g. Kaufman Products, Inc.; Sure Cure 25.
 - h. Lambert Corporation; UV Super Seal.
 - i. L&M Construction Chemicals, Inc.; Lumiseal Plus.
 - j. Meadows, W. R., Inc.; CS-309/30.
 - k. Metalcrete Industries; Seal N Kure 30.
 - l. Right Pointe; Right Sheen 30.
 - m. Vexcon Chemicals, Inc.; Certi-Vex AC 1315.
2. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.08 SEALANT

A. The joint sealant shall be a two-part, gray, nonstaining, nonsagging, polyurethane sealant, which cures at ambient temperature to a firm, flexible, resilient, tear-resistant rubber.

B. Technical Requirements:

- | | |
|---------------------------------|---------------------------------------|
| 1. Consistency | Gun grade |
| 2. Tack free time | 72 hours maximum |
| 3. Pot life | 1 to 3 hours |
| 4. Hardness | 30 Shore A, +/-5 |
| 5. Elongation | 50% |
| 6. Tensile strength, ASTM D 412 | 200 psi |
| 7. Peel strength on concrete | No loss of bond with 50% +/- movement |

8. Temperature service range -40 F to +150 F

- C. Backing Rod: Backing rod shall be an extruded closed-cell polyethylene foam rod. The rod shall be 1/4 inch larger in diameter than the joint width. Where possible, provide full-length sections for the joint; minimize splices. Apply backup rod and bond breaker tape in expansion joints.
- D. Bond breaker tape shall be an adhesive-backed glazed butyl or polyethylene tape, which will adhere to the premolded joint material or concrete surface. The tape shall be the same width as the joint. The tape shall be compatible with the sealant.
- E. Expansion Joint Filler: Extruded closed-cell polyethylene foam equal in thickness to joint. Provide foam with tear off strip where joint to receive sealant.
- F. Premolded joint Filler: Joint filler shall be preformed, nonextruded type constructed of closed-cell neoprene conforming to ASTM D 1752, Type I, as manufactured by W.R. Grace Company of Cambridge, Massachusetts; W.R. Meadows, Inc., Elgin, Illinois; or equal.

2.09 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80, or aromatic polyurea with a Type A shore durometer hardness range of 90 to 95 per ASTM D 2240.
- C. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 - 1. Types I and II, non-load bearing Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Reglets: Fabricate reglets of not less than 0.022-inch thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- F. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.
- G. Nonshrink grout shall conform to ASTM C 1107 and shall be [BASF Masterflow 713], [Sika SikaGrout 212], or equal.

2.10 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.

4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.11 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
1. Fly Ash: 25 percent.
 2. Combined Fly Ash and Pozzolan: 25 percent.
 3. Ground Granulated Blast-Furnace Slag: 50 percent.
 4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
 5. Silica Fume: 10 percent.
 6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
 7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing admixture in concrete, as required, for placement and workability.
 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
 4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
- E. Controlled Low Strength Material (Flowable Fill): Flowable fill shall be manufactured at plants that have qualified as an approved source in accordance with the Standard Operating Procedure for Ready-Mix Concrete

1. The Contractor shall submit mix design for flowable fill to the Engineer for approval. The following table lists the suggested mix design for flowable fill:

<u>Component</u>	<u>Quantity</u>
Cement Type I	75 – 150 lb/yd ³
Fly ash	150 – 600 lb/yd ³
Water	Mix design shall produce a consistency that will result in a flowable, self-leveling product at the time of placement
Air	5% – 15%
Unit Weight	100 – 125 lb/ft ³

2.12 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. See Structural General Notes in the Contract Drawings for concrete mix designs.

2.13 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.14 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 EXECUTION

3.01 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
1. Class A, 1/8 inch for smooth-formed finished surfaces.
 2. Class B, 1/4 inch for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
1. Install keyways, reglets, recesses, and the like, for easy removal.

2. Do not use rust-stained steel form-facing material.

- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.02 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 - 2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 - 3. Install dovetail anchor slots in concrete structures as indicated.

3.03 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.04 VAPOR RETARDERS

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.

1. Lap joints 6 inches and seal with manufacturer's recommended tape.
- B. Granular Course: Cover vapor retarder with fine-graded granular material, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch or minus 3/4 inch.
 1. Place and compact a 1/2-inch thick layer of fine-graded granular material over granular fill.

3.05 STEEL REINFORCEMENT

- A. General: Bar bending details and placing drawings shall conform to the "Manual of Standard Practice for Detailing Reinforced Concrete Structures" ACI 315 and with CRSI's "Manual of Standard Practice" for placing reinforcement.
 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.
- F. Steel in walls, unless otherwise shown, shall be continuous through the length of the various members.
- G. Wire mesh reinforcements in slabs shall be continuous, shall have joints lapped at least one full square + 2", and shall be supported as specified.
- H. Welding of reinforcing bars is prohibited unless noted otherwise. When welding is approved, welding shall be in accordance with AWS D1.4 "Welding Reinforcing Steel".
- I. Provide corner bars of the same size and spacing as adjacent reinforcing.
- J. Openings in walls or structural slabs shall be reinforced with minimum 2-#5 bars on all sides or as indicated in details. Extend reinforcing minimum 24" beyond the opening or as indicated.
- K. All reinforcing bars are to be made continuous or lapped minimum 48 bar diameters or as indicated on drawings.
- L. Dowel Bar Substitution: Contractor has the option to replace any or all dowels indicated on the drawings with a dowel bar substitution. Dowel bar substitution shall be of a size to match size of dowels indicated for strength. Inserts shall be secured to the forms in a manner recommended by the manufacturer. Bolts shall be provided with wire fabricated type to provide bolt clearance.

3.06 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 07 Section "Joint Sealants," are indicated.
 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.07 WATERSTOPS

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.
- B. To properly secure waterstops in wall joints before concrete is placed, drill holes in waterstops approximately 1 inch from each edge or between the outermost ribs at each edge and center the waterstop in the joint. Tie both edges of the waterstop and fasten to reinforcing steel with black annealed steel tie wire as specified for tying reinforcing steel and secure in place so that the waterstop will be perpendicular to the joint and remain in the required position during concrete placement. The spacing of the waterstop ties shall match the spacing of the adjacent reinforcing, but need not be spaced closer than 12 inches on center.

- C. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.
- D. Horizontal PVC waterstops in slabs shall have the edge of the waterstop lifted while placing concrete below the waterstop. Then the waterstop shall be manually forced against and into the placed concrete and covered with fresh concrete, to ensure adequate encasement of the waterstop in concrete.
- E. Waterstops shall be installed so that half of the width will be embedded on each side of the joint. Care shall be exercised to ensure that the waterstop is completely embedded in void-free concrete.

3.08 INSTALLATION OF JOINT SEALANTS

- A. Immediately before installing the joint sealant, clean the joint cavity by sandblasting or power wire brushing. Install bond breaker tape per manufacturer's instructions.
- B. After the joints have been prepared as described above, apply the joint sealant. Apply the primer, if required, and joint sealant only with the equipment and methods recommended by the joint sealant manufacturer.
- C. Application criteria for the sealant materials, such as temperature and moisture requirements and primer cure time, shall be in accordance with the recommendations of the sealant manufacturer.
- D. Apply masking tape along the edges of the exposed surface of the exposed joints. Trowel the joints smooth with a tuck pointing tool wiped with a solvent recommended by the sealant manufacturer.
- E. After the sealant has been applied, remove the masking tape and any sealant spillage.
- F. Installation of Premolded Joint Filler: Install in joint accurately as shown. Attach to concrete with a bonding agent recommended by the joint sealant and joint filler manufacturer for compatibility.

3.09 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless such quantity of water is intentionally withheld for later addition at project site. Such addition, in no case should result in altering of the specified water to cementitious material ratio. Indicate the amount of mixing water that is withheld for later addition at the project site on the batch tickets. Provide such batch tickets to the concrete inspector for review and record.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 - 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into

preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Maintain reinforcement in position on chairs during concrete placement.
 - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 4. Slope surfaces uniformly to drains where required.
 - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- F. Placement in Wall Forms: Concrete shall not be dropped through reinforcement steel or into any deep form, whether reinforcement is present or not, causing separation of the coarse aggregate from the mortar on account of repeatedly hitting rods or the sides of the form as it falls, nor shall concrete be placed in any form in such a manner as to leave accumulation of mortar on the form surfaces above the placed concrete. In such cases, some means such as the use of hoppers and, if necessary, vertical ducts of canvas, rubber, or metal shall be used for placing concrete in the forms in a manner that it may reach the place of final deposit without separation. In no case shall the free fall of concrete exceed 4 feet before the ends of ducts, chutes, or buggies. Concrete shall be uniformly distributed during the process of depositing and in no case after depositing shall any portion be displaced in the forms more than 6 feet in horizontal direction. Concrete in forms shall be deposited in uniform horizontal layers not deeper than 2 feet; and care shall be taken to avoid inclined layers or inclined construction joints except where such are required for sloping members. Each layer shall be placed while the previous layer is still soft. The rate of placing concrete in forms shall not exceed 5 feet of vertical rise per hour.
- G. Conveyor Belts and Chutes: All ends of chutes, hopper gates, and all other points of concrete discharge throughout the Contractor's conveying, hoisting and placing system shall be so designed and arranged that concrete passing from them will not fall separated into whatever receptacle immediately receives it. Conveyor belts, if used, shall be of a type acceptable to the Engineer. Chutes longer than 50 feet will not be permitted. Minimum slopes of chutes shall be such that concrete of the specified consistency will readily flow in them. If a conveyor belt is used, it shall be wiped clean by a device operated in such a manner that none of the mortar adhering to the belt will be wasted. All conveyor belts and chutes shall be covered. Sufficient illumination shall be provided in the interior of all forms so that the concrete at the places of deposit is visible from the deck or runway.
- H. Placement in Slabs: Concrete placed in sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the pour. As the work progresses, the concrete shall be vibrated and carefully worked around the slab reinforcement, and the surface of the slab shall be screeded in an upslope direction
- I. Temperature of Concrete: Concrete temperature shall conform to the applicable requirements of ACI 305R – Hot Weather Concreting, and ACI 306R – Cold Weather Concreting, unless otherwise modified herein. The temperature of concrete when it is being placed shall be not more than 90° F. Concrete ingredients shall not be heated to a temperature higher than that necessary to keep the temperature of the mixed concrete, as placed, from falling below the specified minimum temperature. If concrete is placed when the weather is such that the temperature of the concrete would exceed 90° F, the Contractor shall employ effective means, such as precooling of aggregates and mixing water using ice or placing at night, as necessary to maintain the temperature of the concrete, as it is placed, below 90° F. The Contractor shall be entitled to no additional compensation on the account of the foregoing requirements.

- J. Concrete shall be handled from the mixer to the place of final deposit as rapidly as practicable by methods, which will prevent segregation or loss of ingredients and in a manner that the required quality of the concrete is maintained. No concrete shall be placed more than 1½ hours after mixing of that particular batch has commenced.
- K. Pumping Equipment: Pumping equipment and procedures, if used, shall conform to the recommendations contained in the report of ACI Committee 304 on Placing Concrete by Pumping Methods, ACI 304.2R. The specified slump shall be measured at the point of discharge. The loss of slump in pumping shall not exceed 1 inch with or without a superplastizer. The slump loss shall be determined by tests made at each end of the pumping system. If tests indicate a loss greater than 1 inch, the contractor shall modify the pumping system as required to reduce the slump loss.
- L. The order of placing concrete in all parts of the work shall be acceptable to the Engineer. In order to minimize the effects of shrinkage, placement shall be scheduled so that one end of each unit is free, except at corner closures. The placing of units shall be done by placing alternate units in a manner such that each unit placed shall have cured at least 7 days before the contiguous unit or units are placed, except that the corner sections of vertical walls shall not be placed until the 2 adjacent wall panels have cured at least 14 days.
- M. The surface of the concrete shall be level whenever a run of concrete is stopped. To insure a level, straight joint on the exposed surface of walls, a wood strip at least ¾ of an inch thick shall be tacked to the forms on these surfaces. The concrete shall be carried about ½ of an inch above the underside of the strip. About one hour after the concrete is placed, the strip shall be removed and any irregularities in the edge formed by the strip shall be leveled with a trowel and all laitance shall be removed.
- N. As concrete is placed in the forms or in excavations, it shall be thoroughly settled and compacted, throughout the entire depth of the layer which is being consolidated, into a dense, homogeneous mass, filling all corners and angles, thoroughly embedding the reinforcement, eliminating rock pockets, and bringing only a slight excess of water to the exposed surface of concrete during placement. Vibrators shall be high-speed power vibrators (8,000 to 10,000 rpm) of an immersion type in sufficient number and with (at least one) standby units as required.
- O. Care shall be used in placing concrete around waterstops. The concrete shall be carefully worked by rodding and vibrating to make sure that all air and rock pockets have been eliminated. Where waterstops are placed horizontally, the concrete shall be worked under the waterstops by hand, making sure that all air and rock pockets have been eliminated. Concrete surrounding the waterstops shall be given additional vibration, over and above that used for adjacent concrete placement to assure complete embedment of the waterstops in the concrete.
- P. Concrete in walls shall be internally vibrated and at the same time stirred, or worked with suitable appliances, tamping bars, shovels, or forked tools until it completely fills the forms or excavations and closes snugly against all surfaces, eliminating all air or stone pockets which may cause honeycombing, pitting or planes of weakness. Subsequent layers of concrete shall not be placed until the layers previously placed have been worked thoroughly as specified. Vibrators shall be provided in sufficient numbers, with standby units as required, to accomplish the results herein specified within 15 minutes after concrete of the prescribed consistence is placed in the forms. The vibrating head shall be kept from contact with the surfaces of the forms. Overvibrating and use of vibrators to transport concrete within forms shall not be allowed. Vibrators shall be inserted and withdrawn at many points, approximately 18 inches apart. At each insertion, the duration shall be sufficient to consolidate the concrete, but not sufficient to cause segregation, generally from 5 to 15 sec. duration.
- Q. Backfill placed against walls and grade beams shall be done evenly on both sides. Do not place backfill against walls until the concrete has attained a compressive strength equal to the specified 28-day compressive strength. Backfill against basement foundation walls shall not be placed until ground level floor and lower level slabs that brace this wall are in place and cured unless the wall is properly braced with temporary bracing. All bracing, if used, shall be responsibility of the contractor. Submit all calculations and details to the structural engineer for record. Backfill placed directly adjacent to basement and retaining walls shall be compacted clean free draining granular material. For a minimum of 2'-6" from face of the wall. Provide a 1'-6" deep cap of compacted approved impervious cohesive material at top of

granular backfill. All backfill shall be compacted using hand operated equipment; no heavy equipment shall be allowed within 5'-0" of any wall.

- R. No aluminum of any type shall be allowed in concrete work unless coated to prevent aluminum-concrete reaction.
- S. Cross reference structural and architectural drawings for inserts, anchor bolts, notches, ledges, lugs, etc. required on beams. Width and depth of beams given are overall out-to-out dimensions of concrete.
- T. All field bending of reinforcing shall be done cold. Heating of bars will not be permitted.
- U. Maximum O.D. of embedded conduit shall be no larger than 1/3 of the slab thickness. No conduit shall be placed above the welded wire fabric in slabs- on-grade or concrete fill placed onto composite metal deck. Do not place pipes, ducts, reglets or chases in structural concrete or composite floor systems without approval of the structural engineer through the architect.
- V. Provide vertical construction joints in concrete walls that have their outside surface exposed to view at a maximum uniform spacing not to exceed 30'-0". Coordinate joint locations with architectural drawings. Do not cast unexposed walls or grade beams in lengths over 60'-0". Wait 48 hours between adjacent pours. Provide waterstops at all vertical construction joints in walls.
- W. No footing shall be placed onto or against sub-grades containing free water, frost, or ice.
- X. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- Y. Hot-Weather Placement: Comply with ACI 301 and as follows:
 - 1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.10 CONCRETE SLAB ON GRADE CONSTRUCTION

- A. All unacceptable fill and top soil shall be removed from below all proposed slabs-on-grade and the exposed natural soil shall be proof rolled and the compaction verified by a qualified independent soils testing firm prior to placing fill. Areas exhibiting weakness shall be removed and replaced by acceptable compacted fill.
- B. A minimum 4" of compacted granular fill shall be placed under all slabs-on-grade. All fill required to attain final sub-grade for slabs and walls shall be an acceptable material placed and compacted as directed by the project soils consultant report recommendations.
- C. A vapor barrier with minimum 10 mil thickness shall be placed under all interior slab-on-grade or below granular fill for floors to receive floor covering as indicated on architectural drawings. Lap and seal all edges. No vapor barrier required for slab on grades without floor coverings unless noted otherwise.

- D. Pitch slabs to drains and provide depressions, where shown on the process or structural or architectural drawings, without reducing the thickness of slab indicated. See details for additional reinforcing for slabs on grade depressions greater than 1".
- E. Provide slab-on-grade construction joints around each column, against grade beams, interior walls, and between columns and walls. Provide slab joints to form areas not to exceed 15' in length in each direction. See typical details. Submit detailed drawings showing locations of all construction joints.

3.11 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces not exposed to public view. Example: Exterior walls below grade not exposed to water>
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces exposed to public view. Example: Interior walls of structures or buildings exposed to view.
- C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete for basin and tank walls that are exposed to view and where indicated:
 - 1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
 - 2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
 - 3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.
- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.12 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch (6 mm) in one direction.
 - 1. Apply scratch finish to surfaces indicated.

- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
 - 1. Apply float finish to surfaces indicated.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 - 1. Apply a trowel finish to surfaces indicated.
 - 2. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces. While concrete is still plastic, slightly scarify surface with a fine broom.
 - 1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
 - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.13 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

3.14 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- D. All concrete in liquid containing structures shall be water cured.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.15 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.
 1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
 2. Do not apply to concrete that is less than 28 days' old.
 3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.
- B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.
- C. When called for in Finish Schedule or on plans, apply first coat of clear concrete floor sealer after final troweling. Surface is damp, but not wet, and can no longer be marred by workman spray sealer at rate of 300 sq. ft. per gallon. After all trades have completed work, mop-clean floor with TSP solution to remove oil, grease, and dirt, rinse, allow to dry, then cover with second spray coat of sealer at rate of 400 sq. ft. per gallon. Do not allow puddles to occur in either coat.

3.16 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 - 1. Defer joint filling until concrete has aged at least one month. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.17 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 - 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 - 2. After concrete has cured at least 14 days, correct high areas by grinding.
 - 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 - 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 - 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.
- G. Repair of concrete not passing leakage test: After the structure has been tested for leaks, repair leaking concrete cracks by cutting out a square edged and uniformly aligned joint 3/8 inch wide by 3/4 inch deep, preparing exposed surfaces of the joint, priming the joint, and apply low viscosity polyurethane joint sealant in accordance with Manufacturer. The Contractor may submit alternate methods of crack repair for review by the Engineer.

3.18 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections:
1. Steel reinforcement placement.
 2. Steel reinforcement welding.
 3. Headed bolts and studs.
 4. Verification of use of required design mixture.
 5. Concrete placement, including conveying and depositing.
 6. Curing procedures and maintenance of curing temperature.
 7. Verification of concrete strength before removal of shores and forms from beams and slabs.
- D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C 231, pressure method, for normal-weight concrete one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.

5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 6. Compression Test Specimens: ASTM C 31/C 31M.
 - a. Cast and laboratory cure two sets of two and one set of one standard cylinder specimens for each composite sample.
 7. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days. Hold one set of one specimen for future testing if the two tests mentioned above do not meet strength requirements.
 - a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
 8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
 9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
 10. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
 11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
 12. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
 13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 14. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- E. Water-Soluble Chloride Ion: Water-soluble chloride ion testing shall be performed in accordance with ASTM C 1218.

3.19 PROTECTION OF LIQUID FLOOR TREATMENTS

- A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 033000

SECTION 034100
PRECAST STRUCTURAL CONCRETE

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Precast structural concrete with commercial architectural finish.

1.03 DEFINITION

- A. Design Reference Sample: Sample of approved precast structural concrete color, finish, and texture, preapproved by Architect.

1.04 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design precast structural concrete, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated. Precast concrete submittals shall provide a complete structural analysis, placement drawings and individual piece drawings showing reinforcing steel (mild or otherwise). This submittal shall also bear the seal and signature of a professional engineer licensed in the state where the project is located. Lack of seal and signature will be grounds for rejection.
- B. Structural Performance: Precast structural concrete units and connections shall withstand design loads indicated within limits and under conditions indicated.
 - 1. Design precast structural concrete framing system and connections to maintain clearances at openings, to allow for fabrication and construction tolerances, to accommodate live-load deflection, shrinkage and creep of primary building structure, and other building movements. Maintain precast structural concrete deflections within limits of ACI 318.
 - 2. Fire-Resistance Rating: Select material and minimum thicknesses to provide indicated fire rating.

1.05 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each precast concrete mixture. Include compressive strength and water-absorption tests.
- C. Shop Drawings: Include member locations, plans, elevations, dimensions, shapes and sections, openings, support conditions, and types of reinforcement, including special reinforcement. Detail fabrication and installation of precast structural concrete units.
 - 1. Indicate joints, reveals, and extent and location of each surface finish.
 - 2. Indicate separate face and backup mixture locations and thicknesses.
 - 3. Indicate welded connections by AWS standard symbols. Show size, length, and type of each weld.
 - 4. Detail loose and cast-in hardware, lifting and erection inserts, connections, and joints.

5. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
6. Include and locate openings larger than by 10 inches.
7. Indicate location of each precast structural concrete unit by same identification mark placed on panel.
8. Indicate relationship of precast structural concrete units to adjacent materials.
9. Indicate estimated camber for precast units.
10. Indicate shim sizes and grouting sequence.
11. Design Modifications: If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and Shop Drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the general design concept.

D. Samples:

1. For each type of finish indicated on exposed surfaces of precast structural concrete units with architectural finish, in sets of 3, illustrating full range of finish, color, and texture variations expected; approximately 12 by 12 by 2 inches.
 - a. Where other faces of precast concrete unit are exposed, include Samples illustrating workmanship, color, and texture of backup concrete as well as facing concrete.
2. Samples for each thin- or half-brick unit required, showing full range of color and texture expected. Include Samples showing color and texture of joint treatment.
 - a. Grout Samples for Initial Selection: Color charts consisting of actual sections of grout showing manufacturer's full range of colors.
 - b. Grout Samples for Verification: Showing color and texture of joint treatment.

- E. Delegated-Design Submittal: For precast structural concrete indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.06 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and fabricator.
- B. Welding certificates.
- C. Material Certificates: For the following, from manufacturer:
 1. Cementitious materials.
 2. Reinforcing materials and prestressing tendons.
 3. Admixtures.
 4. Bearing pads.
 5. Structural-steel shapes and hollow structural sections.
- D. Material Test Reports: For aggregates.
- E. Source quality-control reports.
- F. Field quality-control reports.

1.07 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm that assumes responsibility for engineering precast structural concrete units to comply with performance requirements. Responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
 - 1. Participates in PCI's Plant Certification program and is designated a PCI-certified plant as follows:
 - a. Group C, Category C3 - Prestressed Straight Strand Structural Members.
 - b. Group CA, Category C3A - Prestressed Straight-Strand Structural Members.
- B. Installer Qualifications: A precast concrete erector qualified as evidenced by PCI's Certificate of Compliance, to erect Category S1 - Simple Structural Systems.
- C. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
- D. Design Standards: Comply with ACI 318 and design recommendations in PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of precast structural concrete units indicated.
- E. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 116, "Manual for Quality Control for Plants and Production of Structural Precast Concrete Products."
- F. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D.1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.4, "Structural Welding Code - Reinforcing Steel."
- G. Mockups: After sample panel approval but before production of precast structural concrete units with architectural finish, construct full-sized mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockup as indicated on Drawings including and precast structural concrete units with an architectural finish complete with anchors, connections, flashings, and joint fillers.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- H. Preinstallation Conference: Conduct conference at Project site.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Support units during shipment on nonstaining shock-absorbing material in same position as during storage.
- B. Store units with adequate bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.
 - 1. Store units with dunnage across full width of each bearing point unless otherwise indicated.
 - 2. Place adequate dunnage of even thickness between each unit.
 - 3. Place stored units so identification marks are clearly visible, and units can be inspected.
- C. Handle and transport units in a position consistent with their shape and design in order to avoid excessive stresses that would cause cracking or damage.

- D. Lift and support units only at designated points shown on Shop Drawings.

1.09 COORDINATION

- A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction before starting that Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fabricators: Subject to compliance with requirements, available fabricators offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Coreslab Structures Inc., Albuquerque, NM (505)247-3725.

2.02 MOLD MATERIALS

- A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that will provide continuous and true precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.
 - 1. Mold-Release Agent: Commercially produced liquid-release agent that will not bond with, stain or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.
- B. Form Liners: Units of face design, texture, arrangement, and configuration indicated. Furnish with manufacturer's recommended liquid-release agent that will not bond with, stain, or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.
- C. Surface Retarder: Chemical set retarder, capable of temporarily delaying final hardening of newly placed concrete mixture to depth of reveal specified.

2.03 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
- C. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60, deformed bars, assembled with clips.
- D. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
- E. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.
- F. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 116.

2.04 PRESTRESSING TENDONS

- A. Pretensioning Strand: ASTM A 416/A 416M, Grade 270, uncoated, 7-wire, low-relaxation strand.

2.05 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type III, gray, unless otherwise indicated.
 - 1. For surfaces exposed to view in finished structure, mix gray with white cement, of same type, brand, and mill source.
- B. Supplementary Cementitious Materials:
 - 1. Fly Ash: ASTM C 618, Class C or F, with maximum loss on ignition of 3 percent.
 - 2. Metakaolin Admixture: ASTM C 618, Class N.
 - 3. Silica Fume Admixture: ASTM C 1240, with optional chemical and physical requirement.
 - 4. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- C. Normal-Weight Aggregates: Except as modified by PCI MNL 116, ASTM C 33. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.
 - 1. Face-Mixture-Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining; to match selected finish sample.
 - a. Gradation: Uniformly grade.
 - 2. Face-Mixture-Fine Aggregates: Selected, natural or manufactured sand of same material as coarse aggregate unless otherwise approved by Architect.
- D. Coloring Admixture: ASTM C 979, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable, and nonfading.
- E. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 116.
- F. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
- G. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.
 - 1. Water-Reducing Admixtures: ASTM C 494/C 494M, Type A.
 - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 - 4. Water-Reducing and Accelerating Admixture: ASTM C 494/C 494M, Type E.
 - 5. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 - 6. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 - 7. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M.
- H. Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

2.06 STEEL CONNECTION MATERIALS

- A. Carbon-Steel Shapes and Plates: ASTM A 36/A 36M.
- B. Carbon-Steel-Headed Studs: ASTM A 108, AISI 1018 through AISI 1020, cold finished, AWS D1.1/D1.1M, Type A or B, with arc shields and with minimum mechanical properties of PCI MNL 116.

- C. Carbon-Steel Plate: ASTM A 283/A 283M.
- D. Malleable-Iron Castings: ASTM A 47/A 47M.
- E. Carbon-Steel Castings: ASTM A 27/A 27M, Grade 60-30.
- F. High-Strength, Low-Alloy Structural Steel: ASTM A 572/A 572M.
- G. Carbon-Steel Structural Tubing: ASTM A 500, Grade B.
- H. Deformed-Steel Wire or Bar Anchors: ASTM A 496 or ASTM A 706/A 706M.
- I. Carbon-Steel Bolts and Studs: ASTM A 307, Grade A; carbon-steel, hex-head bolts and studs; carbon-steel nuts, ASTM A 563; and flat, unhardened steel washers, ASTM F 844.
- J. High-Strength Bolts and Nuts: ASTM A 325 or ASTM A, Type 1, heavy hex steel structural bolts; heavy hex carbon-steel nuts, ASTM A 563; and hardened carbon-steel washers, ASTM F 436.
 - 1. Do not zinc coat ASTM A 490 bolts.
- K. Zinc-Coated Finish: For exterior steel items, steel in exterior walls, and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A 123/A 123M or ASTM A 153/A 153M.
 - 1. For steel shapes, plates, and tubing to be galvanized, limit silicon content of steel to less than 0.03 percent or to between 0.15 and 0.25 percent or limit sum of silicon and 2.5 times phosphorous content to 0.09 percent.
 - 2. Galvanizing Repair Paint: High-zinc-dust-content paint with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035B or SSPC-Paint 20.
- L. Shop-Primed Finish: Prepare surfaces of nongalvanized-steel items, except those surfaces to be embedded in concrete, according to requirements in SSPC-SP 3, and shop apply lead- and chromate-free, rust-inhibitive primer, complying with performance requirements in MPI 79 according to SSPC-PA 1.
- M. Welding Electrodes: Comply with AWS standards.
- N. Precast Accessories: Provide clips, hangers, plastic or steel shims, and other accessories required to install precast structural concrete units.

2.07 BEARING PADS

- A. Provide one of the following bearing pads for precast structural concrete units as recommended by precast fabricator for application:
 - 1. Elastomeric Pads: AASHTO M 251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, 50 to 70 Shore, Type A durometer hardness, ASTM D 2240; minimum tensile strength 2250 psi, ASTM D 412.
 - 2. Random-Oriented, Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer. 70 to 90 Shore, Type A durometer hardness, ASTM D 2240; capable of supporting a compressive stress of 3000 psi with no cracking, splitting, or delaminating in the internal portions of pad. Test 1 specimen for every 200 pads used in Project.
 - 3. Cotton-Duck-Fabric-Reinforced Elastomeric Pads: Preformed, horizontally layered cotton-duck fabric bonded to an elastomer; 80 to 100 Shore, Type A durometer hardness, ASTM D 2240; complying with AASHTO's "AASHTO Load and Resistance Factor Design (LRFD) Bridge Specifications," Division II, Section 18.10.2; or with MIL-C-882E.
 - 4. Frictionless Pads: Tetrafluoroethylene, glass-fiber reinforced, bonded to stainless- or mild-steel plate, of type required for in-service stress.
 - 5. High-Density Plastic: Multimonomer, nonleaching, plastic strip.

2.08 GROUT MATERIALS

- A. Sand-Cement Grout: Portland cement, ASTM C 150, Type I, and clean, natural sand, ASTM C 144 or ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- B. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, Grade A for drypack and Grades B and C for flowable grout and of consistency suitable for application within a 30-minute working time.
- C. Epoxy-Resin Grout: Two-component, mineral-filled epoxy resin; ASTM C 881/C 881M, of type, grade, and class to suit requirements.

2.09 EXTERIOR WALL PANELS

- A. Exterior panels shall be insulated with a minimum of R-25.

2.10 ANCHORS AND INSERTS

- A. Anchors and Inserts shall be ASTM A 36 steel with unprimed finish. Accurately position built-in anchorage and insert devices and secure to formwork. Locate anchorages and inserts where they do not affect position of main reinforcement or concrete placement. Do not relocate bearing plates in units unless approved by Engineer.

2.11 OPENINGS

- A. Cast-in openings larger than 6 inches in diameter or 6 inches in either length or width according to Shop Drawings. Smaller holes may be field cut by trades requiring them. Contractor to coordinate such field cut opening sizes and locations with engineer and precast manufacturer. Such work should only be conducted after approval is received from precast manufacturer and engineer.

2.12 EXTERIOR WALL PANEL CONNECTIONS

- A. All connections to be concealed below floor slab line, above roof deck line, or embedded beneath interior sealant joints.
- B. Provide no less than 2 intermediate panel connections between adjoining panels.

2.13 DRY PACK AND MORTAR

- A. Dry Pack and Mortar for bedding under pre cast concrete shall be non-shrink, non-ferrous and shall have a minimum compressive strength of 3,000 psi in seven days.

2.14 SEALANTS

- A. Exterior and interior caulking at joints: Two part urethane sealant meeting ASTM C 920 equivalent to Sonneborn Sonolastic NP-2, Tremco Dymeric, or equal.
- B. Back-up: Non-staining closed cell polyethylene foam.
- C. Color: Concrete gray to match concrete panels.

2.15 FORM COATINGS

- A. Form Coatings shall be non-staining and not impact the architectural finish.

2.16 FINISH

- A. Exterior architectural finish shall be as specified in the drawings
- B. Interior architectural finish shall be smooth form face, typical.

2.17 INSULATED FLAT WALL PANEL ACCESSORIES

- A. Molded-Polystyrene Board Insulation: ASTM C 578, Type II, 1.35 lb/cu. ft.; square edges; with R-value of 4 per inch and thickness of 2-inches.
- B. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV, 1.60 lb/cu. ft.; square edges; with R-value of 4 per inch and thickness of 2-inches.
- C. Wythe Connectors: Provide one of the following wythe connectors for precast structural concrete units as recommended by precast fabricator for application: Glass-fiber connectors, Vinyl-ester polymer connectors, Polypropylene pin connectors, Stainless-steel pin connectors, Bent galvanized reinforcing bars, Galvanized welded wire trusses, Galvanized bent wire connectors, or Cylindrical metal sleeve anchors manufactured to connect wythes of precast concrete panels.

2.18 CONCRETE MIXTURES

- A. Prepare design mixtures for each type of precast concrete required.
 - 1. Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.
 - 2. Limit use of fly ash to 25 percent replacement of portland cement by weight and granulated blast-furnace slag to 40 percent of portland cement by weight; metakaolin and silica fume to 10 percent of portland cement by weight.
- B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at precast structural concrete fabricator's option.
- C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 or PCI MNL 116 when tested according to ASTM C 1218/C 1218M.
- D. Normal-Weight Concrete Mixtures: Proportion by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
 - 1. Compressive Strength (28 Days): 5000 psi.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.45.
- E. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to PCI MNL 116.
- F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 116.
- G. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.
- H. Concrete Mix Adjustments: Concrete mix design adjustments may be proposed if characteristics of materials, Project conditions, weather, test results, or other circumstances warrant.

2.19 MOLD FABRICATION

- A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for prestressing and detensioning operations. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.
 - 1. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during concrete placement. Coat form liner with form-release agent.
- B. Maintain molds to provide completed precast structural concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.
 - 1. Form joints are not permitted on faces exposed to view in the finished work.
 - 2. Edge and Corner Treatment: Uniformly chamfered.

2.20 FABRICATION

- A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.
 - 1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."
- B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing precast structural concrete units to supporting and adjacent construction.
- C. Cast-in reglets, slots, holes, and other accessories in precast structural concrete units as indicated on the Contract Drawings.
- D. Cast-in openings larger than 10 inches in any dimension. Do not drill or cut openings or prestressing strand without Architect's approval.
- E. Reinforcement: Comply with recommendations in PCI MNL 116 for fabricating, placing, and supporting reinforcement.
 - 1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy-coated reinforcement exceeds limits specified, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.
 - 2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.
 - 3. Place reinforcement to maintain at least 3/4-inch minimum coverage. Increase cover requirements according to ACI 318 when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
 - 4. Place reinforcing steel and prestressing strand to maintain at least 3/4-inch minimum concrete cover. Increase cover requirements for reinforcing steel to 1-1/2 inches when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.

5. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh spacing and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.
- F. Reinforce precast structural concrete units to resist handling, transportation, and erection stresses.
- G. Prestress tendons for precast structural concrete units by either pretensioning or post-tensioning methods. Comply with PCI MNL 116.
1. Delay detensioning or post-tensioning of precast, prestressed structural concrete units until concrete has reached its indicated minimum design release compressive strength as established by test cylinders cured under same conditions as concrete.
 2. Detension pretensioned tendons either by gradually releasing tensioning jacks or by heat cutting tendons, using a sequence and pattern to prevent shock or unbalanced loading.
 3. If concrete has been heat cured, detension while concrete is still warm and moist to avoid dimensional changes that may cause cracking or undesirable stresses.
 4. Protect strand ends and anchorages with bituminous, zinc-rich, or epoxy paint to avoid corrosion and possible rust spots.
 5. Protect strand ends and anchorages with a minimum of 1-inch- thick, nonmetallic, nonshrink, grout mortar and sack rub surface. Coat or spray the inside surfaces of pocket with bonding agent before installing grout.
- H. Comply with requirements in PCI MNL 116 and in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.
- I. Place face mixture to a minimum thickness after consolidation of the greater of 1 inch or 1.5 times the maximum aggregate size, but not less than the minimum reinforcing cover specified.
- J. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units.
1. Place backup concrete mixture to ensure bond with face-mixture concrete.
- K. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air on surfaces. Use equipment and procedures complying with PCI MNL 116.
1. Place self-consolidating concrete without vibration according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants."
- L. Comply with ACI 306.1 procedures for cold-weather concrete placement.
- M. Comply with PCI MNL 116 procedures for hot-weather concrete placement.
- N. Identify pickup points of precast structural concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each precast structural concrete unit on a surface that will not show in finished structure.
- O. Cure concrete, according to requirements in PCI MNL 116, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.
- P. Discard and replace precast structural concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 116 and meet Architect's approval.

2.21 CASTING INSULATED WALL PANELS

- A. Cast and screed wythe supported by mold.
- B. Place insulation boards abutting edges and ends of adjacent boards. Insert wythe connectors through insulation, and consolidate concrete around connectors according to connector manufacturer's written instructions.
- C. Cast and screed top wythe to meet required finish.

2.22 FABRICATION TOLERANCES

- A. Fabricate precast structural concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished unit complies with PCI MNL 116 product dimension tolerances.

2.23 COMMERCIAL FINISHES

- A. Commercial Grade: Remove fins and large protrusions and fill large holes. Rub or grind ragged edges. Faces must have true, well-defined surfaces. Air holes, water marks, and color variations are permitted. Limit form joint offsets to 3/16 inch.
- B. Standard Grade: Normal plant-run finish produced in molds that impart a smooth finish to concrete. Surface holes smaller than 1/2 inch caused by air bubbles, normal color variations, form joint marks, and minor chips and spalls are permitted. Fill air holes greater than 1/4 inch in width that occur more than once per 2 sq. in. Major or unsightly imperfections, honeycombs, or structural defects are not permitted. Limit joint offsets to 1/8 inch.
- C. Grade B Finish: Fill air pockets and holes larger than 1/4 inch in diameter with sand-cement paste matching color of adjacent surfaces. Fill air holes greater than 1/8 inch in width that occur more than once per 2 sq. in. Grind smooth form offsets or fins larger than 1/8 inch. Repair surface blemishes due to holes or dents in molds. Discoloration at form joints is permitted.
- D. Grade A Finish: Fill surface blemishes with the exception of air holes 1/16 inch in width or smaller, and form marks where the surface deviation is less than 1/16 inch. Float apply a neat cement-paste coating to exposed surfaces. Rub dried paste coat with burlap to remove loose particles. Discoloration at form joints is permitted. Grind smooth all form joints.
- E. Screed or float finish unformed surfaces. Strike off and consolidate concrete with vibrating screeds to a uniform finish. Hand screed at projections. Normal color variations, minor indentations, minor chips, and spalls are permitted. Major imperfections, honeycombing, or defects are not permitted.
- F. Smooth, steel trowel finish unformed surfaces. Consolidate concrete, bring to proper level with straightedge, float, and trowel to a smooth, uniform finish.
- G. Apply roughened surface finish according to ACI 318 to precast concrete units that will receive concrete topping after installation.

2.24 COMMERCIAL ARCHITECTURAL FINISHES

- A. Manufacture member faces free of joint marks, grain, and other obvious defects with corners, including false joints, uniform, straight, and sharp. Finish exposed-face surfaces of precast concrete units to match approved mockups and as follows:
 - 1. Design Reference Sample: Per Architectural Drawings.
 - 2. PCI's "Architectural Precast Concrete - Color and Texture Selection Guide," of plate numbers indicated.

3. Smooth-Surface Finish: Provide surfaces free of excessive air voids, sand streaks, and honeycombs, with uniform color and texture.
4. Textured-Surface Finish: Impart by form liners or inserts to provide surfaces free of pockets, streaks, and honeycombs, with uniform color and texture.
5. Bushhammer Finish: Use power or hand tools to remove matrix and fracture coarse aggregates.
6. Exposed-Aggregate Finish: Use chemical-retarding agents applied to concrete molds and washing and brushing procedures to expose aggregate and surrounding matrix surfaces after form removal.
7. Abrasive-Blast Finish: Use abrasive grit, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces.
8. Acid-Etched Finish: Use acid and hot-water solution, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces. Protect hardware, connections, and insulation from acid attack.
9. Honed Finish: Use continuous mechanical abrasion with fine grit, followed by filling and rubbing procedures.
10. Polished Finish: Use continuous mechanical abrasion with fine grit, followed by filling and rubbing procedures.
11. Sand-Embedment Finish: Use selected stones placed in a sand bed in bottom of mold, with sand removed after curing.

2.25 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to evaluate precast structural concrete fabricator's quality-control and testing methods.
 1. Allow testing agency access to material storage areas, concrete production equipment, concrete placement, and curing facilities. Cooperate with testing agency and provide samples of materials and concrete mixtures as may be requested for additional testing and evaluation.
- B. Testing: Test and inspect precast structural concrete according to PCI MNL 116 requirements.
 1. Test and inspect self-consolidating concrete according to PCI TR-6.
- C. Strength of precast structural concrete units will be considered deficient if units fail to comply with ACI 318 requirements for concrete strength.
- D. If there is evidence that strength of precast concrete units may be deficient or may not comply with ACI 318 requirements, employ a qualified testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42/C 42M.
 1. A minimum of three representative cores will be taken from units of suspect strength, from locations directed by Architect.
 2. Cores will be tested in an air-dry condition or, if units will be wet under service conditions, test cores after immersion in water in a wet condition.
 3. Strength of concrete for each series of 3 cores will be considered satisfactory if average compressive strength is equal to at least 85 percent of 28-day design compressive strength and no single core is less than 75 percent of 28-day design compressive strength.
 4. Test results will be made in writing on same day that tests are performed, with copies to Architect, Contractor, and precast concrete fabricator. Test reports will include the following:
 - a. Project identification name and number.
 - b. Date when tests were performed.
 - c. Name of precast concrete fabricator.
 - d. Name of concrete testing agency.

- e. Identification letter, name, and type of precast concrete unit(s) represented by core tests; design compressive strength; type of break; compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.
- E. Patching: If core test results are satisfactory and precast structural concrete units comply with requirements, clean and dampen core holes and solidly fill with same precast concrete mixture that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.
- F. Defective Units: Discard and replace precast structural concrete units that do not comply with requirements, including strength, manufacturing tolerances, and color and texture range. Chipped, spalled, or cracked units may be repaired, subject to Architect's approval. Architect reserves the right to reject precast units that do not match approved samples, sample panels, and mockups.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Do not install precast concrete units until supporting, cast-in-place, building structural framing has attained minimum allowable design compressive strength or until supporting steel or other structure is complete.

3.02 FORMS

- A. Cast concrete units in leak proof rigid forms of plywood or concrete of sufficient strength to withstand deformation of the units. Use forms with surfaces free from irregularities and dents and produce concrete surfaces of smooth appearance free from fins. Construct forms so that they can be removed without hammering or prying against the concrete.

3.03 CASTING BEDS

- A. Maintain casting platforms or slabs in a clean condition prior to depositing concrete. Clean dirt, oil, footprints, and foreign materials from wall panels. In hot or dry weather, cool the casting platform or slabs by water spray prior to concreting. Cover control joints in castings surfaces with tape or fill with putty to minimize transfer of crack patterns to the wall.

3.04 HANDLING

- A. Do not remove castings until the concrete has attained adequate compressive strength to avoid cracking.
- B. Use handling steel, eyebolts, or other lifting inserts located to minimize stresses in handling.
- C. Store and handle units so that the edges are protected from damage. Replace damaged units at Contractor's expense. Clean surfaces and remove surface residue of the curing compound or bond breaker.
- D. Do not erect pre cast units until the concrete reaches the compressive strength required by the design calculations as confirmed by concrete cylinder tests.

3.05 INSTALLATION

- A. Install clips, hangers, bearing pads, and other accessories required for connecting precast structural concrete units to supporting members and backup materials.
- B. Do not erect precast wall panels on wall footings until footing concrete has attained a minimum of 2000 psi compressive strength confirmed by concrete cylinder tests.
- C. Erect precast structural concrete level, plumb, and square within specified allowable tolerances. Provide temporary structural framing, supports, and bracing as required to maintain position, stability, and alignment of units until permanent connection.
 - 1. Install temporary steel or plastic spacing shims or bearing pads as precast structural concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating.
 - 2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
 - 3. Remove projecting lifting devices and grout fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.
- D. Connect precast structural concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.
 - 1. Do not permit connections to disrupt continuity of roof flashing.
- E. Field cutting of precast units is not permitted without approval of the Architect.
- F. Fasteners: Do not use drilled or powder-actuated fasteners for attaching accessory items to precast, prestressed concrete units unless shown on drawings and approved by precast manufacturer's Engineer. Coordinate all field drilling or fastening with Engineer and precast manufacturer before conducting such work.
- G. Welding: Comply with applicable AWS D1.1/D1.1M and AWS D1.4 for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.
 - 1. Protect precast structural concrete units and bearing pads from damage by field welding or cutting operations, and provide noncombustible shields as required.
 - 2. Clean weld-affected steel surfaces with chipping hammer followed by brushing, and apply a minimum 4.0-mil- thick coat of galvanized repair paint to galvanized surfaces according to ASTM A 780.
 - 3. Clean weld-affected steel surfaces with chipping hammer followed by brushing, and reprime damaged painted surfaces.
 - 4. Remove, reweld, or repair incomplete and defective welds.
- H. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.
 - 1. Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot. For friction connections, apply specified bolt torque and check 25 percent of bolts at random by calibrated torque wrench.
- I. Grouting: Grout connections and joints and open spaces at keyways, connections, and joints where required or indicated on Shop Drawings. Retain grout in place until hard enough to support itself. Pack spaces with stiff grout material, tamping until voids are completely filled.
 - 1. Place grout to finish smooth, level, and plumb with adjacent concrete surfaces.
 - 2. Fill joints completely without seepage to other surfaces.

3. Trowel top of grout joints on roofs smooth and uniform. Finish transitions between different surface levels not steeper than 1 to 12.
4. Place grout end cap or dam in voids at ends of hollow-core slabs.
5. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.
6. Keep grouted joints damp for not less than 24 hours after initial set.

3.06 ERECTION TOLERANCES

- A. Erect precast structural concrete units level, plumb, square, true, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 135.
- B. Minimize variations between adjacent slab members by jacking, loading, or other method recommended by fabricator and approved by Architect.
- C. Remove fins and large protrusions and fill large holes. Rub or grind ragged edges.
- D. Units not conforming to specified tolerances rejected and replaced at Engineer's discretion.

3.07 CURING

- A. Cure in accordance with the requirements of PCI MNL 116 and so strength and finish of unit is not impaired. Protect the pre cast wall units from damage of any nature.
- B. Maintain concrete in a moist condition until the expiration of the minimum curing period specified.

3.08 JOINTS

- A. Seal both interior and exterior longitudinal joints. Use type of sealant and back up material specified.

3.09 TOUCH UP

- A. Touch up exposed hardware with two coats of red primer.

3.10 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 1. Erection of precast structural concrete members.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- C. Field welds will be visually inspected and nondestructive tested according to ASTM E 165 or ASTM E 709. High-strength bolted connections will be subject to inspections.
- D. Testing agency will report test results promptly and in writing to Contractor and Architect.
- E. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
- F. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- G. Prepare test and inspection reports.

3.11 REPAIRS

- A. Repair precast structural concrete units if permitted by Architect.
 - 1. Repairs may be permitted if structural adequacy, serviceability, durability, and appearance of units has not been impaired.
- B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet.
- C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780.
- D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.
- E. Remove and replace damaged precast structural concrete units that cannot be repaired or when repairs do not comply with requirements as determined by Architect.

3.12 CLEANING

- A. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.
- B. After erection, clean units of dirt and debris in an approved manner.
- C. Take precautions not to stain, mark, dirty or damage other work during cleaning operations
- D. Upon completion of work of this Section, remove plant equipment, surplus materials and debris resulting from work of this trade.
- E. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
 - 1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's written recommendations. Clean soiled precast concrete surfaces with detergent and water, using stiff fiber brushes and sponges, and rinse with clean water. Protect other work from staining or damage due to cleaning operations.
 - 2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION

SECTION 051200
STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Structural steel.
 - 2. Grout.

1.02 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
- B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.
- C. Heavy Sections: Rolled and built-up sections as follows:
 - 1. Shapes included in ASTM A 6/A 6M with flanges thicker than 1-1/2 inches.
 - 2. Welded built-up members with plates thicker than 2 inches.
 - 3. Column base plates thicker than 2 inches.
- D. Protected Zone: Structural members or portions of structural members indicated as "Protected Zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.
- E. Demand Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the Seismic-Load-Resisting System and which are indicated as "Demand Critical" or "Seismic Critical" on Drawings.

1.03 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering analysis by a qualified professional engineer, to withstand loads indicated and comply with other information and restrictions indicated.
 - 1. Select and complete connections using schematic details indicated.
 - 2. Use ASD; data are given at service-load level.
- B. Moment Connections: Type FR, fully restrained.
- C. Construction: Shear wall system.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication of structural-steel components.
 - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.

2. Include embedment drawings.
 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
 5. Identify members and connections of the seismic-load-resisting system.
 6. Indicate locations and dimensions of protected zones.
 7. Identify demand critical welds.
 8. For structural-steel connections indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint, including the following:
1. Power source (constant current or constant voltage).
 2. Electrode manufacturer and trade name, for demand critical welds.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer or fabricator.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Mill test reports for structural steel, including chemical and physical properties.
- E. Product Test Reports: For the following:
 1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 2. Direct-tension indicators.
 3. Tension-control, high-strength bolt-nut-washer assemblies.
 4. Shear stud connectors.
 5. Shop primers.
 6. Nonshrink grout.
- F. Source quality-control reports.

1.06 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.
- B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category ACSE.
- C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement or SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."

- D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.
- E. Comply with applicable provisions of the following specifications and documents:
 - 1. AISC 303.
 - 2. AISC 341 and AISC 341s1.
 - 3. AISC 360.
 - 4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- F. Preinstallation Conference: Conduct conference at Project site.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

1.08 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 PRODUCTS

2.01 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A992.
- B. Channels, Angles, M, and S-Shapes, Plate and bars: ASTM A 36.
- C. Corrosion-Resisting Structural-Steel Shapes, Plates, and Bars: ASTM A 588/A 588M, Grade 50.
- D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.

- E. Corrosion-Resisting Cold-Formed Hollow Structural Sections: ASTM A 847/A 847M, structural tubing.
- F. Steel Pipe: ASTM A 53, Type E or S, Grade B.
 - 1. Weight Class: As indicated in the Construction Drawings.
 - 2. Finish: Black except where indicated to be galvanized.
- G. Steel Castings: ASTM A 216/A 216M, Grade WCB with supplementary requirement S11.
- H. Steel Forgings: ASTM A 668/A 668M.
- I. Welding Electrodes: Comply with AWS requirements.

2.02 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; all with plain finish.
 - 1. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with plain finish.
- B. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers.
 - 1. Finish: Hot-dip or mechanically deposited zinc coating.
 - 2. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with mechanically deposited zinc coating, baked epoxy-coated finish.
- C. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
- D. Unheaded Anchor Rods: ASTM F 1554, Grade 36.
 - 1. Configuration: Straight
 - 2. Nuts: ASTM A 563 hex carbon steel.
 - 3. Plate Washers: ASTM A 36/A 36M carbon steel.
 - 4. Washers: ASTM F 436, Type 1, hardened carbon steel.
 - 5. Finish: Plain.
- E. Headed Anchor Rods: ASTM F 1554, Grade 36, straight.
 - 1. Nuts: ASTM A 563 hex carbon steel.
 - 2. Plate Washers: ASTM A 36/A 36M carbon steel.
 - 3. Washers: ASTM F 436, Type 1, hardened carbon steel.
 - 4. Finish: Plain.
- F. Threaded Rods: ASTM A 36/A 36M.
 - 1. Nuts: ASTM A 563 hex carbon steel.
 - 2. Washers: ASTM A 36/A 36M carbon steel.
 - 3. Finish: Plain.
- G. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1035.

- H. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.
- I. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1018.
- J. Post-installed Anchors: Unless otherwise indicated in the drawings, drilled anchors shall be Type 303 or 304 stainless steel, zinc-plated steel, or hot-dipped galvanized steel wedge anchors as manufactured by ITW Ramset/Redhead, Kwik Bolt TZ by Hilti, or equal. Anchors shall have ICC-approved testing. Where indicated in drawings, drilled anchors shall be Type 304 stainless steel heavy-duty wedge anchors suitable for dynamic loading. Anchors shall be HSL-3 heavy-duty wedge anchor by Hilti, Power-Bolt by Rawlplug Company, or equal. For metric anchors, use the size that is closest to, but no smaller than, the required English size.
- L. Epoxy Anchors: Epoxy anchors in concrete shall be Type 304 stainless steel or hot-dipped galvanized steel ASTM F1554, Grade 36 threaded rod adhesive anchors. Adhesive shall be Rawl Power-Fast, Hilti HIT RE 500-SD, Simpson Epoxy-tie with SET epoxy, or equal. Epoxy anchor assemblies shall be ICC approved. Epoxy anchors in grouted concrete masonry walls shall be ASTM A36 threaded rods. Epoxy adhesive shall be Hilti HIT HY 150 MAX, Simpson Epoxy-Tie, or equal.
- M. Screw Anchors: Screw anchors shall be Titen HD Screw anchors by Simpson, HUS-H by Hilti, or equal.

2.03 PRIMER

- A. Primer: Comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting".
- B. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.
- C. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20.

2.04 GROUT

- A. Metallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.
- B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.05 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
 - 1. Camber structural-steel members where indicated.
 - 2. Fabricate beams with rolling camber up.
 - 3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
 - 4. Mark and match-mark materials for field assembly.
 - 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning."
- F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.
- G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.
 - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 - 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.06 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.07 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 - 2. Surfaces to be field welded.
 - 3. Surfaces to be high-strength bolted with slip-critical connections.
 - 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 - 5. Galvanized surfaces.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 - 1. SSPC-SP 2, "Hand Tool Cleaning."
 - 2. SSPC-SP 3, "Power Tool Cleaning."
 - 3. SSPC-SP 7/NACE No. 4, "Brush-Off Blast Cleaning."
 - 4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
 - 5. SSPC-SP 14/NACE No. 8, "Industrial Blast Cleaning."
 - 6. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 7. SSPC-SP 10/NACE No. 2, "Near-White Blast Cleaning."
 - 8. SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning."
 - 9. SSPC-SP 8, "Pickling."

- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 - 2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.
- D. Painting: Prepare steel and apply a one-coat, nonasphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils.

2.08 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M. Provide minimum G60. Galvanizing fasteners, connectors and anchors shall be hot-dipped galvanizing in accordance with ASTM A 153.
 - 1. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.

2.09 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.
 - 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- C. Bolted Connections: Shop-bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - 1. Liquid Penetrant Inspection: ASTM E 165.
 - 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - 3. Ultrasonic Inspection: ASTM E 164.
 - 4. Radiographic Inspection: ASTM E 94.
- E. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - 1. Bend tests will be performed if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 - 2. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 - 1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

3.03 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Base Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of baseplate.
 - 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure.
- C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless approved by Architect.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
- H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

3.04 INSTALLING ANCHOR BOLTS

- A. Preset bolts and anchors by the use of templates. For mechanical equipment (pumps, compressors, and blowers), do not use concrete anchors set in holes drilled in the concrete after the concrete is placed.
- B. After anchor bolts have been embedded, protect projecting threads by applying grease and having the nuts installed until the time of installation of the equipment or metalwork.
- C. Minimum depth of embedment of drilled mechanical anchors shall be as recommended by the manufacturer, but no less than that shown in the drawings.
- E. Minimum depth of embedment of epoxy anchors shall be as calculated from Appendix D in ACI 318 , but no less than that shown in the drawings.
- F. Prepare holes for drilled and epoxy anchors in accordance with the anchor manufacturer's recommendations prior to installation.

3.05 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 - 2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
 - 3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

3.06 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.
- B. Furnish qualified inspectors as the duly designated persons who act on behalf of the Owner on all quality assurance matters within the scope of the AWS Code and AISC Code of Standard Practice to ascertain that all fabrication and erection by welding is performed in accordance with the requirements of the specifications.
- C. Qualification of testing personal:
 - 1. Personnel performing nondestructive weld testing shall be qualified in accordance with the current edition of American Society for Nondestructive Testing Recommended Practice No. SNT-TC 1A. Only individuals qualified for NDT Level 1 and working under the NDT Level 11 or individuals qualified for NDT Level 11 may perform the nondestructive testing specified.
 - 2. Personnel performing inspections of welding work shall be currently registered with the AWS as having successfully complied with the requirements of the AWS Standards for Qualification and Certification of Welding Inspectors QCI.
- D. Bolted Connections: Bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- E. Welded Connections: Field welds will be visually inspected according to AWS D1.1/D1.1M.

1. In addition to visual inspection, field welds will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.
- F. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
 1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.
- G. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.07 REPAIRS AND PROTECTION

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.
- B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
- C. Touchup Painting: Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

END OF SECTION 051200

SECTION 052100
STEEL JOIST FRAMING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. K-series steel joists.
 - 2. KCS-type K-series steel joists.
 - 3. K-series steel joist substitutes.
 - 4. LH- and DLH-series long-span steel joists.
 - 5. Joist accessories.

1.03 DEFINITIONS

- A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."
- B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support nonuniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of joist, accessory, and product.
- B. Shop Drawings:
 - 1. Include layout, designation, number, type, location, and spacing of joists.
 - 2. Include joining and anchorage details, bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.
 - 3. Indicate locations and details of bearing plates to be embedded in other construction.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer and professional engineer.
- B. Welding certificates.
- C. Manufacturer certificates.
- D. Mill Certificates: For each type of bolt.
- E. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications."
 - 1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.
- B. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle joists as recommended in SJI's "Specifications."
- B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

1.08 SEQUENCING

- A. Deliver steel bearing plates to be built into cast-in-place concrete and masonry construction.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated.
 - 1. Use ASD; data are given at service-load level.
 - 2. Design special joists to withstand design loads with deflections no greater than the following:
 - a. Roof Joists: Vertical deflection of $1/360$ for live load only and $1/240$ of the span for total load.
- B. Any single panel point of the lower chord of exposed roof joists and truss girders shall be capable of carrying safely a suspended concentrated load of not less than 200 lbs in addition to dead load and live load.
- C. Joist manufacture to design and detail all bridging requirements. Design, detail and provide bridging per SJI specifications.
- D. All joists and joist girders shall be designed for their full loads published in manufacturer's data or SJI's specifications. Joist capacity shall not be reduced to actual loads.

2.02 K-SERIES STEEL JOISTS

- A. Manufacture steel joists of type indicated according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.
 - 1. Joist Type: K-series steel joists and KCS-type K-series steel joists.
- B. Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.
- C. Provide holes in chord members for connecting and securing other construction to joists.
- D. Top-Chord Extensions: Extend top chords of joists with SJI's Type S top-chord extensions where indicated, complying with SJI's "Specifications."

- E. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated, complying with SJI's "Specifications."
- F. Camber joists according to SJI's "Specifications."
- G. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.03 PRIMERS

- A. Primer: SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.
- B. Primer: Provide shop primer that complies with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

2.04 JOIST ACCESSORIES

- A. Bridging: Provide bridging anchors and number of rows of horizontal and/or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.
- B. Fabricate steel bearing plates from ASTM A 36/A 36M steel with integral anchorages of sizes and thicknesses indicated. Shop prime paint.
- C. Steel bearing plates with integral anchorages are specified in Section 055000 "Metal Fabrications."
- D. Furnish ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch of finished wall surface unless otherwise indicated.
- E. Carbon-Steel Bolts and Threaded Fasteners: ASTM A 307, Grade A, carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers.
 - 1. Finish: Plain, uncoated.
- F. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.
 - 1. Finish: Plain.
- G. Welding Electrodes: Comply with AWS standards.
- H. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20.
- I. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.
- J. Provide bottom chord ceiling support extensions where shown on the structural and/or architectural drawings.

2.05 CLEANING AND SHOP PAINTING

- A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.
- B. Do not prime paint joists and accessories to receive sprayed fire-resistive materials.

- C. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.
- D. Shop priming of joists and joist accessories is specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Do not install joists until supporting construction is in place and secured.
- B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written recommendations, and requirements in this Section.
 - 1. Before installation, splice joists delivered to Project site in more than one piece.
 - 2. Space, adjust, and align joists accurately in location before permanently fastening.
 - 3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
 - 4. Rigid connections of bottom chord extensions to column or supports, if shown on drawings, should be delayed until dead loads are applied. Do not rigidly connect bottom chord extensions with supports unless specifically shown and detailed on drawings.
- C. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
- D. Bolt joists to supporting steel framework using carbon-steel bolts.
- E. Bolt joists to supporting steel framework using high-strength structural bolts. Comply with Research Council on Structural Connection's "Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts" for high-strength structural bolt installation and tightening requirements.
- F. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.
- G. All joists at or nearest to column lines shall be bolted with long slotted holes in the bearing shoe. Where joists align with columns, joist bottom chord shall extend to a column connection plate without welding, unless noted otherwise.
- H. No concentrated load or connection greater than 100 lbs shall be applied to the joists further than 4" from any panel point unless an additional web member is provided from the load point to a panel point at the opposite chord. See appropriate details. Additional web member shall be L2x2x3/16 unless otherwise shown on the drawings.
- I. All mechanical ducts and lightweight mechanical units to be suspended from the open web joists shall be supported from hangers and framing supplied by the trade contractor. Connect hangers at joist panel points only.

3.03 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and bolted connections and to perform field tests and inspections and prepare test and inspection reports.
- B. Visually inspect field welds according to AWS D1.1/D1.1M.
 - 1. In addition to visual inspection, test field welds according to AWS D1.1/D1.1M and the following procedures, as applicable:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709.
 - c. Ultrasonic Testing: ASTM E 164.
 - d. Radiographic Testing: ASTM E 94.
- C. Visually inspect bolted connections.
- D. Correct deficiencies in Work that test and inspection reports have indicated are not in compliance with specified requirements.
- E. Perform additional testing to determine compliance of corrected Work with specified requirements.

3.04 PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates, abutting structural steel, and accessories.
 - 1. Clean and prepare surfaces by hand-tool cleaning according to SSPC-SP 2, or power-tool cleaning according to SSPC-SP 3.
 - 2. Apply a compatible primer of same type as primer used on adjacent surfaces.
- C. Touchup Painting: Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- D. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that joists and accessories are without damage or deterioration at time of Substantial Completion.

END OF SECTION

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BARTLETT — *&* — **WEST**

SECTION 053100
STEEL DECKING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Roof deck.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.
- B. Shop Drawings:
 - 1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.
 - 2. Submit current ICC approval for deck diaphragm shear values for deck welds.
- C. Proof of Compliance:
 - 1. Fabrication: Prior to erection of metal decking, deliver to the Owner's Representative a letter signed by an official of the manufacturer's firm certifying that metal decking delivered for this work was fabricated in accordance with these specifications.
 - 2. Erection: Upon completion of erection, deliver to the Owner's Representative a letter signed by an official of the erector's firm certifying that metal decking installed in this work was installed in accordance with these specifications.

1.04 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Product Certificates: For each type of steel deck.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
 - 1. Power-actuated mechanical fasteners.
 - 2. Acoustical roof deck.
- D. Evaluation Reports: For steel deck.
- E. Field quality-control reports.

1.05 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel." Decking welded in place is subject to inspection and testing in accordance with the provisions of the building code. Expense of removing and replacing any portion of decking for testing purposes will be borne by the Owner if welds are found to be satisfactory. If any welds are found defective, the Contractor shall be responsible for the expense of testing and removal and replacing that portion of decking to the satisfaction of the Owner's Representative.
- C. FM Global Listing: Provide steel roof deck evaluated by FM Global and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.
- D. Qualifications of Erector: The erector shall have at least five years' continuous experience in the erection of metal decking.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.
 - 1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Comply with the current editions of codes and regulations including current editions or revisions and supplements of the following reference standards:
 - 1. International Building Code.
 - 2. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
 - 3. AWS D1.3, "Structural Welding Code – Sheet Steel."
 - 4. SDI "Steel Roof Deck Design Manual."
- B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
- C. Compute the properties of metal roof deck sections on the basis of the effective design width as limited by the provisions of the AISI specifications. Provide not less than the specified deck section properties shown including section modulus and moment of inertia per foot of width.
- D. Allowable Deflection: Design and fabricate deck for a maximum deflection of 1/240 of the clear span under the total uniform dead and live load.
- E. Uplift Loading: Install and anchor roof deck units to resist a gross uplift loading of 30 psf (less dead load for roof areas).
- F. Diaphragm Shear: Provide deck and fastenings that have ICC diaphragm shear value and rigidity equal to or greater than the deck indicated in the drawings.

2.02 ROOF DECK

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. ASC Profiles, Inc.; a Blue Scope Steel company.
 2. Canam United States; Canam Group Inc.
 3. CMC Joist & Deck.
 4. Consolidated Systems, Inc.; Metal Dek Group.
 5. DACS, Inc.
 6. Epic Metals Corporation.
 7. Marlyn Steel Decks, Inc.
 8. New Millennium Building Systems, LLC.
 9. Nucor Corp.; Vulcraft Group.
 10. Roof Deck, Inc.
 11. Valley Joist; Subsidiary of EBSCO Industries, Inc.
 12. Verco Manufacturing Co.
- B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
1. Prime-Painted Steel Sheet: ASTM A 1008/A 1008M, Structural Steel (SS), Grade 33 minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
 - a. Color: Manufacturer's standard.
 2. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33, G90 zinc coating.
 3. Deck Profile: As indicated on the Contract Drawings. Retain one profile depth from "Profile Depth" Subparagraph below or revise to suit Project. Indicate locations on Drawings if various depths are required. FM Global approval, if required, is limited to roof deck 1-1/2 inches (38 mm) deep.
 4. Profile Depth: As indicated on the Contract Drawings.
 5. Design Uncoated-Steel Thickness: As indicated on the Contract Drawings.
 6. Span Condition: Triple span or more.
 7. Side Laps: Overlapped or interlocking seam at Contractor's option.

2.03 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- D. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- E. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

- F. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch thick, with factory-punched hole of 3/8-inch minimum diameter.
- G. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.
- H. Galvanizing Repair Paint: ASTM A 780, SSPC-Paint 20 or MIL-P-21035B, with dry film containing a minimum of 94 percent zinc dust by weight.
- I. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.03 ROOF-DECK INSTALLATION

- A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:
 1. Weld Diameter: 5/8 inch, nominal.
 2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds maximum 12 inches apart in the field of roof and 6 inches apart in roof corners and perimeter.

3. Weld Washers: Install weld washers at each weld location.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding 18 inches and as follows:
 1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
 2. Mechanically clinch or button punch.
 3. Fasten with a minimum of 1-1/2-inch- long welds.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 1. End Joints: Lapped 2 inches minimum or butted at Contractor's option.
- D. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.
 1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

3.04 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Field welds will be subject to inspection.
- C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.
- D. Remove and replace work that does not comply with specified requirements.
- E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.05 PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces top surface of prime-painted deck immediately after installation, and apply repair paint.
 1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
 2. Wire brushing, cleaning, and repair painting of bottom deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- C. Repair Painting: Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- D. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION

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BARTLETT & WEST

SECTION 055000
METAL FABRICATIONS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Steel framing and supports for overhead doors and grilles.
2. Steel framing and supports for countertops.
3. Steel framing and supports for mechanical and electrical equipment.
4. Steel framing and supports for applications where framing and supports are not specified in other Sections.
5. Shelf angles.
6. Metal ladders.
7. Ladder safety cages.
8. Metal floor plate and supports.
9. Miscellaneous steel trim including steel angle corner guards and steel edgings.
10. Metal bollards.
11. Cast-iron wheel guards.
12. Metal downspout boots.

B. Products furnished, but not installed, under this Section:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

C. Related Sections:

1. Section 033000 "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
2. Section 051200 "Structural Steel Framing."
3. Section 055300 "Metal Gratings, Cover Plates and Access Hatches."

1.03 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design steel members including comprehensive engineering analysis by a qualified professional engineer licensed in the state where the project is located, using performance requirements and design criteria indicated on the drawings and in accordance with the building code.

- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

1.04 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Nonslip aggregates and nonslip-aggregate surface finishes.
 - 2. Metal nosings and treads.
 - 3. Paint products.
 - 4. Grout.
- B. Shop Drawings: Show fabrication and installation details for metal fabrications.
 - 1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
- C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified professional engineer.
- B. Mill Certificates: Signed by manufacturers of stainless-steel certifying that products furnished comply with requirements.
- C. Welding certificates.
- D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.06 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 - 3. AWS D1.6, "Structural Welding Code - Stainless Steel."

1.07 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.08 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages and steel weld plates and angles for casting into concrete. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 PRODUCTS

2.01 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.02 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 304.
- C. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.
- D. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- E. Rolled-Stainless-Steel Floor Plate: ASTM A 793.
- F. Steel Tubing: ASTM A 500, cold-formed steel tubing.
- G. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40) unless otherwise indicated.
- H. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
 - 1. Size of Channels: 1-5/8 by 1-5/8 inches. As indicated.
 - 2. Material: Galvanized steel, ASTM A 653/A 653M, commercial steel, Type B, structural steel, Grade 33, with G90 (Z275) coating; 0.108-inch nominal thickness.
 - 3. Material: Cold-rolled steel, ASTM A 1008/A 1008M, commercial steel, Type B, structural steel, Grade 33; [0.0966-inch minimum thickness; hot-dip galvanized after fabrication.
- I. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

2.03 NONFERROUS METALS

- A. Aluminum Plate and Sheet: ASTM B 209, Alloy 6061-T6.
- B. Aluminum Extrusions: ASTM B 221, Alloy 6063-T6.
- C. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.
- D. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

- E. Bronze Plate, Sheet, Strip, and Bars: ASTM B 36/B 36M, Alloy UNS No. C28000 (muntz metal, 60 percent copper).
- F. Bronze Extrusions: ASTM B 455, Alloy UNS No. C38500 (extruded architectural bronze).
- G. Bronze Castings: ASTM B 584, Alloy UNS No. C83600 (lead red brass) or No. C84400 (lead semired brass).
- H. Nickel Silver Extrusions: ASTM B 151/B 151M, Alloy UNS No. C74500.
- I. Nickel Silver Castings: ASTM B 584, Alloy UNS No. C97600 (20 percent lead nickel bronze).

2.04 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 - 1. Provide stainless-steel fasteners for fastening aluminum.
 - 2. Provide stainless-steel fasteners for fastening stainless steel.
 - 3. Provide stainless-steel fasteners for fastening nickel silver.
 - 4. Provide bronze fasteners for fastening bronze.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 325, Type 3; with hex nuts, ASTM A 563, Grade C3; and, where indicated, flat washers.
- D. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers; Alloy Group 1.
- E. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
 - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- F. Eyebolts: ASTM A 489.
- G. Machine Screws: ASME B18.6.3.
- H. Lag Screws: ASME B18.2.1.
- I. Wood Screws: Flat head, ASME B18.6.1.
- J. Plain Washers: Round, ASME B18.22.1.
- K. Lock Washers: Helical, spring type, ASME B18.21.1.
- L. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
- M. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

- N. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
 - 2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 1 or Group 2 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.
- O. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

2.05 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Shop Primers: Provide primers that comply with Section 099113 Exterior Painting, Section 099123 Interior Painting.
- C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- F. Nonshrink, Metallic Grout: Factory-packaged, ferrous-aggregate grout complying with ASTM C 1107, specifically recommended by manufacturer for heavy-duty loading applications.
- G. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- H. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi.

2.06 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.
 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
 - G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
 - H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
 - I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
 1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.07 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
 1. Fabricate units from slotted channel framing where indicated.
 2. Furnish inserts for units installed after concrete is placed.
- C. Galvanize miscellaneous framing and supports where indicated.
- D. Prime miscellaneous framing and supports with primer specified in Section 099600 "High-Performance Coatings" where indicated.

2.08 SHELF ANGLES

- A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and 24 inches o.c., unless otherwise indicated.
 1. Provide mitered and welded units at corners.
- B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.
- C. Galvanize shelf angles located in exterior walls.
- D. Prime shelf angles located in exterior walls with zinc-rich primer.
- E. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.09 METAL LADDERS

- A. General:

1. Comply with ANSI A14.3 unless otherwise indicated.
 2. For elevator pit ladders, comply with ASME A17.1.
- B. Vertical Ladders: Fabricate ladders as shown in the drawings. Ladders shall be welded steel construction and galvanized after fabrication as indicated in the drawings. The distance between rungs, cleats, and steps shall not exceed 12 inches and shall be uniform throughout the length of the ladder. The minimum clear length of rungs or cleats shall be 16 inches. [Coat rungs with coarse grain nonskid epoxy coating No. 6901T44 as supplied by McMaster-Carr Supply Company, Los Angeles, California, or equal. Color of coating shall be gray. Apply nonskid coating per manufacturer's recommendations.
- C. Steel Ladders:
1. Space siderails 18 inches apart unless otherwise indicated.
 2. Siderails: Continuous, 3/8-by-2-1/2-inch steel flat bars, with eased edges.
 3. Rungs: 3/4-inch steel bars.
 4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
 5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
 6. Provide nonslip surfaces on top of each rung by coating with abrasive material metallurgically bonded to rung.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - (1) IKG Industries, a division of Harsco Corporation; Mebac.
 - (2) SlipNOT Metal Safety Flooring, a W. S. Molnar company; SlipNOT.
 7. Provide platforms as indicated fabricated from welded or pressure-locked steel bar grating, supported by steel angles. Limit openings in gratings to no more than 3/4 inch in least dimension.
 8. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets.
 9. Galvanize exterior ladders, including brackets and fasteners.

2.10 LADDER SAFETY CAGES

- A. General:
1. Fabricate ladder safety cages to comply with ANSI A14.3. Assemble by welding or with stainless-steel fasteners.
 2. Provide primary hoops at tops and bottoms of cages and spaced not more than 20 feet o.c. Provide secondary intermediate hoops spaced not more than 48 inches o.c. between primary hoops.
 3. Fasten assembled safety cage to ladder rails and adjacent construction by welding or with stainless-steel fasteners unless otherwise indicated.
- B. Steel Ladder Safety Cages:
1. Primary Hoops: 1/4-by-4-inch flat bar hoops.
 2. Secondary Intermediate Hoops: 1/4-by-2-inch flat bar hoops.
 3. Vertical Bars: 3/16-by-1-1/2-inch flat bars secured to each hoop.
 4. Galvanize ladder safety cages, including brackets and fasteners.
 5. Prime ladder safety cages, including brackets and fasteners, with zinc-rich primer.

2.11 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
 - 1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.
- C. Galvanize exterior miscellaneous steel trim.

2.12 METAL BOLLARDS

- A. Fabricate metal bollards from Schedule 40 steel pipe, 1/4-inch wall-thickness steel shapes, as indicated.
 - 1. Cap bollards with 1/4-inch thick steel plate.
 - 2. Where bollards are indicated to receive controls for door operators, provide necessary cutouts for controls and holes for wire.
 - 3. Where bollards are indicated to receive light fixtures, provide necessary cutouts for fixtures and holes for wire.
- B. Fabricate bollards with 3/8-inch thick steel baseplates for bolting to concrete slab. Drill baseplates at all four corners for 3/4-inch anchor bolts.
 - 1. Where bollards are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.
- C. Fabricate sleeves for bollard anchorage from steel pipe or tubing with 1/4-inch thick steel plate welded to bottom of sleeve. Make sleeves not less than 8 inches deep and 3/4 inch larger than OD of bollard.
- D. Fabricate internal sleeves for removable bollards from Schedule 40 steel pipe or 1/4-inch wall-thickness steel tubing with an OD approximately 1/16 inch less than ID of bollards. Match drill sleeve and bollard for 3/4 inch steel machine bolt.
- E. Prime bollards with zinc-rich primer.

2.13 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Galvanize plates.
- C. Prime plates with zinc-rich primer.

2.14 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.15 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.
- C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.16 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
 - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
 - 1. Shop prime with primers specified in Section 099113 "Exterior Painting" or primers specified in Section 099123 "Interior Painting" unless zinc-rich primer is indicated.
- C. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning." requirements indicated below:
 - 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 3. Items Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 4. Other Items: SSPC-SP 3, "Power Tool Cleaning."
- D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.17 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. As-Fabricated Finish: AA-M10 (Mechanical Finish: as fabricated, unspecified).
- C. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
 - 1. Cast Aluminum: Heavy coat of bituminous paint.
 - 2. Extruded Aluminum: Two coats of clear lacquer.

3.02 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Anchor supports for operable partitions securely to and rigidly brace from building structure.
- C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
 - 1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.
- D. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installing Bearing and Leveling Plates" Article.
 - 1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.03 INSTALLING METAL BOLLARDS

- A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.
 - 1. Do not fill removable bollards with concrete.
- B. Anchor bollards to existing construction with anchor bolt. Provide four 3/4-inch bolts at each bollard unless otherwise indicated.
 - 1. Embed anchor bolts at least 8 inches in concrete.

- C. Anchor bollards in concrete with pipe sleeves preset and anchored into concrete. Fill annular space around bollard solidly with nonshrink, nonmetallic grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward bollard.
- D. Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.
- E. Anchor internal sleeves for removable bollards in concrete by inserting into pipe sleeves preset into concrete. Fill annular space around internal sleeves solidly with nonshrink, nonmetallic grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward internal sleeve.
- F. Anchor internal sleeves for removable bollards in place with concrete footings. Center and align sleeves in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace sleeves in position until concrete has cured.
- G. Place removable bollards over internal sleeves and secure with 3/4-inch machine bolts and nuts. After tightening nuts, drill holes in bolts for inserting padlocks. Owner will furnish padlocks.
- H. Fill bollards solidly with concrete, mounding top surface to shed water.
 - 1. Do not fill removable bollards with concrete.

3.04 INSTALLING PIPE GUARDS

- A. Provide pipe guards at exposed vertical pipes in parking garage where not protected by curbs or other barriers. Install by bolting to wall or column with expansion anchors. Provide four 3/4-inch bolts at each pipe guard. Mount pipe guards with top edge 26 inches above driving surface.

3.05 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
 - 1. Use nonshrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations unless otherwise indicated.
 - 2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.06 INSTALLING LADDERS

- A. Mount ladders so that no permanent obstruction is within 7 inches of the ladder's centerline.

3.07 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting" or Section 099123 "Interior Painting."

- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION

SECTION 072115
BOARD INSULATION

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section includes materials and installation of foam plastic board insulation.

1.02 SUBMITTALS

- A. Submit shop drawings and samples in accordance with the General Conditions.
- B. Submit manufacturer's catalog data and descriptive literature including product characteristics, performance criteria, limitations and installation instructions.

1.03 DELIVERY

- A. Protect insulation from physical damage and from becoming wet, soiled, covered with ice or snow or deteriorated by moisture. Store inside and in a dry location. Comply with manufacturer's recommendations for handling, storage, and protection during installation.
- B. Do not expose to sunlight except to necessary extent for period of installation and concealment.
- C. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site before installation time.
- D. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.
- E. Label insulation packages to include material name, production date, and/or product code.
- F. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Engineer and at no additional cost to the Owner.

PART 2 PRODUCTS

2.01 BOARD INSULATION

- A. Extruded Polystyrene Board Insulation: ASTM C 578, of type and minimum compressive strength indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Chemical Company.
 - b. Owens Corning.
 - c. CertianTeed.
 - d. Or equal.
 - 2. Thermal Resistance: R-5 per inch minimum.
 - 3. Compressive Strength: 25psi minimum.
 - 4. Water Absorption: 0.3% by volume maximum.

- B. Polyisocyanurate Board Insulation, Faced: ASTM C 1289, Type II, Class 1 or , with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

1. Manufacturers: Subject to compliance with requirements, :
 - a. Atlas Roofing Corporation.
 - b. Firestone Building Product Company.
 - c. Johns Manville
 - d. Or equal.
2. Thermal Resistance: R-6 per inch minimum.
3. Compressive Strength: 20psi minimum.
4. Water Absorption: 0.3% by volume maximum.

2.02 ADHESIVES

- A. As recommended by insulation manufacturer for application.

2.03 ACCESSORIES

- A. Mechanical Anchors: Type as recommended by insulation manufacturer for type of application and condition of substrate.
- B. Mastic Sealer: Type recommended by insulation manufacturer for bonding edge joints between units and filling voids in work.
- C. Protection Board: Pre-molded, semi-rigid asphalt/fiber composition board, 1/4 inch thick, formed under heat and pressure, standard sizes.
- D. Crack Sealer for Board Insulation: Provide polymeric insulating foam in aerosol dispenser designed for filling voids in board insulation.

2.04 OTHER MATERIALS

- A. Provide materials as recommended by the insulation manufacturer or as indicated in the drawings and as required for complete and proper installation of the work in this section.
- B. Impaling pins.
- C. Sheet metal closure angle at edges of insulation board where interrupted by door or louver openings, equipment, and fixtures.

PART 3 EXECUTION

3.01 INSPECTION AND PREPARATION

- A. Examine the areas and conditions under which work of this section will be installed. Verify that adjacent materials are dry and ready to receive insulation. Verify mechanical and electrical equipment and fixtures have been installed.
- B. Provide written report listing conditions detrimental to performance of work in this section. Do not proceed with installation until unsatisfactory conditions have been corrected.
- C. Do not install adhesives when temperature or weather conditions are detrimental to successful installation. Check with manufacturer for temperature restrictions.

- D. Verify substrate surface is flat, free of honeycomb, fins, irregularities, materials or substances that may impede adhesive bond.
- E. In the event of a discrepancy, immediately notify the Engineer. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.02 INSTALLATION, BELOW GRADE

- A. Vertical Insulation:
 - 1. Place insulation boards as indicated in the Drawings.
 - 2. Where trenched foundations are indicated, trench width shall be increased by amount equal to or greater than the insulation width to maintain the soil contact area indicated.
 - 3. Where formed foundations are indicated, adhere insulation to foundation per manufacturer's recommendations.
- B. Horizontal Insulation:
 - 1. Extend insulation 24" in from exterior wall unless otherwise indicated.
 - 2. Install insulation so it is firmly supported with edges in moderate contact.
- C. Cut insulation to fit snugly around pilasters, projections, curves and irregularities on the wall surface. Fill voids with insulation.
- D. Do not permit work to be damaged prior to covering insulation.

3.03 INSTALLATION, WALLS

- A. Apply insulation directly to the interior surface of the walls with spindle or prong-type anchors. Ensure snug fit between framing members.
- B. Fasten anchors to concrete or masonry with adhesive. Follow manufacturer's recommendations for surface preparation and adhesive pattern.
 - 1. Where insulation is applied over a control joint, adhere a strip of polyethylene sheet over control joint with double beads of adhesive each side of joint between sheets. Extend sheet full height of joint.
 - 2. Apply adhesive in three continuous beads per board length to full bed 1/8 inch thick on substrate. Daub adhesive tight to protrusions to ensure continuity of vapor retarder and air seal.
 - 3. Place membrane surface against adhesive. Place membrane surface facing out.
- C. Impale insulation on anchors and secure with washers. Select pin lengths to ensure tight fit. Protect pin tips where subject to human contact. See manufacturer's diagram for impaling pin pattern.
- D. Carefully cut and fit board insulation around pipes, conduits, and other obstructions less than 12 inches by 12 inches in area. For openings larger than 12 inches by 12 inches, provide sheet metal closure angle as detailed in the drawings.
- E. Tape seal all joints.
- F. Do not permit work to be damaged prior to covering insulation.

3.04 INSTALLATION, ROOF

- A. Position insulation snugly fit between z-furring channel to minimize thermal bridge at channel.

- B. Close all gaps on insulation thermal barrier.
- C. Tape seal all joints.
- D. Do not permit work to be damaged prior to covering insulation.

END OF SECTION

SECTION 072600
VAPOR RETARDER

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes materials and installation of polyethylene film vapor retarder.

1.02 ACTION SUBMITTALS

- A. Submit shop drawings and samples in accordance with the General Conditions.
- B. Submit manufacturer's catalog data, descriptive literature, and samples of the vapor barrier material, tape, and adhesive.

PART 2 PRODUCTS

2.01 APPLICATION / SCOPE

- A. Provide a puncture resistant membrane designed to restrict the transmission of moisture from the ground into concrete slabs.

2.02 VAPOR RETARDER

- A. Classification – ASTM E1745: Class A
- B. Thickness: 10 mils
- C. Tensile Strength – ASTM E154: 150 lb/in minimum
- D. Puncture Resistance – ASTM D1790: 2300 grams minimum
- E. Permeance – ASTM E96: 0.069 US perms
- F. Sheets shall be as wide a practicable for application that will result in the least number of laps.

2.03 RELATED MATERIALS

- A. Seaming tape shall be pressure sensitive adhesive tape, 4" wide minimum, as approved by vapor retarder manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Site Verification of Conditions:
 - 1. Verify that substrate conditions, which have been previously installed under other sections or contracts, are acceptable for product installation in accordance with manufacturer's instructions prior to installation of vapor retarder.
- B. If substrate preparation is the responsibility of another installer, notify Engineer of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Level, tamp and roll the sub-grade soil so that it is well compacted.
- B. Prepare granular base with sharp crushed rock base course and place over the soil to provide maximum density.
- C. Ensure that the finished granular sub-base is level, smooth and dense as possible and at the proper elevation.
- D. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

- A. Place vapor retarder as indicated on Drawings.
- B. Follow manufacturer's current installation guidelines, procedures found in the current version of the ACI 302.1R-04, in accordance with ASTM E-1643 and code bodies having jurisdiction. In the event of a conflict in installation requirements, the more stringent method of installation will prevail.
- C. Unroll vapor retarder over compactable sub-base layer with longest dimension parallel to the direction of the pour. Open folds to full 20 foot (6096mm) width. Ensure that the top layer is always overlapping the bottom layer so that the concrete works its way over the top of the sheets and cannot work its way between adjacent sheets during the pour.
- D. Overlap seams of vapor retarder a minimum 6 inches (152 mm) and seal with a minimum 4 inch (102 mm) wide tape.
- E. For below grade floor slab installation, lay vapor retarder over footing, stopping at vertical wall and corner of footing. Seal these terminations with adhesive type waterstop.
- F. Seal any holes and openings in the vapor retarder. Seal around any penetrations through the vapor retarder, including plumbing systems, piping, and conduit.

3.04 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 076000
FLASHING AND SHEET METAL

PART 1 GENERAL

1.01 SUMMARY

- A. This section includes materials and installation of flashing and sheet metal.

1.02 DESIGN CRITERIA

- A. Conform to the recommendations of SMACNA's Architectural Sheet Metal Manual.

1.03 ACTION SUBMITTALS

- A. Submit shop drawings and samples in accordance with the General Conditions.
- B. Provide details to show sizes, installation, anchorage, and interface with adjacent work of each metal configuration.
- C. Indicate gauge, composition of sheet metal, and compliance with ASTM standards.

1.04 DELIVER, STORAGE, AND HANDLING

- A. Do not store sheet metal materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal materials away from uncured concrete and masonry.
- B. Protect strippable protective covering on sheet metal from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal installation

PART 2 PRODUCTS

2.01 GALVANIZED STEEL

- A. Comply with ASTM A653 with Coating Designation G90. Provide minimum 22-gauge thickness unless noted otherwise.

2.02 ALUMINUM

- A. Comply with ASTM B209, Alloy 3003, Temper H14, 0.032-inch minimum thickness.

2.03 STAINLESS STEEL SHEET

- A. Sheetting shall be Type 304 or 304L per ASTM A666, 22-gauge minimum thickness. Finish shall be No. 4 per ASTM A480.

2.04 WELDING RODS AND WIRE FOR STAINLESS STEEL SHEET

- A. Electrodes shall be Type E308 with Type 304 SS and E316 with Type 316 SS. Welding electrodes shall comply with AWS A5.4. Bare wire shall comply with AWS A5.9.

2.05 NAILS

- A. Use flathead, wire, barbed, slating type, galvanized steel nails, conforming to ASTM F1667, with steel components and sheet. Use flathead, wire, barbed, slating type, aluminum nails, conforming to ASTM F1667 with aluminum components and sheet.

2.06 SCREWS

- A. Use self-tapping sheet-metal type, conforming to ASME B18.6.4. Screw material shall be aluminum or stainless steel for use with aluminum flashing and galvanized steel for use with steel flashing.

2.07 SOLDER FOR GALVANIZED STEEL

- A. Comply with ASTM B32, Alloy Grade Sn50.

2.08 SEALANT

- A. Comply with ASTM C920, Type M, Grade P, Class 25 (minimum) for horizontal joints and Grade NS, Class 25 (minimum) for vertical joints.

2.09 CLEATS

- A. Provide with minimum width of 2 inches. Use the same material and thickness as the sheet metal.

2.10 REGLETS

- A. Use same material as sheet metal. Provide shop-formed corners and joint connectors.

2.11 FABRICATION

- A. Fabricate sheet metal with lines, breaks, and angles sharp and true with surfaces free from objectionable wave, warp, or buckle. Fold exposed edges of sheet metal back to form 1/2-inch-wide hem on side concealed from view. Finish work free from water leakage under all weather conditions.

PART 3 EXECUTION

3.01 PREPARATION FOR INSTALLATION

- A. Verify that substrates are smooth and clean to extent needed for sheet metalwork. Verify that reglets, cants, and blocking to receive sheet metal are installed and free of concrete and soil. Verify shapes and dimensions of surface to be covered.

3.02 INSTALLATION

- A. Install work watertight, without waves, warps, buckles, fastening stresses, or distortion, allowing for expansion and contraction. Hem exposed edges. Angle bottom edges of exposed vertical surfaces to form drips. Clean and flux metals prior to soldering.
- B. Common Lock Seams: 5/8-inch finished width. Four-ply loose lock.
- C. Flat-Lock Seams: 3/4-inch finished width. Four-ply flat lock, malleted tight. Sweat full with solder.
- D. Single-Corner Seams: 5/8-inch finished width. Three-ply loose lock. Corners lapped and soldered.

- E. Lap Seams: 7/8-inch finished width.
- F. Spaced Cleats: 2 feet on center. Secure to substrate with fasteners and cover heads with cleat tabs.
- G. Continuous Cleats: Secure to substrate with fasteners spaced 1 foot on center.
- H. Reglets: Install straight, in line, and with leakproof joints.
- I. Roof Counterflashing: Overlap base flashing 4 inches minimum. Install bottom edge tight against base flashing. Lap seam vertical joints 3 inches minimum and apply sealant. Miter, lap seam, and close corner joints with solder or sealant. Overlap base flashing with counterflashing 1 inch minimum. Slope storm collar away from penetration.
- J. Roof Penetration Flashing: Extend base flashing flange onto roof 6 inches minimum away from penetration. Extend flange upward around penetration to at least 8 inches above roofing felts. Solder lap joints.
- K. Fabricate coping to the shapes and dimensions shown in the drawings. Install with continuous cleats and butt-type joints, 10 feet on center joints to allow for expansion and contraction. Miter, seam, and seal all corners.

3.03 CLEANING

- A. As work progresses, neutralize excess flux with 5% to 10% washing soda solution and thoroughly rinse. Leave work clean and free of stains, scrap, and debris.

3.04 PAINTING AND COATING

- A. Coat aluminum in contact with ferrous metal, concrete, or masonry per Section 099100.
- B. Exposed galvanized steel flashing shall have a natural finish.
- C. Exposed aluminum flashing shall have a mill anodized finish.

END OF SECTION

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BARTLETT  **WEST**

SECTION 076100
SHEET METAL ROOFING & METAL SOFFIT PANELS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes materials and installation of standing seam sheet metal roofing.
- B. Section included material and installation of metal soffit panel and trim.

1.02 COORDINATION

- A. Coordinate sheet metal roofing layout and seams with sizes and locations of roof curbs, equipment supports, equipment provided, and roof penetrations.
- B. Coordinate sheet metal roofing installation with rain drainage work, flashing, trim, soffit panels and construction of roofing substrate, parapets, walls, and other adjoining work to provide leak proof, secure, and noncorrosive installation.

1.03 SUBMITTALS

- A. Submit shop drawings and samples in accordance with the General Conditions.
- B. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, product test reports, sample warranties, and finishes for each manufactured product and accessory.
- C. Shop Drawings: For sheet metal roofing.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Detail fabrication and installation layouts, expansion joint locations, fixed points, and keyed details. Distinguish between shop- and field-assembled work.
 - 3. Include details for forming, including seams and dimensions.
 - 4. Include details for joining and securing, including layout and spacing of fasteners, cleats, and other attachments. Include pattern of seams.
 - 5. Include details of termination points and assemblies.
 - 6. Include details of expansion joints, including showing direction of expansion and contraction from fixed points.
 - 7. Include details of roof penetrations.
 - 8. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings.
 - 9. Include details of special conditions.
 - 10. Include details of connections to adjoining work.
- D. Finish and Color: Include manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each sealant exposed to view.
- E. Maintenance Data: For roofing sheet metals and accessories to include in maintenance manuals.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Roofing installer shall have received training from metal panel manufacturer for installation of the specified roof panel system, and:
- B. Current licensed installer status.
- C. Having and using only equipment authorized and inspected by metal panel manufacturer.
- D. Pre-Installation Conference: Before start of roofing work, Contractor shall hold a meeting to discuss the proper installation of materials and requirements to achieve the warranty.
- E. Require attendance with all parties directly influencing the quality of roofing work or affected by the performance of roofing work.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver products in manufacturer's original containers, dry and undamaged, with seals and labels intact and legible.
- B. Exercise extreme care in unloading, storing, and installing metal panels to prevent bending, warping, twisting, and surface damage.
- C. Store products above ground on well-supported platforms that provide minimum of 1:48 slope. Store under waterproof covering or indoors and provide proper ventilation of metal components to prevent condensation build-up between metal components.

1.06 WARRANTY

- A. Comply with all warranty procedures required by manufacturer, including notifications, scheduling, and inspections.
- B. Manufacturer's warranty is in addition to, and not a limitation of, other rights the owner may have under the contract documents.
- C. Warranty: Covering roof panels and associated metal components, roof sheathing/insulation, and accessories, covering weathertightness, finish, materials, labor, and workmanship.
 - 1. Limit of Liability: No dollar limitation.
 - 2. Scope of Coverage: Repair leaks in the roofing system caused by:
 - a. Ordinary wear and tear of the elements.
 - b. Manufacturing defect in materials.
 - c. Defective workmanship used to install these materials.
 - d. Damage due to winds up to 90 mph.
 - 3. Not Covered:
 - a. Damage due to winds in excess of 140 mph.
 - b. Damage due hurricanes or tornadoes.
 - c. Hail.
 - d. Intentional damage.
 - e. Unintentional damage due to normal rooftop inspections, maintenance, or service.
 - 4. Warranty Period: Two years from date of Substantial Completion.

- D. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal roofing that shows evidence of deterioration of factory-applied finishes within specified warranty period.
1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 2. A 20 year period is available for fluoropolymer finishes and is the maximum included with manufacturer's data; 10 year is typical for polyester. Longer periods may be available.
 3. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturer - Metal Roof Panels and Associated Sheet Metal Components:
1. Provide all components of system supplied or specified by same manufacturer.
 2. Roofing systems manufactured by others may be acceptable provided the roofing system is completely equivalent in materials and warranty conditions and the manufacturer meets the following qualifications:
 - a. Specializing in manufacturing the roofing system to be provided.
 - b. Minimum ten years of experience manufacturing the roofing system to be provided.
 - c. Able to provide a no dollar limit, single source roof system warranty that is backed by corporate assets in excess of one billion dollars.
 - d. ISO 9002 certified.
 - e. Able to provide waterproofing membrane underlayment.

2.02 ROOFING SYSTEM DESCRIPTION

- A. Roofing System: Standing seam metal roof panels and other components, together forming a watertight assembly having the following characteristics:
1. Warranty: 20 year.
 2. Panel Seam Type: Standing Seam, Double Locking in conjunction with concealed clip and bearing plate; Mechanically field seamed.
 3. Panel Material: Steel, 22 gauge (0.79 mm) with Kynar 500 PVDF "Cool Roof" fluoropolymer finish, over G90 hot-dipped galvanized coating.
 4. Color: To be selected from manufacturer's standard and premium colors.
 5. Design Loads: In accordance with ASCE 7, current edition, and as indicated on the drawing documents; otherwise:
 - a. Design Snow Load: Not less than 20 psf (960 kPa).
 - b. Maximum Deflection Under Snow Load: Not more than L/180 or as recommended by ASCE 7, whichever is less.
 - c. Wind Uplift Resistance: Class 90 rating, minimum, when tested in accordance with UL 580.
 - d. Wind Pull-Off Resistance: No failure of roof panel or fasteners when tested in accordance with ASTM E1592 for negative loading equal to negative design wind load; for assemblies not tested, capacity for gauge, span, or loading may be determined by interpolating between test values only.

6. Impact Resistance: Minimum of Class 4, when tested in accordance with UL 2218.
7. Thermal Effects: Design roof panels and their attachment to allow free movement in response to expansion and contraction forces resulting from temperature variation, as specified in the MBMA Metal Roofing Systems Design Manual.
8. External Fire Resistance: Class A, B, A, when tested in accordance with ASTM E108 or UL 790.
9. Provide all necessary members and connections, whether indicated in the manufacturer's standard detail drawings or not.
10. Accessories and Fasteners: Capable of resisting the specified design wind uplift forces and allowing for thermal movement of the roof panel system, not restricting free movement of the roof panel system resulting from thermal forces except at designed points of roof panel fixity.

B. Roof System Components: In order from the top down:

1. Metal roofing panels and trim.
2. Underlayment: Self-adhering, high temperature underlayment: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.
3. DensDeck cover board; minimum 1/4 inch (6 mm) thick.
4. Roof Insulation: Polyisocyanurate foam insulation board.
 - a. Total Thickness: 5 inches (51 mm). [Note: Nominal R value = 5.7 R per 1 inch.]
5. Cover Board: Gypsum-based cover board; minimum 1/4 inch (6 mm) thick.

2.03 ROOF PANELS AND SHEET METAL FABRICATIONS

- A. Roof Panels: Standing Seam Roofing; roll formed roofing panels produced in a permanent factory environment with fixed-base roll-forming equipment.
 1. Seam Height: 2 inches (50.8 mm).
 2. Seam Spacing (Panel Width): Manufacturer's Standard Width Equivalent to: 18 inches (157.2 mm).
 3. Profile: Flat.
 4. Texture: Smooth.
 5. Provide factory applied integral seam sealant in leg of panel.
 6. Form roofing panels in longest practical lengths, true to shape, accurate in size, square, and free from distribution or manufacturing defects.
- B. Steel Sheet: ASTM A653/A653M, lock-forming quality, extra smooth, tension-leveled, galvanized/galvannealed steel, minimum spangle.
- C. Aluminum Sheet For Painted and Mill Finish: ASTM B209, alloy 3003-H14/3105-H14.
- D. Fluoropolymer Coating: 70 percent full strength Kynar 500/Hylar 5000 "Cool Roof".
 1. Exposed Surface: 1.0 mil (0.25 mm) plus/minus 0.1 mil (0.025 mm) total dry film thickness.
 2. Concealed Surface: 0.2 to 0.3 mils (0.05 to 0.08 mm) total dry film thickness.
 3. Color: To be selected from manufacturer's standard and premium colors.
- E. Sheet Metal Components Associated with Metal Roof Panels: Made by same manufacturer and compatible with roof panels; of not less than minimum thickness required by roof panel manufacturer.
 1. Fabricate trim, flashing, and accessories to roofing manufacturer's specified or approved profiles.

2. Exposed metal components of same finish as panels.
3. Flush metal soffit panels.
 - a. Color: Same as panels.
4. Provide the following formed sheet metal components: As indicated on the Drawing Documents.

2.04 METAL SOFFIT PANELS

- A. General: Provide metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.
- B. Flush-Profile Metal Soffit Panels: Solid panels formed with vertical panel edges and a flat pan between panel edges; with flush joint between panels.
 1. Material: Same material, finish, and color as metal [wall] [roof] panels.
 2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: 0.034 inch (0.86 mm).
 - b. Exterior Finish: Two-coat fluoropolymer.
 - c. Color: Match Roof Panel / Trim Color.
- C. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A 792/A 792M, Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
 1. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.
 2. Soffit Framing: clip furring channels to supports, as required to comply with requirements for assemblies indicated.
- D. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
 1. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- E. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Finish flashing and trim with same finish system as adjacent metal panels.
- F. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- G. Panel Sealants: Provide sealant types recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing; 1/8 inch (3 mm) thick.

2. Joint Sealant: ASTM C 920; as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.05 ROOF INSULATION AND COVER BOARDS

- A. Gypsum-Based Cover Board: Non-combustible, water resistant gypsum core with embedded glass mat facers, complying with ASTM C1177/C 1177M, and with the following additional characteristics:
 1. Thickness: As indicated elsewhere.
 2. Surface Water Absorption: 2.5 g, maximum, when tested in accordance with ASTM C473.
 3. Spanning Capability: Recommended by manufacturer for following minimum flute spans:
 - a. 1/4 inch (6 mm) Thickness: 2-5/8 inches (66 mm), minimum.
 4. Surface Burning Characteristics: Flame spread of 0, smoke developed of 0, when tested in accordance with ASTM E84.
 5. Combustibility: Non-combustible, when tested in accordance with ASTM E136.
 6. Factory Mutual approved for use with FM 1-60 and 1-90 rated roofing assemblies.
 7. Mold Growth Resistance: Zero growth, when tested in accordance with ASTM D3273 for minimum of 4 weeks.
 8. Pre-primed for better adhesion.
 9. Acceptable Product: Georgia-Pacific DensDeck Prime Roof Guard.
- B. Insulation/Cover Board Fasteners: Type and size as required by roof membrane manufacturer for roofing system and warranty to be provided; use only fasteners furnished by roof system manufacturer.

2.06 ACCESSORY MATERIALS

- A. Self-Adhered Underlayment: Rubberized sheet waterproof membrane complying with ASTM D 1970/D1970M, self-adhering.
 1. Resistance to Direct Exposure: At least 90 days.
 2. Minimum High Temperature Resistance: 230 degrees F (110 degrees C).
 3. Water Vapor Permeance: 0.1 perm (5.7 ng/(Pa s sq m)), maximum.
- B. Fasteners: In strict accordance with metal roof panel manufacturer's requirements; minimize exposed fasteners.
 1. Fasteners Exposed to Weather: Sealed or with sealed washers on exterior side of covering to waterproof fastener penetration; washer material compatible with screw head; minimum 3/8 inch (9.5 mm) diameter washer for structural connections; gasket portion of fasteners or washers made of EPDM, neoprene, or other equally durable elastomeric material.
 2. Fasteners Exposed to View: Head of color matching panel or component in which installed.

PART 3 INSTALLATION

3.01 GENERAL

- A. Install roofing, insulation, flashings, and accessories in accordance with roofing manufacturer's published instructions and recommendations for the specified roofing system. Where manufacturer provides no instructions or recommendations, follow good roofing practices and industry standards. Comply with federal, state, and local regulations.

- B. Obtain all relevant instructions and maintain copies at project site for duration of installation period.
- C. Verify that shop drawings prepared by metal roof panel manufacturer have been approved and are available to installers; do not use drawings prepared by others for installation drawings.
- D. Verify that the specifications and drawing details are workable and not in conflict with the roofing manufacturer's recommendations and instructions; start of work constitutes acceptance of project conditions and requirements.
- E. Do not start work until Pre-Installation Notice has been submitted to manufacturer as notification that this project requires a manufacturer's warranty.
- F. Perform work using competent and properly equipped personnel.
- G. Temporary closures, which ensure that moisture does not damage any completed section of the new roofing system, are the responsibility of the applicator. Completion of flashings, terminations, and temporary closures shall be completed as required to provide a watertight condition.
- H. Install roofing only when surfaces are clean, dry, smooth and free of snow or ice; do not apply roofing during inclement weather or when ambient conditions will not allow proper application; consult manufacturer for recommended procedures during cold weather. Do not work with sealants and adhesives when material temperature is outside the range of 60 to 80 degrees F (15 to 25 degrees C).
- I. Protect adjacent construction, property, vehicles, and persons from damage related to roofing work; repair or restore damage caused by roofing work.
 - 1. Protect from spills and overspray from bitumen, adhesives, sealants and coatings.
 - 2. Particularly protect metal, glass, plastic, and painted surfaces from bitumen, adhesives, and sealants within the range of wind-borne overspray.
 - 3. Protect finished areas of the roofing system from roofing related work traffic and traffic by other trades.
- J. Until ready for use, keep materials in their original containers as labeled by the manufacturer.
- K. Consult panel manufacturer's instructions, container labels, and Safety Data Sheets (SDS) for specific safety instructions. Keep all adhesives, sealants, primers and cleaning materials away from all sources of ignition.
- L. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

3.02 EXAMINATION

- A. Examine roof deck to determine that it is sufficiently rigid to support installers and their mechanical equipment and that deflection will not strain or rupture roof components or deform deck.
- B. Verify that surfaces and site conditions are ready to receive work. Correct defects in the substrate before commencing with roofing work.
- C. Verify that the substructure installation is in accordance with the approved shop drawings and roof panel manufacturer's requirements, the fasteners are correct for the substrate, and the substrate is installed to accommodate and support the appropriate fastener spacing and attachment.
- D. Verify that installed work of other trades that such work is complete to a point where the roofing system installation may commence.

- E. Verify that roof openings, curbs, pipes, sleeves, ducts, vents, and other penetrations through roof substrate are complete and properly located.
- F. In event of discrepancy, notify Architect in writing; do not proceed with installation until discrepancies have been resolved.

3.03 INSULATION INSTALLATION

- A. Install insulation over entire area to be roofed, mechanically fastened as required by roofing manufacturer.
- B. Provide wood nailers at all perimeters of insulation and at other locations where indicated on the drawings, of total height matching the total thickness of insulation being used.
 - 1. Install with 1/8 inch (3 mm) gap between each length and at each change of direction.
 - 2. Mechanically fasten to deck to resist force of 200 lbf per linear foot (35 kN/m).

3.04 COVER BOARD INSTALLATION

- A. Install cover board over entire area to be roofed, mechanically fastened as required by roofing manufacturer.

3.05 UNDERLAYMENT INSTALLATION

- A. Install underlayment in accordance with manufacturer's instructions.
- B. Install self-adhered underlayment over entire roofing surface.

3.06 ROOF PANEL INSTALLATION

- A. Install the metal roof panel system in accordance with the manufacturer's instructions, installation drawings, and approved shop drawings, so that it is weathertight and allows for thermal movement.
- B. Locate and space all fasteners in accordance with roof panel manufacturer's recommendations. For required exposed fasteners, use proper torque settings to obtain controlled uniform compression for a positive seal without rupturing the sealing washers.
- C. Do not place utility penetrations through the panel seams.
- D. Do not allow panels or trim to come into contact with dissimilar materials (i.e. copper, lead, graphite, treated lumber, mortar, etc). Protect from water run-off from these materials.
- E. Perform field cutting of panels and related sheet metal components by means of hand or electric shears. At no time shall a hot/friction saw be used.
- F. Remove protective film immediately after installation.

3.07 FLASHING AND ACCESSORIES INSTALLATION

- A. Install flashings, including laps, splices, joints, bonding, adhesion, and attachment, as required by roof panel manufacturer's recommendations and details.
- B. Install metal trim, accessories, and edgings in locations indicated on the drawings.
- C. Follow roofing manufacturer's instructions.

- D. Remove protective plastic surface film immediately before installation.
- E. Flashing at Walls, Curbs, and Other Vertical and Sloped Surfaces: Install weathertight flashing at all walls, curbs, parapets, curbs, skylights, and other vertical and sloped surfaces that the roofing system abuts to; extend flashing at least 8 inches high above panel surface.
- F. Flashing at Penetrations: Flash all penetrations passing through the panel; make flashing seals directly to the penetration.
 - 1. Pipes, Round Supports, and Similar Items: Flash with specified pre-molded pipe flashings wherever practical.
 - 2. Where pre-molded pipe flashings are not practical, provide flashing detail as recommended by metal panel manufacturer.

3.08 METAL SOFFIT PANEL INSTALLATION

- A. Metal Soffit Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
 - 1. Apply panels and associated items true to line for neat and weathertight enclosure.
 - 2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
 - 3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
 - 4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
- B. Watertight Installation:
 - 1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels and elsewhere as needed to make panels watertight.
 - 2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
 - 3. At panel splices, nest panels with minimum 6-inch (152-mm) end lap, sealed with sealant and fastened together by interlocking clamping plates.
- C. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
- D. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

3.09 FIELD QUALITY CONTROL

- A. Inspection by Manufacturer: Provide final inspection of the roofing system by a Technical Representative employed by roofing system manufacturer specifically to inspect installation for warranty purposes (i.e. not a sales person).
- B. Perform all corrections necessary for issuance of warranty.

3.10 ADJUSTING AND CLEANING

- A. Repair panels having minor damage.

- B. Remove panels damaged beyond repair and replace with new panels to match adjacent undamaged panels.
- C. Clean exposed panel surfaces promptly after installation in accordance with recommendations of panel and coating manufacturers.
- D. Clean all contaminants generated by roofing work from building and surrounding areas, including adhesives, sealants, and coatings.
- E. Repair or replace building components and finished surfaces damaged or defaced due to the work of this section; comply with recommendations of manufacturers of components and surfaces.
- F. Remove leftover materials, trash, debris, equipment from project site and surrounding areas.

3.11 PROTECTION

- A. Where construction traffic must continue over finished roof panels, provide durable protection and replace or repair damaged roofing to original condition.

END OF SECTION

SECTION 077200
ROOF ACCESSORIES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Roof hatches.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of roof accessory indicated.
- B. Retain first paragraph below for Work that involves custom fabrication.
- C. Shop Drawings: For roof accessories.
- D. Samples: For each exposed product and for each color and texture specified.

1.03 INFORMATIONAL SUBMITTALS

- A. Retain first paragraph below if Drawings do not include detailed plans or if Project involves unusual coordination requirements.
- B. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items.
- C. Warranty: Sample of special warranty.

1.04 WARRANTY

- A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within 20 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 METAL MATERIALS

- A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation.
 - 1. Exposed Coil-Coated Finish: Two-coat fluoropolymer finish; AAMA 621; system consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.
- B. Steel Shapes: ASTM A 36/A 36M, hot-dip galvanized according to ASTM A 123/A 123M unless otherwise indicated.

2.02 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

- C. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWPAC2; not less than 1-1/2 inches (38 mm) thick.
- E. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners.
- F. Sealants: As recommended by roof accessory manufacturer for installation indicated.

2.03 ROOF HATCH

- A. Roof Hatches: Metal roof-hatch units with lids and insulated double-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, stepped integral metal cant raised the thickness of roof insulation, and integrally formed deck-mounting flange at perimeter bottom.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by an available manufacturer offering products that may be incorporated into the Work.
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide The Bilco Company; Type E or comparable product.
- B. Type and Size: Single-leaf lid, 36 by 36 inches (900 by 900 mm)
- C. Loads: Minimum 40-lbf/sq. ft. (1.9-kPa) external live load and 20-lbf/sq. ft. (0.95-kPa) internal uplift load.
- D. Hatch Material: Zinc-coated (galvanized) steel sheet, 0.079 inch (2.01 mm) thick.
 - 1. Finish: Two-coat fluoropolymer.
 - a. Color: As selected by Architect from manufacturer's full range.
- E. Construction:
 - 1. Retain one option in first subparagraph below. Insulation is exposed to exterior in roof hatches with single-walled curbs.
 - 2. Insulation: Polyisocyanurate board.
 - 3. Retain one of first two subparagraphs below; first is more common.
 - 4. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
 - 5. Hatch Lid: Glazed, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
 - 6. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
 - 7. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
 - 8. Fabricate curbs to minimum height of 12 inches (300 mm) unless otherwise indicated.
 - 9. Sloping Roofs: Where slope or roof deck exceeds 1:48, fabricate curb with perimeter curb height that is [constant]. Equip hatch with water diverter or cricket on side that obstructs water flow.
- F. Hardware: Galvanized-steel spring latch with turn handles, butt- or pintle-type hinge system, and padlock hasps inside and outside.
 - 1. Provide two-point latch on lids larger than 84 inches (2130 mm).
 - 2. Provide remote-control operation.

- G. Safety Railing System: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.
- H. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder. Post locks in place on full extension; release mechanism returns post to closed position.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General: Verify dimensions of roof openings for roof accessories. Install roof accessories according to manufacturer's written instructions.
 - 1. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.
 - 2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
 - 3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
 - 4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
 - 1. Coat concealed side of uncoated aluminum, stainless-steel roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
 - 2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene sheet.
- C. Seal joints with sealant as required by roof accessory manufacturer.

3.02 REPAIR AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A 780.
- B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Section 099100 "Painting".
- C. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION

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BARTLETT  **WEST**

SECTION 079200
ARCHITECTURAL CAULKING AND SEALANTS

PART 1 - GENERAL

1.01 SUMMARY

- A. This section includes materials and installation of architectural caulking and sealants for waterproofing buildings and structures.

1.02 SUBMITTALS

- A. Submit shop drawings and samples in accordance with the General Conditions Submit manufacturer's catalog data and descriptive literature including color charts.

1.03 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.04 STORAGE AND HANDLING

- A. Store sealants at temperatures below 50 degrees F. Do not use compounds when they become too jelled to be discharged in a continuous flow from the gun. Do not modify compounds by addition of liquids, solvents, or powders.

1.05 WARRANTY

- A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.01 SYNTHETIC RUBBER SEALING COMPOUND (POLYURETHANE)

A. Polymer-Rubber FS TT-S-00227e Multi-Part Polyurethane

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Building Systems.
 - b. Dow Corning Corporation.
 - c. GE Advanced Materials - Silicones.
 - d. May National Associates, Inc.
 - e. Pecora Corporation.
 - f. Polymeric Systems, Inc.
 - g. Schnee-Morehead, Inc.
 - h. Sika Corporation; Construction Products Division.
 - i. Tremco Incorporated.
2. Type: Single component (S) and Multi component (M)
3. Grade: Pourable (P) and nonsag (NS).
4. Class: A.
5. Uses Related to Exposure: Traffic (T) and Nontraffic (NT)

2.02 SILICONE JOINT SEALANTS

A. Mildew-Resistant Neutral-Curing Silicone Joint Sealant: ASTM C 920.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Building Systems.
 - b. Dow Corning Corporation.
 - c. GE Advanced Materials - Silicones.
 - d. May National Associates, Inc.
 - e. Pecora Corporation.
 - f. Polymeric Systems, Inc.
 - g. Schnee-Morehead, Inc.
 - h. Sika Corporation; Construction Products Division.
 - i. Tremco Incorporated.
2. Type: Single component (S)
3. Grade: (NS).
4. Class: 25.
5. Uses Related to Exposure: Nontraffic (NT).

2.03 LATEX JOINT SEALANTS

A. Latex Joint Sealant: Acrylic latex, ASTM C 834, Type OP, Grade NF.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. BASF Building Systems.
- b. Bostik, Inc.
- c. May National Associates, Inc.
- d. Pecora Corporation.
- e. Schnee-Morehead, Inc.
- f. Tremco Incorporated.

2.04 JOINT SEALANT BACKING

A. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

2.05 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.01 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.

1. Remove laitance and form-release agents from concrete.
2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.02 INSTALLATION

- A. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
- F. Acoustical Sealant Installation: Comply with ASTM C 919 and with manufacturer's written recommendations.
- G. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.03 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.
 - 1. Joint Locations:
 - a. Isolation and contraction joints in cast-in-place concrete slabs.
 - 2. Joint Sealant: Polyurethane, Type (M), pourable (P), traffic (T).
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 1. Joint Locations:
 - a. Construction joints in cast in place concrete.

- b. Joints between precast architectural concrete units.
 - c. Control and expansion joints in unit masonry.
 - d. Joints in exterior insulation and finish systems.
 - e. Joints between metal panels.
 - f. Joints between different materials listed above.
 - g. Perimeter joints between materials listed above and frames of doors windows and louvers.
 - h. Control and expansion joints in ceilings and other overhead surfaces. Retain one of first four subparagraphs below.
 - 2. Joint Sealant: Polyurethane, Type (S), nonsag (NS), non-traffic (NT).
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
- 1. Joint Locations:
 - a. Isolation joints in cast-in-place concrete slabs (Not in areas scheduled for polished/stained concrete.)
 - 2. Joint Sealant: Polyurethane, Type (M), pourable (P), traffic (T).
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
- 1. Joint Locations:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints of exterior openings where indicated.
 - c. Tile control and expansion joints.
 - d. Perimeter joints between interior wall surfaces and frames of interior door, windows.
 - 2. Joint Sealant: Polyurethane, Type (S), nonsag (NS), non-traffic (NT).
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- E. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
- 1. Joint Sealant Location:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Tile control and expansion joints where indicated.
 - 2. Joint Sealant: Silicone, Type (S), nonsag (NS), Class 25, non-traffic (NT).
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- F. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
- 1. Joint Location:
 - a. Joints at paintable surfaces along gypsum wall assemblies.
 - b. Other joints as indicated.
 - 2. Joint Sealant: Acrylic latex, Type OP, Grade NF
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

3.04 FIELD QUALITY CONTROL

- A. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.05 MISCELLANEOUS CAULKING AND SEALING WORK

- A. Provide caulking wherever required to prevent light leakage as well as moisture leakage. Refer to drawings for conditions and related parts of the work.

END OF SECTION

SECTION 081110
METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes metal door work.

1.02 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.03 ACTION SUBMITTALS

- A. Submit shop drawings and samples in accordance with the General Conditions.
- B. Submit manufacturer's catalog data and descriptive literature including construction details, descriptions, core descriptions, fire resistance ratings, installation instructions, and finishes.
- C. Schedule: Provide a schedule of metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.04 DELIVER, STORAGE, AND HANDLING

- A. Deliver metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
 - 1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store metal work vertically under cover at Project site with head up. Place on minimum 4-inch- high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.02 REGULATORY REQUIREMENTS

- A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
 - 1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

- B. Fire-Rated, Borrowed-Light Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.03 EXTERIOR DOORS AND FRAMES

- A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3. At locations indicated in the Door and Frame Schedule.
 - 1. Physical Performance: Level A according to SDI A250.4.
 - 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches.
 - c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.
 - d. Edge Construction: Model 2, Seamless.
 - e. Core: Manufacturer's standard polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.
 - (1) Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 2.1 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.
 - 3. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.
 - b. Construction: Full profile welded.
 - 4. Exposed Finish: Prime.

2.04 HOLLOW METAL PANELS

- A. Provide hollow-metal panels of same materials, construction, and finish as adjacent door assemblies.

2.05 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8 inch diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
- B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:
 - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2.06 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- D. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
 - 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- F. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- G. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.
- H. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- I. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.07 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow Metal Doors:
 - 1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch, steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches apart. Spot weld to face sheets no more than 5 inches o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
 - 2. Fire Door Cores: As required to provide fire-protection ratings indicated.
 - 3. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches.
 - 4. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets.
 - 5. Bottom Edge Closures: Close bottom edges of doors with end closures or channels of same material as face sheets.
 - 6. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.
- C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 2. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.

3. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
 4. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
 5. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.
- E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

2.08 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.09 ACCESSORIES

- A. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.03 INSTALLATION

- A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.
- B. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 as required by standards specified.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - b. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - c. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 - 3. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 - 4. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
 - 1. Non-Fire-Rated Steel Doors:
 - a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
 - c. At Bottom of Door: 3/4 inch plus or minus 1/32 inch.
 - d. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.
 - 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

3.04 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.

- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- E. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.

END OF SECTION

SECTION 083323
COILING DOORS

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section includes materials and installation of coiling doors.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Miscellaneous Structural Steel and Aluminum: 051210.
- B. Door Finish Hardware: 087110.
- C. Painting and Coating: 099000.

1.03 SUBMITTALS

- A. Submit shop drawings and samples in accordance with the General Conditions.
- B. Submit manufacturer's catalog data and descriptive literature. Submit dimensional drawings. Show details for attachment to walls complete, showing door, tracks, hoods, operators, etc.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Overhead Door Corp., Cookson, Cornell, McKeon Door Co., or equal.

2.02 COILING DOOR DESIGN

- A. Coiling doors shall be face mounted and chain operated.

2.03 CURTAINS

- A. Form curtains of galvanized steel with interlocking slats to resist a wind pressure of 20 psf. Slat shall be minimum 24 U.S. gauge. Reinforce the bottom of each curtain with two angles of equal weight. Insulate the voids in the slats with an acoustical blanket having an STC rating of 21. Slat-type curtains shall be Overhead Door Design F265I, insulated, or equal.

2.04 GUIDES

- A. Fabricate guides of structural steel angles not less than 3/16-inch thick. Provide wind bars.

2.05 HOODS

- A. Fabricate hoods of galvanized steel.

2.06 COUNTERBALANCE ASSEMBLY

- A. Provide counterbalance assembly with oil-tempered helical torsion springs having a safety factor of 1.25. Fix springs to tapered cast anchors permanently lubricated, mounted on a single solid torsion rod. Attach torsion rod to spring tension adjustment wheel. House assembly in steel pipe shaft, with deflection not to exceed 0.03 inch per foot of span. Design to balance door such that effort to operate door does not exceed 35 pounds.

2.07 BRACKET PLATES

- A. Bracket plates shall be of steel plate. Provide sealed ball bearings to support the counterbalance assembly. Provide brackets to form end closures and support hoods.

2.08 WEATHER SEALS

- A. Provide neoprene weather seals at sides (external), bottom bar, and internal baffle in hood.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install per manufacturer's recommendations. Isolate dissimilar metals from each other.

3.02 PAINTING AND COATING

- A. Factory primed & finished, as selected by Architect from Manufacturer's full standard color range.

3.03 TESTING

- A. Operate doors through two full cycles of opening or closing. Assure that doors operate smoothly and do not stick or bind. Repair or replace doors that exhibit binding or sticking.

END OF SECTION

SECTION 084110
ALUMINUM STOREFRONT SYSTEM

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section includes the materials and installation of glazed wall systems, including aluminum entrance doors, frames, and finish hardware.

1.02 DESIGN

- A. Design aluminum window walls to withstand a minimum wind pressure of 15 psf with a maximum permissible deflection of 1/175 of the length, or as required by local codes, whichever is more stringent.
- B. Provide reinforcing to resist vertical and lateral forces prescribed in the IBC. Keep within dimensions of aluminum sections detailed.

1.03 SUBMITTALS

- A. Submit shop drawings and samples in accordance with the General Conditions.
- B. Submit fully detailed shop drawings for aluminum work and doors included in this section including a complete hardware schedule for doors.
- C. Shop drawings shall show that members and reinforcing conform with IBC code requirements for dead load, wind load, and connections.
- D. Submit sample of anodized aluminum member and glazing gasket.
- E. Submit color samples of doors and matching hardware.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Kawneer, U.S. Aluminum Corp., or equal.
- B. Aluminum members noted in the drawings are those of the Kawneer Company.

2.02 ALUMINUM

Extruded aluminum sections shall be Alloy 6063-T6, with the major portions of each extrusion not less than 0.093 inch in thickness unless otherwise noted or specified. Glass stops shall be 0.050 inch thick. Sheet aluminum shall be 5005 aluminum alloy. Exposed materials shall be free from defects and other surface blemishes. Aluminum members shall conform to ASTM B221, Alloy 6063-T5.

2.03 FINISHES

- A. Exposed aluminum surfaces shall be 'AAMA 2605' Fluoropolymer Coating (70% PVDF), as selected by architect from manufacturer's full standard color range.
- B. Exposed surfaces shall be free from defects, die marks, scratches, streaks, or other surface blemishes before being anodized.

- C. Exposed fasteners shall match the color finish of the adjacent material.
- D. Plate exposed door hardware to match the color and finish of the doors.

2.04 WALL SYSTEM

- A. Vertical and horizontal frame members shall be as shown, noted, or specified in the drawings. Provide solid watertight box sections at heads and jambs where shown.
- B. Glass framing members shall provide for flush glazing on all sides with through sight lines and no projecting stops on face joints. The system shall provide fully resilient setting of glass by use of neoprene gaskets on both sides of the glass. Do not use vinyl gaskets.
- C. Size vertical and horizontal steel reinforcing for members based on structural calculations and design analyses for imposed dead loads and wind load.
- D. Flashing shall have a minimum thickness of 0.040 inch.

2.05 FASTENERS

- A. Nuts, screws, washers, bolts, clips, miscellaneous fastening devices, and internal components shall be aluminum or stainless steel.

2.06 GLAZING GASKETS

- A. Extruded neoprene synthetic rubber, bulb type, continuous, in color to match aluminum finish.

2.07 CAULKING AND SEALANTS

- A. Sealant work and materials shall conform to Section 079200.
- B. Application of final sealants in exterior perimeter joints exposed after erection of aluminum or adjacent work is included under Section 079200. Sealant work in conjunction with the erection and installation of aluminum work shall be included as work under this section.

PART 3 EXECUTION

3.01 DELIVERY, STORAGE, HANDLING, AND PROTECTION OF MATERIALS

- A. Deliver materials with manufacturer's label still intact and legible.
- B. Store materials indoors on raised platforms.
- C. When materials are in areas under construction, cover to prevent concrete, mortar, and other materials from dropping onto metal or glass surfaces.
- D. After constructing storefront, provide tape at glazing and cover exposed frames when construction is still in progress.

3.02 INSTALLATION

- A. Erect work plumb, level, square, and in proper alignment and relationship to surrounding work. Finished aluminum work shall be free of waves, buckles, dents, or other defects and shall be securely anchored to the structure as detailed and required. Provide anchors, clips, bolts, reglets, etc., required to properly

secure all work in place. Do not use exposed screws, rivets, or bolts for any portion of the work. Do not use powder-driven fasteners for securing aluminum members to concrete.

- B. Tightly and continuously caulk and tape joints.
- C. Wherever aluminum is installed in contact with concrete or masonry, separate with butyl tape. Use butyl tape to separate aluminum from dissimilar metal. Provide protection during fabrication, shipment, site storage, and erection to prevent damage to finish work. Clean aluminum work, removing blemishes, finger marks, oxidation, etc. Obtain the storefront system manufacturer's approval of the cleaning compound.
- D. Caulk and seal the component parts of the assembly to produce a weatherproof installation. Aluminum fabricator shall examine and approve the methods and materials to be used in glazing before any glass is installed. Glass and glazing are specified in Section 088100.
- E. Install without marking or defacing hardware or finish work. Fasten hardware with machine screws or bolts. Do not use sheet metal screws for attaching hardware. Fastenings shall be stainless steel or tempered aluminum. Fasten items of finish hardware at all points where fasteners are indicated or required. Install thresholds embedded in sealant. Test hardware to assure correct alignment and operation. Adjust door closers so that doors open smoothly. Clean and polish hardware.
- F. Do not apply manufacturer's trade names in conspicuous, exposed locations.

END OF SECTION

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BARTLETT —
— **& WEST**

SECTION 087100
DOOR HARDWARE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes commercial door hardware for the following:
 - 1. Swinging doors.
 - 2. Sliding doors.
 - 3. Other doors to the extent indicated.
- B. Door hardware includes, but is not necessarily limited to, the following:
 - 1. Mechanical door hardware.
 - 2. Electromechanical door hardware, power supplies, back-ups and surge protection.
 - 3. Cylinders specified for doors in other sections.
- C. Related Sections:
 - 1. Division 08 Section "Door Hardware Schedule".
 - 2. Division 08 Section "Hollow Metal Doors and Frames".
 - 3. Division 08 Section "Flush Wood Doors".
- D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
 - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
 - 2. ICC/IBC - International Building Code.
 - 3. NFPA 80 - Fire Doors and Windows.
 - 4. NFPA 101 - Life Safety Code.
 - 5. NFPA 105 - Installation of Smoke Door Assemblies.
 - 6. State Building Codes, Local Amendments.
- E. Standards: All hardware specified herein shall comply with the following industry standards:
 - 1. ANSI/BHMA Certified Product Standards - A156 Series
 - 2. UL10C - Positive Pressure Fire Tests of Door Assemblies

1.03 SUBMITTALS

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
 2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
 3. Content: Include the following information:
 - a. Type, style, function, size, label, hand, and finish of each door hardware item.
 - b. Manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - e. Explanation of abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for door hardware.
 - g. Door and frame sizes and materials.
 4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
- C. Shop Drawings: Details of electrified access control hardware indicating the following:
1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
 - a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
 - b. Complete (risers, point-to-point) access control system block wiring diagrams.
 2. Electrical Coordination: Coordinate with related Division 26 Electrical Sections the voltages and wiring details required at electrically controlled and operated hardware openings.
- D. Keying Schedule: Prepared under the supervision of the Owner, separate schedule detailing final keying instructions for locksets and cylinders in writing. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner to approve submitted keying schedule prior to the ordering of permanent cylinders.
- E. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals. The manual to include the name, address, and contact information of the manufacturers providing the hardware and their nearest service representatives. The final copies delivered after completion of the installation test to include "as built" modifications made during installation, checkout, and acceptance.
- F. Warranties and Maintenance: Special warranties and maintenance agreements specified in this Section.

1.04 QUALITY ASSURANCE

- A. **Manufacturers Qualifications:** Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. **Installer Qualifications:** Installers, trained by the primary product manufacturers, with a minimum 5 years documented experience installing both standard and electrified builders hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- C. **Door Hardware Supplier Qualifications:** Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor in good standing by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.
 - 1. **Scheduling Responsibility:** Preparation of door hardware and keying schedules.
- D. **Source Limitations:** Obtain each type and variety of Door Hardware specified in this Section from a single source, qualified supplier unless otherwise indicated.
 - 1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
 - 2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.
- E. **Regulatory Requirements:** Comply with NFPA 70, NFPA 80, NFPA 101 and ANSI A117.1 requirements and guidelines as directed in the model building code including, but not limited to, the following:
 - 1. NFPA 70 "National Electrical Code", including electrical components, devices, and accessories listed and labeled as defined in Article 100 by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - 2. Where indicated to comply with accessibility requirements, comply with Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG)," ANSI A117.1 as follows:
 - a. **Handles, Pulls, Latches, Locks, and other Operating Devices:** Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.
 - b. **Door Closers:** Comply with the following maximum opening-force requirements indicated:
 - 1) Interior Hinged Doors: 5 lbf applied perpendicular to door.
 - 2) Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 - c. **Thresholds:** Not more than 1/2 inch high. Bevel raised thresholds with a slope of not more than 1:2.
 - 3. **NFPA 101:** Comply with the following for means of egress doors:
 - a. **Latches, Locks, and Exit Devices:** Not more than 15 lbf to release the latch. Locks shall not require the use of a key, tool, or special knowledge for operation.
 - b. **Thresholds:** Not more than 1/2 inch high.

4. Fire-Rated Door Assemblies: Provide door hardware for assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252 (neutral pressure at 40" above sill) or UL-10C.

- a. Test Pressure: Positive pressure labeling.

- F. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.
- G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
 1. Function of building, purpose of each area and degree of security required.
 2. Plans for existing and future key system expansion.
 3. Requirements for key control storage and software.
 4. Installation of permanent keys, cylinder cores and software.
 5. Address and requirements for delivery of keys.
- H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
 1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
 2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
 3. Review sequence of operation narratives for each unique access controlled opening.
 4. Review and finalize construction schedule and verify availability of materials.
 5. Review the required inspecting, testing, commissioning, and demonstration procedures
- I. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.06 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of

other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

- B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.
- C. Door and Frame Preparation: Related Division 08 Sections (Steel, Aluminum and Wood) doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.07 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
 - 1. Structural failures including excessive deflection, cracking, or breakage.
 - 2. Faulty operation of the hardware.
 - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 4. Electrical component defects and failures within the systems operation.
- C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.
- D. Special Warranty Periods:
 - 1. Seven years for heavy duty cylindrical (bored) locks and latches.
 - 2. Twenty five years for manual surface door closers.
 - 3. Two years for electromechanical door hardware.

1.08 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
- B. Continuing Service: Beginning at Substantial Completion, and running concurrent with the specified warranty period, provide continuous (6) months full maintenance including repair and replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door opening operation. Provide parts and supplies as used in the manufacture and installation of original products.

PART 2 - PRODUCTS

2.01 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

1. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:

- a. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

- B. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.02 HANGING DEVICES

- A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity, unless otherwise indicated:
 - a. Two Hinges: For doors with heights up to 60 inches.
 - b. Three Hinges: For doors with heights 61 to 90 inches.
 - c. Four Hinges: For doors with heights 91 to 120 inches.
 - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
 - a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
 - b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
 - a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
 - b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
4. Hinge Options: Comply with the following where indicated in the Hardware Sets or on Drawings:
 - a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the following applications:
 - 1) Out-swinging exterior doors.
 - 2) Out-swinging access controlled doors.
 - 3) Out-swinging lockable doors.
5. Acceptable Manufacturers:
 - a. Bommer Industries (BO).
 - b. Hager Companies (HA).
 - c. McKinney Products (MK).

2.03 DOOR OPERATING TRIM

- A. Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified automatic, self-latching, and manual flush bolts and surface bolts. Manual flush bolts to be furnished with top rod of sufficient length to allow bolt location approximately six feet from the floor. Furnish dust proof strikes for bottom bolts. Surface bolts to be minimum 8" in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
1. Acceptable Manufacturers:
- Burns Manufacturing (BU).
 - Door Controls International (DC).
 - Rockwood Manufacturing (RO).
 - Trimco (TC).
- B. Coordinators: ANSI/BHMA A156.3 certified door coordinators consisting of active-leaf, hold-open lever and inactive-leaf release trigger. Coordinators fabricated from steel with nylon-coated strike plates and built-in adjustable safety release.
1. Acceptable Manufacturers:
- Burns Manufacturing (BU).
 - Door Controls International (DC).
 - Rockwood Manufacturing (RO).
 - Trimco (TC).
- C. Door Push Plates and Pulls: ANSI/BHMA A156.6 certified door pushes and pulls of type and design specified below or in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.
1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
 2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
 3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
 4. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.
- a. Acceptable Manufacturers:
- 1) Hiawatha, Inc. (HI).
 - 2) Rockwood Manufacturing (RO).
 - 3) Trimco (TC).

2.04 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
- B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.
1. Acceptable Manufacturers:
- a. Schlage (SC). "C" keyway 6 pin
 - b. All key records are at Becker Lock & Key

- C. Cylinders: Original manufacturer cylinders complying with the following:
1. Mortise Type: Threaded cylinders with rings and straight- or clover-type cam.
 2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
 3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
 4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
 5. Keyway: Match Facility Standard.
- D. Keying System: Each type of lock and cylinders to be factory keyed. Conduct specified "Keying Conference" to define and document keying system instructions and requirements. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner. Incorporate decisions made in keying conference, and as follows:
1. Existing System: Master key or grand master key locks to Owner's existing system.
- E. Key Quantity: Provide the following minimum number of keys:
1. Top Master Key: One (1)
 2. Change Keys per Cylinder: Two (2)
 3. Master Keys (per Master Key Group): Two (2)
 4. Grand Master Keys (per Grand Master Key Group): Two (2)

2.05 MECHANICAL LOCKS AND LATCHING DEVICES

- A. Cylindrical Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.2, Series 4000, Grade 1 certified cylindrical (bored) locksets furnished in the functions as specified in the Hardware Sets. Lock chassis fabricated of heavy gauge steel, zinc dichromate plated, with through-bolted application. Furnish with solid cast levers, standard 2 3/4" backset, and 1/2" (3/4" at rated paired openings) throw brass or stainless steel latchbolt. Locks are to be non-handed and fully field reversible.
1. Acceptable Manufacturers:
 - a. Corbin Russwin Hardware (RU) – CL3300 Series.
 - b. Sargent Manufacturing (SA) – 10 Line.
 - c. Schlage (SC) – ND Series.
 - d. Yale Locks and Hardware (YA) 5400LN Series.
- B. Lock Trim Design: As specified in Hardware Sets.

2.06 LOCK AND LATCH STRIKES

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
 2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
 3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
- B. Standards: Comply with the following:
1. Strikes for Mortise Locks and Latches: BHMA A156.13.

2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.5.
4. Dustproof Strikes: BHMA A156.16.

2.07 DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers including installation and adjusting information on inside of cover.
2. Standards: Closers to comply with UL-10C and UBC 7-2 for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
3. Cycle Testing: Provide closers which have surpassed 15 million cycles in a test witnessed and verified by UL.
4. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ANSI ICC/A117.1.
5. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
 - a. Where closers are indicated to have mechanical dead-stop, provide heavy duty arms and brackets with an integral positive stop.
 - b. Where closers are indicated to have mechanical hold open, provide heavy duty units with an additional built-in mechanical holder assembly designed to hold open against normal wind and traffic conditions. Holder to be manually selectable to on-off position.
 - c. Where closers are indicated to have a cushion-type stop, provide heavy duty arms and brackets with spring stop mechanism to cushion door when opened to maximum degree.
 - d. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics. Provide drop plates or other accessories as required for proper mounting.
6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates, and through-bolt or security type fasteners as specified in the door Hardware Sets.

B. Door Closers, Surface Mounted (Large Body Cast Iron): ANSI/BHMA A156.4, Grade 1 surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control.

1. Acceptable Manufacturers:
 - a. Corbin Russwin Hardware (RU) - DC8000 Series.
 - b. LCN Closers (LC) - 4040XP Series.
 - c. Norton Door Controls (NO) - 9500 Series.
 - d. Sargent Manufacturing (SA) - 281 Series.

2.08 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
3. Metal Protection Plates: ANSI/BHMA A156.6 certified metal protection plates (kick, armor, or mop), beveled on four edges (B4E), fabricated from the following:
 - a. Stainless Steel: 300 series, .050-inch thick, with countersunk screw holes (CSK).
4. Fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets.
5. Acceptable Manufacturers:
 - a. Burns Manufacturing (BU).
 - b. Hiawatha, Inc. (HI).
 - c. Rockwood Manufacturing (RO).
 - d. Trimco (TC).

2.09 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
 1. Acceptable Manufacturers:
 - a. Burns Manufacturing (BU).
 - b. Hiawatha, Inc. (HI).
 - c. Rockwood Manufacturing (RO).
 - d. Trimco (TC).

2.010 ARCHITECTURAL SEALS

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
 1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
 - 1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and UBC 7-2, Fire Tests of Door Assemblies.
- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated, based on testing according to ASTM E 1408.
- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- F. Acceptable Manufacturers:
 - 1. Pemko Manufacturing (PE).
 - 2. Reese Enterprises, Inc. (RS).
 - 3. Zero International (ZE).

2.011 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.012 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.02 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.
- B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.03 INSTALLATION

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
 - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - 2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
 - 3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
 - 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.04 FIELD QUALITY CONTROL

- A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

3.05 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.06 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.

- C. Clean operating items as necessary to restore proper finish. and provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.07 DEMONSTRATION

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.08 DOOR HARDWARE SCHEDULE

- A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

- B. Manufacturer's Abbreviations:

1. MK - McKinney
2. RO - Rockwood
3. SA - Sargent
4. SC - Schlage
5. NO - Norton
6. PE - Pemko

Hardware Schedule

Set: 1

Doors: 1/101, 1/111

Description: Exterior

6 Hinge	T4A3386 NRP 4-1/2" x 4-1/2"	US32D	MK
1 Dust Proof Strike	570	US26D	RO
2 Flush Bolts	555 12"	US26D	RO
1 Exit Devise	8904 ETL LC	US32D	SA
1 Cylinder	20-771 x length required	626	SC
2 Closer (surface)	P1601BCSS		NO
2 Kick Plate	K1050 10" x 2" LDW 4BE CSK	US32D	RO
2 Door Stop	462	US2C	RO
1 Threshold	2005AT x Opening Width		PE
1 Weather-strip	2891AS (Head & Jambs)		PE
1 Astragal	S88D		PE
2 Drip Sweep	345ANB x Door Width		PE

Notes: Install weather-strip before installing Door Closer.

Notes: Metal overlapping astragal furnished by Hollow Metal Door Supplier.

Notes: Install S88D gasketing to be installed on inside face of astragal to help seal between doors.

END OF SECTION

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BARTLETT —
— **& WEST**

SECTION 088100
GLASS AND GLAZING

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section includes materials and installation of all glass and glazing including glass for door and unframed mirrors.

1.02 SUBMITTALS

- A. Submit shop drawings and samples in accordance with the General Conditions
- B. Submit 12-inch by 12-inch samples of each type of glass.
- C. Submit 12-inch lengths of each type of gasket.
- D. Submit one bead, approximately 1/4 inch wide and 3 inches long, of each sealant.
- E. Submit diagram of the glass layout and location of tong marks.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Guardian.
- B. Pilkington Libby-Owens-Ford Co.
- C. Cardinal Glass Industries.
- D. Viracon.
- E. Or equal.

2.02 GENERAL REQUIREMENTS

- A. Provide manufacturer's labels, showing strength, grade, thickness, type, and quality on each piece of glass. Labels shall remain on glass until it has been set in place.
- B. Deliver glazing compounds and sealants in manufacturer's sealed containers.
- C. Conform to local building codes for minimum glazing requirements, and assure that minimum frame lap (minimum grip of glass) and edge clearances are provided for sizes of openings.
- D. Tong marks of tempered plate glass, when glazing, shall occur on the side of the narrow dimension only. When the long dimension of glass panes are vertical, then the tong marks shall occur at the bottom of the pane. When the long dimension of glass panes are horizontal, the tong marks shall occur at the extreme right side when panes are to the right of the entrance and at the extreme left side when panes are to the left of the entrance.

2.03 PLATE GLASS

- A. Float glass of glazing quality conforming to ASTM C1036. Color shall be as noted in drawings.

2.04 TEMPERED PLATE GLASS

- A. Float glass of glazing quality conforming to ASTM C1048. Color shall be as noted in drawings.

2.05 INSULATING GLASS

- A. Float or plate glass conforming to SIGMA 65-7-2, current edition.
- A. Glass Type GL-1: Low-e-coated, clear insulating glass.
 - 1. Overall Unit Thickness: 1 inch.
 - 2. Thickness of Each Glass Lite: 1/4".
 - 3. Outdoor Lite: Ultraclear fully tempered float glass.
 - 4. Interspace Content: Argon.
 - 5. Indoor Lite: Ultraclear fully tempered float glass.
 - 6. Low-E Coating: Pyrolytic or sputtered on second or third surface.
 - 7. Visible Light Transmittance: 75 percent minimum.
 - 8. Winter Nighttime U-Factor: .3 maximum.
 - 9. Summer Daytime U-Factor: .3 maximum.
 - 10. Solar Heat Gain Coefficient: .75 maximum.
 - 11. Provide safety glazing labeling.

2.06 SETTING BLOCKS

- A. Semihard neoprene or vinyl rubber, Shore A 70-90 durometer.

2.07 SEALANT

- A. Sealant shall comply with ASTM C920, Type M, Grade P, Class 25, Use G for horizontal joints and Grade NS, Class 25, Use G for vertical joints and be recommended by the manufacturer for continuous immersion in water. Color as selected from manufacturer's standard colors.

2.08 GLAZING COMPOUNDS

- A. Conforming to ASTM C669 for glazing in metal surrounds, in manufacturer's standard color as selected by the Owner's Representative.

2.09 GLAZING GASKETS

- A. Glazing gaskets for aluminum frames and doors are specified in Section 084110.

2.10 PREINSTALLATION

- A. Glazing channels shall be free of burrs, irregularities, and debris.
- B. Glass shall be free of edge damage or face imperfections.

2.11 PREPARATION

- A. Field Measurements:

1. Measure size of frame to receive glass.
2. Compute actual glass size, allowing for edge clearances.

B. Preparation of Surfaces:

1. Remove protective coatings from surfaces to be glazed.
2. Clean glass and glazing surfaces to remove dust, oil, and contaminants and wipe dry.

2.12 INSTALLATION

- A. Install glass in accordance with manufacturer's recommended instructions.
- B. Furnish fastenings and mounting devices for "blind" mounting installation. Butt joints of abutting mirrors shall be tight hairline joints.

2.13 CLEANING

- A. Remove excess glazing compound from installed glass.
- B. Remove labels from glass surfaces.
- C. Wash and polish both faces of glass.
- D. Remove debris from site.

2.14 PROTECTION OF COMPLETED WORK

- A. Attach crossed streamers away from glass.
- B. Do not apply markers to glass surface.
- C. Replace damaged glass.

END OF SECTION

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SECTION 099100

PAINTING

PART 1 GENERAL

1.01 SUMMARY

- A. This Section consists of painting and surface preparation shown in the Drawings, specified herein and as required for a complete installation.

1.02 GENERAL INFORMATION AND DESCRIPTION

- A. The term "paint", as used herein, includes emulsions, paints, stains, varnishes, sealers, cement filler, cement-latex filler and other coatings, whether used as prime, intermediate, or finish coats.
- B. All buildings, facilities, structures, and appurtenances, as indicated on the Drawings and as specified herein, shall be painted with not less than one shop coat and two field coats, or one prime coat and two finish coats of the appropriate paint. Items to be painted include, but are not limited to exterior and interior concrete walls, precast concrete panels, structural steel, miscellaneous metals, steel doors and frames, all gypsum drywall, pipe fittings, valves, mechanical equipment, motors, conduit, and all other work which is obviously required to be painted unless otherwise specified.
- C. Baked-on enamel finishes and items with standard shop finishes such as graphic panels, electrical equipment, instrumentation, etc., shall not be field painted unless the finish is damaged during shipment or installation. Aluminum, stainless steel, fiberglass and bronze work shall not be painted unless color coding and marking is required or otherwise specified. A list of surfaces not to be coated is included in Article 3.07.

1.03 REFERENCES

- A. Steel Structures Painting Council:
 - 1. SSPC-SP5 No. 6 Commercial Blast Cleaning.
 - 2. SSPC-SP10 No. 10 Near-White Blast Cleaning.

1.04 SUBMITTALS

- A. Manufacturer's standard color charts and any project specific colors specified herein.
- B. List of paint proposed for use on each item to be painted. Include description of each type of paint, manufacturer's data sheets, name of manufacturer, and manufacturer's instructions for thickness of coats.
- C. Certificates of Compliance: Except for lead-based metal primers for use in concealed spaces, the contractor shall furnish a certificate of compliance attesting that all paints proposed for use contain not more than 0.06% lead as defined in paragraph HAZARDOUS MATERIALS RESTRICTIONS.

- D. Manufacturer's Instructions: Detailed mixing, thinning and application instructions, minimum and maximum application temperature, and curing time and drying time between coats shall be furnished for epoxy, polyester-epoxy, and moisture cure polyurethane.
- E. The Contractor shall prepare a complete schedule of surfaces to be coated and shall identify the surface preparation and paint system he proposes to use. The Paint Schedule shall be in conformance with Article 3.04. The schedule shall contain the name of the paint manufacturer, and the name, address and telephone number of the manufacturer's representative that will inspect the Work. The schedule shall be submitted to the Engineer for review as soon as possible following the Notice to Proceed so that the schedule may be used to identify colors and to specify shop painting systems on order for fabricated equipment.

1.05 SERVICES OF MANUFACTURERS REPRESENTATIVE

- A. The Contractor shall purchase paint from an acceptable manufacturer. The manufacturer shall assign a representative to inspect the application of his product both in the shop and field. The Contractor, through the manufacturer's representative, shall submit his report to the Engineer at the completion of his Work identifying the products used and verifying that said products were properly applied and that the paint systems were proper for the exposure and service.

1.06 QUALITY ASSURANCE

- A. General:
 - 1. The contractor shall give the engineer a minimum of three days advance notice of the start of any field surface preparation work of coating application work.
 - 2. All such Work shall be performed only in the presence of the Engineer, unless the Engineer has specifically allowed the performance of such Work in his absence.
 - 3. Review by the Engineer, or the waiver of review of any particular portion of the Work, shall not relieve the Contractor of his responsibility to perform the Work in accordance with these Specifications.
- B. Subcontractors: Where protective coatings are to be performed by a subcontractor, the Contractor shall provide five references which show that the painting subcontractor has previous successful experience with the specified or comparable coating systems. Include the name, address, and the telephone number for the owner of each installation for which the painting subcontractor provided the protective coating.

1.07 SAFETY AND HEALTH REQUIREMENTS

- A. In accordance with requirements of OSHA Safety and Health Standards for Construction (29CFR1926) and the applicable requirements of regulatory agencies having jurisdiction, as well as manufacturer's printed instructions, appropriate technical bulletins, manuals, and material safety data sheets, the Contractor shall provide and require use of personnel protective and safety equipment for persons working in or about the project site.

- B. All paints must comply with the requirements of the National Ambient Air Quality Standards.

1.08 PRODUCTS DELIVERY, STORAGE AND HANDLING

- A. Deliver paints to project in unopened containers listing manufacturer's name, type of paint, manufacturer's stock number, color and instructions for reducing, where applicable.
- B. Store only acceptable project materials on project site.
- C. Store only in a suitable location and temperature within the paint manufacturers recommendations.
- D. Comply with health and fire regulations.
- E. Protect work of others and surfaces not being worked on by use of adequate drop cloths.

1.09 ENVIRONMENTAL CONDITIONS

- A. The ambient temperature shall be between 45 and 95 degrees F. when applying coatings unless otherwise recommended by the paint manufacturer. The substrate temperature must be 5 degrees F. or more above the dew point temperature while painting and during coating cure.
- B. Paints, except water-thinned types, shall be applied only to surfaces that are completely free of surface moisture as determined by sight or touch.
- C. In no case shall paint be applied to surfaces upon which there is visible frost or ice.

1.10 PIPING IDENTIFICATION

- A. The Contractor shall paint all piping, valves, equipment, exposed conduit and all appurtenances which are integral to a complete functional mechanical pipe and electrical conduit system and identified with lettering or tags designating the service of each piping system. Piping not scheduled to be color coded shall be painted to match adjacent wall or ceiling surfaces or existing piping in the area.
- B. In general, the pumps and equipment shall be painted the same color as the piping system to which it is connected unless otherwise directed by the Engineer. Where colors are not designated for piping and conduit systems below, they will be selected during the shop drawing review.
- C. Banding. Where bands are indicated in the Color Coding Schedule, the pipe shall be painted for its full circumference with a band of the color indicated. The bands shall be six inches wide, neatly made by masking, and spaced eight feet apart. The Contractor may substitute precut prefinished bands on piping subject to acceptance by the Engineer. Where banded pipes are running concurrently in a space, bands shall be located so that on adjacently located pipes, bands will be grouped beside each other.
- D. The Contractor shall apply identification titles and arrows indicating the direction of flow of liquids to all types and sections of piping. Titles shall be as directed by the Engineer. Identification titles shall be located midway between color coding bands where possible. Identification lettering and arrows shall be provided near equipment served, adjacent to valves, at each branch or tee, and directly adjacent to each side of any wall or slab the pipeline passes through. Titles shall be placed as directed by the

Engineer, but shall generally be located each fifteen feet in pipe length and shall be properly inclined to the pipe axis to facilitate easy reading from operating positions. If, in the opinion of the Engineer, the foregoing requirements will result in excessive numbers of labels or arrows on a run of pipe, the number required shall be reduced as directed. Flow arrows shall be provided adjacent to titles to indicate the direction of flow of materials under normal operating conditions.

- E. The titles shall identify the contents by complete name at least once in each area through which it passes and thereafter be abbreviated.
- F. The numbers and letters shall be die-cut from pressure sensitive minimum 3.5 mil vinyl film prespace on carrier tape. Adhesive and finish surface shall be protected with one piece removable lines. Color shall be black on white as directed and shall have an overall height in inches in accordance with the subsection entitled "Letter Size".

1.11 COLOR CODING AND LETTERING SCHEDULE

- A. Piping color and lettering shall be in accordance with the following schedule:

Material	Color		
	Pipe	Letters & Arrows	Legend
Raw Water	Olive	Black	Raw Water
Air	Light Green	Black	Air
Natural Gas	Red w/black bands	Black	Gas

- B. In addition, special painting of the following items will be required:

Item	Color
Valve Handwheels & Levers	Red

1.12 LETTER SIZE

Letter size shall be as follows:

Outside diameter of pipe or pipe covering	Min. Width of Color Band	Size of Legend letters and numerals
3/4" to 1-1/4"	8"	1/2"
1-1/2" to 2"	8"	3/4"

2-1/2" to 6"	12"	1- 1/4"
8" to 10"	24"	2-1/2"
Over 10"	32"	3- 1/2

Notes:

1. Letter type shall be Helvetica Medium upper case. The manufacturer's instructions shall be followed in respect to storage, surface preparation and application.
2. For piping less than 3/4 inch diameter, the Contractor shall furnish and attach corrosion resistant color "snap on" plastic sleeves with the required lettering.

1.13 HAZARDOUS MATERIALS RESTRICTIONS

- A. Lead: paint shall contain not more than 0.06% lead by weight (calculated as lead metal) in the total nonvolatile content of the paint except lead-based metal primers as hereinbefore specified may be used in concealed spaces.

1.14 PACKAGING, LABELING AND STORAGE

- A. Paints shall be in sealed containers that legibly show the designated name, formula or specification number, batch number, color, quantity, date of manufacturer, manufacturer's formulation number, manufacturer's directions, including any warnings and special precautions, and name of manufacturer. Pigmented paints shall be furnished in containers not larger than 5 gallons. Paint shall be stored on the project site or segregated at the source of supply sufficiently in advance of need to allow 30 days for testing. Emulsion paints shall be stored to prevent freezing.

1.15 QUALITY WORKMANSHIP

- A. The Contractor shall be responsible for the cleanliness of his painting operations and shall use covers and masking tape to protect the work whenever such covering is necessary, or if so requested by the Owner. Any unwanted paint shall be carefully removed without damage to any finished paint or surface. If damage does occur, the entire surface, adjacent to and including the damaged area, shall be repainted without visible lapmarks and without additional cost to the Owner.
- B. Painting found defective shall be scraped or sandblasted off and repainted as the Owner may direct. Before final acceptance of the work, damaged surfaces of paint shall be cleaned and repainted as directed by the Owner.

1.16 ADDITIONAL PAINT

- A. At the end of the project, the Contractor shall turn over to the Owner a gallon can of each type and color of paint, primer, thinner or other coating used in the field painting. If the manufacturer packages

the material concerned in gallon cans, then it shall be delivered in unopened labeled cans as it comes from the factory. If the manufacturer does not package the material in gallon cans, and in the case of special colors, the materials shall be delivered in new gallon containers, properly closed with typed labels indicating brand, type, color, etc. The manufacturer's literature describing the materials and giving directions for their use shall be furnished in three bound copies. A type-written inventory list shall be furnished at the time of delivery.

PART 2 PRODUCTS

2.01 PAINT - PIPING

- A. Paints listed in the Application Schedule are manufactured by Tnemec Company, Inc. Approved equal coating systems and products of Sherwin-Williams may be furnished.
- B. Materials selected for coating systems for each type of surface shall be the product of a single manufacturer.
- C. All paint used for intermediate and finish coats shall be guaranteed by the paint manufacturer to be fume-proof and suitable for sewage plant atmosphere containing hydrogen sulfide. Any paint that cannot be so guaranteed shall not be used. Paint shall be lead-free and mercury-free if available, but in no case shall the lead or mercury content cause discoloration in sewage plant atmosphere.

2.02 COLORS

- A. All colors shall be as designated by the Engineer/Architect at the shop drawing review. The Contractor shall submit color samples to the Engineer as specified in Submittals section. The Contractor shall submit suitable samples of all colors and finishes for the surfaces to be painted. The Engineer shall decide upon the choice of colors and other finishes when alternates exist. No variation shall be made in colors without the acceptance of the Owner. Color names and/or numbers shall be identified according to the appropriated color chart issued by the manufacturer of the particular product in question. Engineer will provide a schedule of all colors of paints and coatings required.
- B. Mix paints to match tints specified in the color schedule.

PART 3 EXECUTION

3.01 PREPARATION OF SURFACES

- A. General: Items not to be painted which are in contact with or adjacent to painted surfaces shall be removed or protected prior to surface preparation and painting operations. Surfaces to be painted shall be clean before applying paint or surface treatments. Oil and grease shall be removed with clean cloths and cleaning solvents prior to mechanical cleaning. Cleaning solvents shall be of low toxicity with a flashpoint in excess of 100 degrees F. Cleaning shall be programmed so that dust and other contaminants will not fall on wet, newly painted surfaces.
- B. All new surfaces to be coated shall be thoroughly cleaned of all dust and debris. Existing painted surfaces to be recoated shall be thoroughly cleaned to remove all loose or unbonded paint prior to application

of new coatings. All existing painted ferrous surfaces to be recoated shall have their surfaces roughened, spot primed and cleaned prior to application of new top coat.

- C. Ferrous Surfaces - Non Submerged or Not Exposed to Sewage: Ferrous surfaces that have not been shop-coated shall be solvent cleaned. Unpainted surfaces that contain loose rust, loose mill scale and other foreign substances shall be mechanically cleaned by power wire brushing or sandblasting. Minor amounts of residual rust that cannot be removed except by thorough blast-cleaning, and tight mill scale that cannot be removed by applying a sharp knife to any edge, will be allowed to remain. After cleaning, one coat of the specified primer shall be applied to all ferrous surfaces to be painted. Shop coated ferrous surfaces shall be protected from corrosion by treating and touching up corroded areas immediately upon detection.
- D. Ferrous surfaces (exterior surfaces above ground & submerged or exposed to sewage) field preparation - Steel surfaces shall be cleaned of mill scale, paint, rust and foreign matter by blast cleaning in accordance with Steel Structures Painting Council Surface Preparation Specification No. SSPC-SP10-Near-White Blast Cleaning.
- E. Remove hardware, electrical device plates, register faces, and other removable trim.
- F. Apply protective masking and/or covering to electrical components and other fixed items not to be painted.
- G. Damaged or abraded areas on shop primed ferrous metal shall be sandpapered or wire brushed clean and painted with one coat of rust inhibitive primer.
- H. Galvanized metal surfaces, copper and other non-ferrous surfaces shall have surface deposits removed with xylolo-naptha and wiped clean and dry with clean cloths and treated with vinyl wash primer.
- I. Concrete and masonry shall be clean and dry to permit uniform penetration. Minimum 28 day cure. Clean off any scale, mud, loose paint or efflorescence with a stiff brush.
- J. Existing work, where scheduled for repainting, shall be put in condition to provide good adhesion and to receive paint.

3.02 APPLICATION OF PAINT

- A. Apply paints only in dust-free atmosphere.
- B. All paint materials shall be evenly spread to cover and hide the underlying surface without holidays, thin spots, runs, drips, sags or fat edges.
- C. Apply succeeding coats only over thoroughly dry previous coats.
- D. Enamels shall be lightly sanded between coats.
- E. Enamel coats shall flow on level without ropiness or brush marks.
- F. Paints shall be applied in the thickness and methods recommended by the manufacturer.

- G. Time between Surface Preparation and Painting: Surfaces that have been cleaned, pre-treated and otherwise prepared for painting shall be given a coat of the specified first coat as soon as practicable after such pre-treatment has been completed, but prior to any deterioration of the prepared surface.

3.03 FACTORY OR SHOP-PAINTED ITEMS

- A. Surfaces of items finish-painted by the manufacturer, or specified to be finish-painted under other sections of the specifications, are exempted from the requirements for surface preparation and painting. Shop-primed items shall receive surface preparation and finish painting as required by this section.
- B. All factory prime painting shall be touched up for elimination of all abraded and scratched areas, rendering surfaces suitable for finish painting. All factory finish painting shall be touched up to provide acceptable finish painting. Mismatching of touch-up color and surface or equipment painted with non-desirable colors shall be repainted.

3.04 APPLICATION SCHEDULE

- A. General: Apply the paints and finishes to the respective new surfaces as scheduled in the table at the end of this section.
 - 1. Piping shall not be painted until the piping has been tested and approved.
 - 2. Shop Painted Items: Surfaces of fabricated and assembled items that are finish-painted by the manufacturer, or specified to be finish-painted under other sections of the specifications, are exempted from the following schedule requirements for surface preparation and painting. Shop-primed items shall receive surface preparation and finish painting as required by this section.
 - 3. Existing painted surfaces noted to be painted shall have all repaired or new areas primed and coated as scheduled and remainder of surfaces in good paint condition need receive only the final coat.
 - 4. Dry film thickness per coat shall be as specified by the paint manufacture. Surfaces that do not meet the manufacturer's dry film thickness will be required to be repainted prior to the application of the final coat at no additional charge to the owner.

3.05 ANSI AND OSHA SAFETY COLORS

- A. Items specified in the following shall be finish color coated as specified. ANSI colors shall conform with (OSHA) ANSI Z53.1-1971 and latest revisions. Color coating shall be with the system specified for the equipment, concrete, etc. Where the coating system is not specified and color coating is required, the items shall be coated with a primer and two coats Glid-Guard Alkyd Industrial Enamel, or equal.

- Red:** Items listed in ANSI Z53.1-1971, Section 2.1 shall be painted ANSI Red. In general, these items shall include fire protection equipment and apparatus; wall mounted breathing apparatus, danger signs and locations; and stop bars, buttons or switches. In addition all hose valves and riser pipes, fire protection piping and sprinkler systems, and electrical stop switches shall be painted ANSI Red.
- Orange:** Items listed in ANSI Z53.1-1971, Section 2.2 shall be painted ANSI Orange. ANSI Orange shall be used as a basic color for designating dangerous parts of machines or energized equipment which may cut, crush, shock, or otherwise injure and to emphasize such hazards when enclosure doors are open or when gear belt or other guards around moving equipment are open or removed, exposing unguarded hazards. In addition, moving machinery having a linear or peripheral speed in excess of 10 feet per minute, which is either inadequately guarded due to physical problems or may be operated with the guard removed, rims or sprockets, gears, pulleys, etc.; crossheads of large engines and compressors; and flywheels shall be coated ANSI Orange.
- Yellow:** Items listed in ANSI Z53.1-1971, Section 2.3 shall be painted ANSI Yellow. Yellow shall be the basic color for designating caution and for making physical hazards such as striking against, stumbling, falling, tripping, and "caught in between". In addition, an 8-inch wide strip on the top and bottom tread of stairways shall be coated.
- Green:** Items listed in ANSI Z53.1-1971, Section 2.4 shall be painted ANSI Green. Green shall be the basic color for designating safety and the location of first-aid kits, eye wash facilities, and safety deluge showers shall be coated with ANSI Green.
- Blue:** Blue shall be used for designating caution, limited to warning against the starting, the use of, or the movement of equipment under repair or being worked upon.
- Purple:** Items listed in ANSI Z53.1-1971, Section 2.5 shall be painted ANSI Purple. In general, atomic sludge density meters shall be coated ANSI Purple.

3.06 GALVANIZED METAL TOUCH-UP

- A. Provide SSPC-SP1 surface preparation. Coat with Rust-Oleum Zinc Rich "Cold Galvanizing compound", 3-mils DFT minimum.

3.07 SURFACES NOT REQUIRING PAINTING. The following listed items will not require painting.

- A. Prefinished items not to be painted include, but are not limited to, the following factory-finished components:
1. Shop finished mechanical and electrical equipment.
 2. Light fixtures.

3. Motor Control Center and Switchgear.
4. Metal Building Walls (Interior and Exterior) and Roof Panels.

B. Finished metal surfaces not to be painted include:

1. Aluminum. (when not in contact with concrete.)
2. Stainless steel.
3. Galvanized steel. (Except as required to coat exposed ends created by field cutting.)
4. Chromium plated.
5. Copper pipe, except for mechanical identification.

C. Operating parts not to be painted include moving parts of operating equipment, such as the following:

1. Valve and damper operators.
2. Linkages.
3. Sensing devices.
4. Motor and fan shafts.
5. Flexible couplings, lubricated bearing surfaces, insulation and plastic pipe and conduit.
6. Packing glands and other adjustable parts of mechanical equipment.

D. Miscellaneous items such as the following:

1. Finish hardware
2. Plastic switch plates and receptacle plates.
3. Aluminum doors and windows.

E. Labels: Do not paint over Underwriters Laboratories, Factory Mutual or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

F. Touch-up paint pre-finished items if coating or surfaces are damaged during construction.

3.08 MISCELLANEOUS

- A. Installation of Removed Items: Following completion of painting of each space, removed items shall be reinstalled by workmen skilled in the trade involved.

3.09 CLEANING

- A. The Contractor shall protect at all times, in areas where painting is being done, floors, materials of other crafts, equipment, vehicles, fixtures, and finished surfaces adjacent to the paint work. Cover all electrical plates, surface hardware, nameplates, gauge glasses, etc., before start of painting work.

- B. Touch up and restore finish where damaged.
- C. Remove spilled, splashed or splattered paint from all surfaces.
- D. All damaged hardware and other items shall be replaced.
- E. Cloths, cotton waste and other debris that might constitute a fire hazard shall be placed in closed metal containers and removed at the end of each day. Upon completion of the work, staging scaffolding and containers shall be removed from the site or destroyed in an approved manner. Paint and other deposits upon adjacent surfaces shall be removed and the entire job left clean and acceptable.

3.10 PROTECTION OF MACHINERY, FLOORS AND EQUIPMENT

- A. Drop cloths shall be used to protect machinery, finished floors and equipment.

3.11 PAINTING FIRE PRECAUTION

- A. Painting with flammable paint shall not be done in the vicinity of a welding operation or any other open flame.

PAINT SYSTEMS SCHEDULE

(Utilizing Tnemec Paints)

System No.	Description	Surface	Prime Coat		Intermediate Coat		Final Coat	
		Preparation	Series	Min. DFT	Series	Min. DFT	Series	DFT
1	Exterior Metal - Architectural	SSPC SP3	10	4.0 to 6.0	6	2.0 to 3.0	6	2.0 to 3.0
* 2	Exterior Metal - Corrosive	SSPC SP6	66-1211	2.0 to 3.0	66	2.0 to 3.0	73	2.0 to 3.0
* 3	Exterior Galv. Metal	SSPC SP1 & brush blast	66-1211	4.0 to 6.0	66	2.0 to 3.0	73	2.0 to 3.0
* 4	Exterior Concrete - Architectural	28 day cure	130	60 to 80 ft ² /gal	6	2.0 to 3.0	6	2.0 to 3.0
* 4	Exterior Concrete	14 day cure & clean and dry	156	4.0 to 8.0	---	---	156	4.0 to 8.0
* 5	Exterior Buried Concrete	14 day cure & clean and dry	46-465	8.0 to 12.0	---	---	46-465	8.0 to 12.0
* 6	Exterior Masonry	28 day cure & clean and dry	130	60 to 80 ft ² /gal	156	4.0 to 8.0	156	4.0 to 8.0
7	Exterior Wood	sand & no residues	36	2.0 to 3.0	6	2.0 to 3.0	6	2.0 to 3.0
8	Exterior Pipe and Equipment	SSPC SP6, See Note 2 for DIP	66-1211	3.0 to 5.0	66	4.0 to 6.0	73	4.0 to 6.0
* 9	Exterior PVC and FRP	Lightly Abrade	66	2.0 to 3.0	---	---	73	1.0 to 2.0
* 10	Buried Metal	SSPC SP10	46H-413	14.0 to 20.0	---	---	---	---
11	Aluminum in Contact with Concrete	SSPC SP6	46-465	8.0 to 12.0	---	---	46-465	8.0 to 12.0
* 12	Submerged Metal - Potable	SSPC SP10	20-1255	3.0 to 5.0	---	---	20-WH02	4.0 to 6.0
13	Submerged Metal - Nonpotable	SSPC SP10	66-1211	3.0 to 5.0	66	4.0 to 6.0	46H-413	14.0 to 20.0
* 14	Submerged Concrete - Potable	28 day cure & brush blast	20-1211	4.0 to 6.0	20-1255	4.0 to 6.0	20-WH02	4.0 to 6.0
* 15	Submerged Concrete - Nonpotable	28 day cure & brush blast	66	4.0 to 6.0	66	4.0 to 6.0	66	4.0 to 6.0
16	Metal High Temp	SSPC SP10	39	.7 to 1.5	39	0.7 to 1.5	39	0.7 to 1.5
17	Interior Metal - Architectural	SSPC SP3	10	2.0 to 3.5	6	2.0 to 3.0	6	2.0 to 3.0
* 18	Interior Metal - Corrosive	SSPC SP6	66	2.0 to 3.0	66	3.0 to 5.0	66	3.0 to 5.0
19	Interior Galv. Metal	SSPC SP1 & brush blast	27	4.0 to 6.0	---	---	73	2.0 to 3.0
* 20	Interior Concrete - Architectural	28 day cure & clean and dry	6	2.0 to 3.0	---	---	6	2.0 to 3.0
* 21	Interior Concrete - Corrosive	28 day cure & brush blast	66-1211	4.0 to 6.0	---	---	66	4.0 to 6.0
* 22	Concrete Floor Painted	28 day cure & brush blast	201	6.0 to 8.0	280	8.0 to 10.0	280	8.0 to 10.0
23	Concrete Floor Clear Sealer	28 day cure & brush blast	201	10.0 to 12.0	---	---	---	---
* 24	Interior Masonry - Architectural	28 day cure	130	60 to 80 ft ² /gal	6	2.0 to 3.0	6	2.0 to 3.0
* 25	Interior Masonry - Corrosive	28 day cure	130	60 to 80 ft ² /gal	66	4.0 to 6.0	66	4.0 to 6.0
* 26	Interior Wood	sand & no residues	36	2.0 to 3.0	6	2.0 to 3.0	6	2.0 to 3.0
* 27	Interior Gypsum Drywall	See Spec. 092116	51-792	1.0 to 2.0	6	1.5 to 2.0	6	1.5 to 2.0
* 28	Sound Absorption Panels	No residues	66-1211	3.0 to 5.0	66	4.0 to 6.0	---	---
29	Interior Pipe and Equipment (1)	SSPC SP6, See Note 2 for DIP	66-1211	3.0 to 5.0	66	4.0 to 6.0	66	4.0 to 6.0
30	Interior PVC and FRP	Lightly Abrade	66-1211	2.0 to 3.0	---	---	66	2.0 to 3.0
31	Electrical Conduit Runs, Metallic Tubing	SSPC SP6	37	2.0 to 3.5	Match	Wall	Match	Wall
* 32	Cotton/Canvas on Pipe Insulation	---	6	1.5 to 2.0	---	---	6	1.5 to 2.0
* 33	Submerged Metal - Zinc Primer	SSPC SP10	91-H2O	2.5 to 3.5	20-1255	4.0 to 6.0	20-WH02	4.0 to 6.0
* 34	Metal Corrosive - Zinc Primer	SSPC SP6	91-H2O	2.5 to 3.5	66	3.0 to 5.0	66	3.0 to 5.0
* 35	Interior Gypsum Drywall - Epoxy	See Spec. 092116	151-1051	1.0 to 2.0	84	3.0 to 4.0	84	3.0 to 8.0
* 36	Exterior Metal - Architectural, Epoxy	SSPC SP 3	27	4.0 to 6.0	---	---	73	2.0 to 3.0
* 37	Interior Metal - Architectural, Epoxy	SSPC SP 3	27	4.0 to 6.0	---	---	73	2.0 to 3.0

Notes:

* Paint system not used on this project.

1. Unless otherwise specified.

2. Surface prep shall be in compliance with Tnemec Technical Bulletin No. 07-52. If surface profile is less than 1.5 mils then brush-off blast clean.

END OF SECTION

SECTION 101470
ROOM DESIGNATORS AND HAZARDOUS AREA SIGNS

PART 1 GENERAL

1.01 SUMMARY

- A. This section includes materials and installation of room designator and hazardous area signs.

1.02 SUBMITTALS

- A. Submit shop drawings and samples in accordance with the General Conditions
- B. Submit fully detailed shop drawings of identifying devices including installation details. Submit manufacturer's catalog data and descriptive literature.

PART 2 PRODUCTS

2.01 IDENTIFYING SIGNS

- A. Each sign shall have a square-cornered insert plaque contained within an aluminum frame. Frames shall be separated from the insert plaque by a 3/32-inch black reveal. Aluminum frames shall have a clear duranodic finish. Plaques shall be of 0.125-inch-thick satin matte finish opaque acrylic. Letter style to be helvetica medium, all caps.

2.02 HAZARD SIGNS

- A. Provide hazard signage for all doors accessing hazardous rooms. Signs shall be 10 inches wide by 7 inches high. Signs shall be vinyl cloth with pressure-sensitive adhesive. Sign colors and letter size shall comply with OSHA requirements and local jurisdiction. Sign wording shall be as follows:

Area	Sign Wording
Caisson Well Shaft	Caution – Confined Space – Permit Required
Meter Vaults	Caution – Confined Space – Permit Required

PART 3 EXECUTION

3.01 INSTALLATION

- A. Do not install signs until final paint coat on surface is dry.
- B. Install in center of door, 4 feet 6 inches from bottom of door.
- C. Comply with manufacturer's installation recommendations.

END OF SECTION

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BARTLETT & WEST

SECTION 104416
FIRE EXTINGUISHERS

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section includes materials and installation of fire extinguishers.

1.02 SUBMITTALS

- A. Submit shop drawings and samples in accordance with the General Conditions.
- B. Submit manufacturer's literature including catalog cuts, data sheets, and UL certification and label.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Model numbers included are items manufactured by Potter-Roemer, Inc.
- B. Equivalent items of the following manufacturers are acceptable:
1. J. L. Industries.
 2. Larsen's Manufacturing Co.

2.02 FIRE EXTINGUISHERS--MULTIPURPOSE CHEMICAL TYPE

- A. Fire extinguishers shall be ABC multipurpose dry-chemical type per NFPA 10 and UL 299, red enamel steel shell, stored-pressure type with indicating gauge and UL rating of 10A:120B:C.

2.03 FIRE EXTINGUISHER CABINETS FOR MULTIPURPOSE CHEMICAL EXTINGUISHERS

- A. Fire extinguisher cabinets shall be Potter-Roemer "Buena Series" No. 7149 surface mounted or equal. Provide red aluminum frame with 1/4-inch clear acrylic panel with vertical red lettering.

PART 3 EXECUTION

3.01 DELIVERY AND STORAGE

- A. Deliver items with manufacturer's tags and labels intact. Handle and store to avoid damage and protect after installation.

3.02 INSTALLATION

- A. Install fire extinguishers at the locations indicated in the drawings by the abbreviation "FE" or "FEC" (recessed) with the top of the unit 48 inches above the floor.
- B. Install fire extinguishers having a gross weight not exceeding 40 pounds so that the top of the fire extinguisher is not more than 5 feet above the floor. Install fire extinguishers having a gross weight greater than 40 pounds so that the top of the fire extinguisher is not more than 3-1/2 feet above the floor. The clearance between the bottom of the fire extinguisher and the floor shall not be less than 4 inches.

C. Location of fire extinguishers shall be per NFPA 10 and verified with the fire marshal.

END OF SECTION

SECTION 133423

FABRICATED METAL METER ENCLOSURE

PART 1 GENERAL

1.01 DESCRIPTION

- A. The contractor shall furnish and install one (1) factory-built, factory delivered, below ground meter station in a steel welded capsule on a structural base with all necessary internal piping, valves, fittings, supports, meter and other necessary appurtenances as shown on the plans and specified herein.
- B. The station shall be complete when delivered and will not require internal contractor construction except to install the power service through the service conduit provided for that purpose and to connect the main water service to the required points and other work as may be required for a complete installation.

1.02 ACCEPTABLE MANUFACTURERS

- A. Engineered Fluid, Inc
- B. Approved equal.

1.03 SUBMITTAL DATA

- A. The submittals shall contain a minimum of two (2) drawings, one (1) each covering the meter station (full size 24" x 36") and the electrical control schematic (reduced size 8-1/2" x 11"). The meter station drawing shall be specific to this project, in at least three (3) different views, be to scale and illustrate the National Electrical Code (NEC) clearances per Section 110-26 of the Code.
- B. The submittal booklets will be complete with data sheets covering all major components that make up the station and the UL/ETL file number under which the manufacturer is listed, service department personnel statement as detailed in the specifications and be complete with the manufacturer's formal warranty policy and a full size photocopy of the manufacturer's combination UL/manufacturer logo Packaged Pumping Systems label.
- C. For all other requirements, see Section 013300 – Submittal Procedures.

1.04 MANUFACTURER'S RESPONSIBILITY FOR PERFORMANCE

- A. The specifications and drawings for the factory-built equipment do not necessarily include all the details for the design and fabrication for the equipment. The drawings are generally schematic but the specifications call out strict requirements to known methods, components and assemblies that must be in a full, complete and functional meter station. As such, the manufacturer shall accept and hold complete responsibility for the functionality of the meter station and its workings.

1.05 QUALITY ASSURANCE

- A. The equipment furnished shall be designed, constructed, and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the contract drawings and operated per manufacturer's recommendations.

1.06 THIRD PARTY INSPECTION LISTING (STATIONS 600V MAX.)

- A. The station manufacturer shall be required to affix to the station an UNDERWRITERS LABORATORIES (UL) LABEL attesting to the compliance of the station equipment under the PACKAGED PUMPING SYSTEMS (QCZJ) UL Listing Category and/or INTERTEK TESTING SERVICES (ETL) LABEL attesting to the compliance of the station equipment under PACKAGED PUMPING SYSTEMS. The ETL label shall state the station conforms to UL STD 778 and is certified to CAN/CSA STD C22.2 NO. 108.

1.07 SHIPPING AND DELIVERY

- A. The specified equipment shall be delivered by the manufacturer FOB DESTINATION and thereby the station manufacturer shall hold the full responsibility for the condition and completeness of the equipment upon its delivery.
- B. The Engineer shall hold the right to inspect the equipment prior to unloading and setting so as to assure the quality and condition of the equipment is in no way deficient.
- C. If, in the view of the Engineer or Engineer's inspector, the equipment is deficient when delivered, delivery shall be refused.

1.08 SPECIFIED COMPONENTS

- A. Certain components are listed by name and/or model number for that manufacturer's specific product. As such, no "OR EQUAL" is allowed for that manufacturer as these listed components have been chosen because of the Engineer's and Owner's knowledge of and experience with the listed components.

1.09 FACTORY START-UP AND TRAINING SERVICE

- A. Without exception, the station manufacturer is directly responsible for station start-up and operator training. Third party contractors are not to be allowed to start up the station nor the equipment therein. As such;
 - 1. Start-up Factory Service Technician shall be a regular employee of the station manufacturer.
 - 2. The manufacturer shall provide two (2) copies of the complete Operation & Maintenance Manual in electronic form.

1.10 MANUFACTURER'S WARRANTY

- A. The warranty is the sole responsibility of the station manufacturer and that manufacturer's warranty shall be provided in written form, being placed in both the submittal documents covering the specified equipment and the O&M manuals provided with that equipment.
- B. It is required that the station warranty provide the owner with a single source responsibility for all components specified herein and the system as a whole. That single source shall be the station manufacturer. Third party suppliers, service contractors and "pass-through" warranties are not acceptable.
- C. Said manufacturer's warranty shall at a minimum cover:
 - 1. A period of one (1) year commencing upon successful start-up, not to exceed eighteen (18) months from the date of shipment.
 - 2. The warranty period shall be inviolate regardless of any component manufacturer's warranty for equipment and components within the station.
 - 3. The manufacturer's warranty shall cover all equipment, components and systems provided in or with the station by the manufacturer of the station, exclusive of those components supplied by and/or installed by others independent of the manufacturer of record for this station.
 - 4. The warranty shall provide for the station manufacturer to bear the full cost of labor and materials for replacement and/or repair of faulty or defective components so there shall be no cost incurred by the Owner for this work during the warranty period.
 - 5. The manufacturer's warranty policy is amended only by the items considered consumable, i.e., light bulbs, pump seals, pump packing, lubricants and other maintenance items consumed by usage.
 - 6. No assumption of contingent liabilities for any component failure during manufacturer's warranty is made.
 - 7. The warranty pertains only where the equipment has been operated in strict accordance with the manufacturer's instructions and requirements. Evidence of misuse or modification to the equipment voids the warranty.
- D. If the submitted written manufacturer's warranty does not meet the minimum requirements set forth above, that submittal will forthrightly be rejected.

PART 2 PRODUCTS AND COMPONENTS

2.01 EQUIPMENT CAPSULE DESIGN STANDARDS

- A. The equipment capsule shown is suitable by construction and materials for direct burial with water-tight integrity.
- B. The size shown for the capsule is appropriate for National Standard mandated clearances and for proper clearances above, below and around equipment to provide for safe servicing, removal and reinstallation of that equipment.
- C. The entrance manway in the locations shown shall be sized to provide eventual removal and replacement of any component within the station without altering the station to accomplish that task.
- D. The drawing for this equipment illustrates equipment centerline and clearance/maintenance dimensions about the major equipment items. These dimensions are minimum.

2.02 EQUIPMENT CAPSULE – CONSTRUCTION

- A. The plate steel employed throughout the capsules shall be $\frac{1}{4}$ " as minimum thickness and meet or exceed the requirements for ASTM A-36.
- B. The structural shapes, channels and angles used shall be of the thickness/weight as shown on the plans for this item and shall meet or exceed the requirements for ASTM A-36.
- C. The side sheet, if pieced, shall have only vertical piecing seams and no horizontal piecing seams. For capsules under 96" diameter there shall be no more than three (3) vertical piecing seams.
- D. The end sheets for tanks of 96" diameter or less, if pieced, shall be made up of no more than three (3) pieces.
- E. Piecing seam welds shall be only full penetration, double sided butt welds. The piecing seam welds shall ground smooth both inside and outside the capsule.

2.03 CAPSULE DIMENSIONS

- A. The capsule shall be a rolled, vertical cylinder steel capsule of sealed welded construction with top and bottom and side sheets and with appropriate supporting structure.
- B. The capsule shall be sized as shown on the drawings.

2.04 CAPSULE REINFORCEMENT

- A. The top, bottom and sides of the equipment capsules shall be supported and reinforced by a combination of standard structural shapes of the sizes and weights as shown on the plans for this item.

2.05 PLATE/SHEET CAPSULE JOINTS – LAP SEAM WELD

- A. The construction of the capsule as a buried system requires construction techniques necessary to ensure a long service life. The side sheet/top sheet joint construction is specified to provide maximum coating effectiveness and minimal corrosion potential by the elimination of sharp edges or abrupt transitions where the coating process cannot maintain full film thickness and so promote corrosion and undercutting.
- B. The plate forming the top and bottom of the capsules shall be rolled edge, cold formed prior to assembly so as to form a lap joint with the side wall.
- C. The lap joint shall be continuously full fillet welded on the capsule interior by hand and the exterior by machine to form an airtight seal.
- D. The lower side wall continuous weld shall be an average 1-1/2 inches above the capsule floor. Capsules without lap joints will not be accepted.
- E. The lap joint shall be in full conformance with Steel Tank Institute (STI) P-3 specifications Section 4.2.6 and Underwriters Laboratories (UL) 58 Construction Section 6, Figure 6.1 Head Joint #23 specifications for steel vessels in buried service.

2.06 TANK SHEET PENETRATION WELDS

- A. Any ferrous metal device, namely water transmission piping and conduits passing through the capsule wall, shall be welded fully long its circumference or length, being welded on both sides of the capsule wall using a metal-added, MIG shielded arc welding process.

2.07 LIFTING PLATES AND EQUIPMENT LIFTING EYES

- A. Four (4) lifting plates of 3/8 inch minimum thickness shall be placed about the perimeter of the capsule to facilitate the lifting and handling of the station.

2.08 FLOOR SUMP

- A. The capsule will be complete with a sump. The sump shall be a minimum of eighteen (18) inches in diameter by eight (8) inches deep. The sump shall be provided with a four (4") inch plugged outlet for gravity outflow as required.

2.09 HATCHES - RAISED MOUNTED SCUTTLES

- A. The entrance manway shall be Bilco Model MS-50 roof scuttle, with a minimum clear inside opening of thirty (30) inches by thirty-six (36) inches.
- B. The equipment hatch shall be Bilco Model F-50 roof scuttle, with a minimum clear inside opening of forty-eight (48) inches by forty-eight (48) inches.
- C. Cover: Shall be 11 gauge aluminum with a 3" beaded flange with formed reinforcing members. Cover shall have a heavy extruded EPDM rubber gasket that is bonded to the cover interior to assure a continuous seal when compressed to the top surface of the curb.
- D. Cover insulation: Shall be fiberglass of 1" thickness, fully covered and protected by an 18 gauge aluminum liner.
- E. Curb: Shall be 12" in height and of 11 gauge aluminum. The curb shall be formed with a 3-1/2" flange with 7/16" holes provided for securing to the roof deck.
- F. Curb insulation: Shall be rigid, high-density fiberboard of 1" thickness on outside of curb.
- G. Lifting mechanisms: Manufacturer shall provide compression spring operators enclosed in telescopic tubes to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and closing. The upper tube shall be the outer tube to prevent accumulation of moisture, grit, and debris inside the lower tube assembly. The lower tube shall interlock with a flanged support shoe welded to the curb assembly.
- H. Hardware:
 - 1. Heavy pintle hinges shall be provided
 - 2. Cover shall be equipped with a spring latch with interior and exterior turn handles
 - 3. Roof hatch shall be equipped with interior and exterior padlock hasps.
 - 4. The latch strike shall be a stamped component bolted to the curb assembly.
 - 5. Cover shall automatically lock in the open position with a rigid hold open arm equipped with a 1" diameter red vinyl grip handle to permit easy release for closing.
 - 6. Compression spring tubes shall be an anti-corrosive composite material and all other hardware shall be zinc plated and chromate sealed.
 - 7. Cover hardware shall be bolted into heavy gauge channel reinforcing welded to the underside of the cover and concealed within the insulation space.
 - 8. Finishes: Factory finish shall be mill finish aluminum.

2.10 ACCESS LADDER

- A. An all-aluminum access ladder will be provided. The ladder shall be a Type 1A with 300 lbs. load rating and meet ANSI A14.3 fixed ladder standard. The ladder will have serrated rungs with 3" full I-Beam side rails.
- B. The uppermost ends of the side rails will be protected by plastic caps bolted into place. The complete access ladder will be bolted into place at a minimum of two (2) points both top and bottom so as to be easily removable to facilitate equipment maintenance.

2.11 LADDER ASSIST DEVICE

- A. A Bilco Model LU-1 ladder-up safety post shall be installed on the vertical centerline of the ladder.

2.12 CAPSULE CATHODIC PROTECTION

- A. The station manufacturer shall furnish for the contractor's proper installation two (2) seventeen pound packaged magnesium anodes for cathodic protection.
- B. The anodes shall be H-1 alloy cast to meet ASTM B-80, alloy AZ-63. The anode lead wires shall be silver soldered and potted to be waterproof.
- C. The anodes shall be buried equally spaced around the station and connected by heavy copper wire to lugs on the station provided for that purpose.

2.13 SAFETY FLOOR MATTING

- A. The walkway area (that space from the entrance ladder to the control panel and the entire NEC clearance area) shall be covered with a rubber drainage runner. The runner shall be medium duty, 1/2 inch minimum thickness of open slot design allowing fluids to drain understanding or walking surfaces. The runner shall have a tread design to promote sure footing. The underside of the runner shall have a raise knob design to permit aeration and drainage, and to reduce runner fatigue. The runner shall not be glued to the floor.

2.14 PIPING

- A. Piping shall be in accordance with applicable sections in Division 40.

2.15 TANK/WALL PENETRATION COATING PROTECTION SLEEVE

- A. Where a fusion bonded epoxy interior coated pipe passes through the steel tank shell, prior to fusion bonded coating of that pipe, a pipe sleeve shall be welded over the pipe in the area where the pipe passes through the steel sheet.
- B. The sleeve shall be one-half (1/2") inch thickness and fit closely over the transmission pipe. The sleeve shall be seal welded to the transmission pipe at each end with a full and continuous fillet weld.
- C. Following the welding of the sleeve to the transmission piping, the sleeve welds and the sleeve shall be grit blasted to an SP-6 finish so the pipe is prepared for fusion bonded epoxy coating by the process specified elsewhere in these documents.

2.16 COATINGS - CORROSION PROTECTION

- A. All interior and exterior surfaces of the exposed steel structure, transmission piping, and fittings shall be gritblasted equal to commercial blast cleaning (SSPC-SP6). Following fabrication all exposed surfaces of the station, interior and exterior, shall be coated according to the following requirements.
- B. Welment Prime Coating
 - 1. All weldments will be pretreated by hand to provide additional corrosion protection using the same product as the base coat. Following the pretreatment full coating application shall take place.
- C. Base Coating
 - 1. The base coating shall take place immediately after surface preparation. The protective coating shall consist of a two-component, high solids, high build, fast drying epoxy system for protection and finishing of steel and having excellent corrosion resistant properties. The epoxy system shall be self-priming and require no intermediate coatings.
- D. Top Coating
 - 1. Following the base coating application, a full finish coating application shall take place. The protective coating shall consist of a two-component, high solids, high build, fast drying epoxy system for protection and finishing of steel and having excellent corrosion resistant properties. The epoxy system shall be self-priming and require no intermediate coatings. The base and finish coats shall provide a total dry mil thickness of 8.0 mils.
- E. Post-Assembly Coating
 - 1. Following assembly and just prior to shipping, there shall take place a thorough cleaning of the floor of the station followed by a rolled on coating of the two part epoxy coating to cover over any scuffing or scaring that might have occurred during assembly.

2.17 SERVICE CONNECTIONS ON INTERNAL PIPING

- A. The meter spool shall be easily removed from the piping by the presence of restrained flange adapter as shown on the drawing.

2.18 RESTRAINING POINTS

- A. The main inlet and outlet piping to the station shall each be provided with restraining points as welded on "eyes" or similar device welded to the capsule wall adjacent to the pipe penetration to facilitate the attachment of joint restraint tie rods or other device to be used in retarding any pipe movement at the connections.

2.19 LINE PRESSURE GAUGE

- A. Line pressure gauges shall be in accordance with applicable sections in Division 41, with the exceptions noted herein.
- B. The combination pressure gauge shall have a built-in pressure snubber and have 4-1/2" minimum diameter face and turret style case, black fiberglass-reinforced thermoplastic with a clear acrylic window with Buna-N gasket. The movement shall be rotary; the bourdon tube shall be copper alloy C-type. The gauge shall have a 1/4" MNPT lower mount process connection and contain a 0.6mm copper alloy restrictor. The pressure gauge range and scale graduations shall be in psi and feet of water as specified by the engineer.
- C. The gauge shall be panel mounted off the pipeline and be connected to its respective sensing point. The gauge trim tubing shall be complete with both isolating and vent valves and the tubing shall be so arranged as to easily vent air and facilitate gauge removal. Gauges mounted directly to the pipeline or at the sensing point will not be accepted.

2.20 STATIC AND SENSING LINES

- A. The gauge sensing line shall be minimum 1/4" OD white polypropylene tubing run from the sensing point and a ball valve to the point of device mounting.
- B. The tubing shall be run in a workmanlike manner with elastomeric/stainless steel mounting straps to securely hold the tubing to be free of stress and vibration. The alignment and organization of the sensing lines shall be continuously rising.

2.21 HOSE BIBB WITH VACUUM BREAKER

- A. There shall be provided a standard hose bibb with valve and vacuum breaker on the piping. The hose bibb connection shall be through a pressure regulator if the header pressure would exceed 60 psi.

2.22 FLOWMETER SYSTEM

- A. The flowmeter will be supplied as specified in either Section 409123 or 409721, as specified by the Engineer.

PART 3 EXECUTION

3.01 PRESSURE TESTING

- A. Pressure testing shall be done in accordance with Section 400522.

3.02 ELECTRICAL DESIGN, ASSEMBLY & TEST

- A. Electrical work and materials shall be in accordance with the applicable sections in Division 26, except as noted herein. If there is a contradiction between this specification and Division 26, the requirements in Division 26 will prevail, unless a variance is approved by the Engineer.
- B. The electrical apparatus and panel design, assembly, and installation, and the integration of

component parts will be the responsibility of the manufacturer of record for this station. That manufacturer shall maintain at its regular place of business a complete electrical design, assembly and test facility to assure continuity of electrical design with equipment application. Control panels designed, assembled or tested at other than the regular production facilities or by other than the regular production employees of the manufacturer of record for this station will not be approved.

3.03 CONFORMANCE TO BASIC ELECTRICAL STANDARDS

- A. Electrical work and materials shall be in accordance with the applicable sections in Division 26, except as noted herein. If there is a contradiction between this specification and Division 26, the requirements in Division 26 will prevail, unless a variance is approved by the Engineer.
- B. The manufacturer of electrical control panels and their installation shall be done in strict accordance with the requirements of UL Standard 508A and the National Electrical Code (NEC), NFPA 70 latest revision so as to afford a measure of security as to the ability of the eventual owner to safely operate the equipment.
- C. No exceptions to the requirements of these codes and standards will be allowed. Failure to meet these requirements will be cause to remove the equipment and correct the violation.

3.04 U.L. LISTING

- A. Electrical work and materials shall be in accordance with the applicable sections in Division 26, except as noted herein. If there is a contradiction between this specification and Division 26, the requirements in Division 26 will prevail, unless a variance is approved by the Engineer.
- B. All electrical panels shall be constructed and installed in strict accordance with Underwriter's Laboratories (UL) Standard 508A "Industrial Control Equipment." The UL label shall also include an SE "Service Entrance" rating stating that the main distribution panel is suitable for use as service entrance equipment. The panels shall be shop inspected by UL, or constructed in a UL recognized facility. All panels shall bear a serialized UL label indicating acceptance under Standard 508A and under Enclosed Industrial Control Panel or Service Equipment Panel.
- C. A photocopy of the UL labels for this specific project shall be transmitted to both the project engineer and the contractor for installation within their permanent project files, prior to shipment of the equipment covered under these specifications.

3.05 E.T.L. LISTING

- A. Electrical work and materials shall be in accordance with the applicable sections in Division 26, except as noted herein. If there is a contradiction between this specification and Division 26, the requirements in Division 26 will prevail, unless a variance is approved by the Engineer.
- B. All control panels shall be E.T.L. Listed by Intertek Testing Services (ITS) under the Industrial Control Panel (ICP) Category. Each completed control panel shall bear an ETL listing label stating that the panel conforms to UL STD 508A and is certified to CAN/CSA STD C22.2 NO. 14. The listing label shall include the station manufacturer's name, address and telephone number. The station manufacturer shall have quarterly inspections performed by ETL at the manufacturer's facility to ensure that the products being listed comply with the report and procedural guide for that product.

3.06 EQUIPMENT GROUNDING

- A. Electrical work and materials shall be in accordance with the applicable sections in Division 26, except as noted herein. If there is a contradiction between this specification and Division 26, the requirements in Division 26 will prevail, unless a variance is approved by the Engineer.
- B. Each electrical equipment item in the station shall be properly grounded per Section 250 of the National Electrical Code. Items to be grounded include, but are not limited to, pump motor frames, control panel, transformer, convenience receptacles, dedicated receptacle for heater, air conditioner, dehumidifier, lights, light switch, exhaust fans and pressure switches.
- C. All ground wires from installed equipment shall be in conduit and shall lead back to the control panel to a copper ground buss specific for grounding purposes and so labeled. The ground buss shall be complete with a lug large enough to accept the installing electrician's bare copper earth ground wire. The bus shall serve as a bond between the earth ground and the equipment ground wires.

3.07 PANEL MOUNTING HARDWARE

- A. Electrical work and materials shall be in accordance with the applicable sections in Division 26, except as noted herein. If there is a contradiction between this specification and Division 26, the requirements in Division 26 will prevail, unless a variance is approved by the Engineer.
- B. Metal framing channel and hangers shall be used exclusively for mounting of electrical panels and electrical components except for those specifically designated otherwise.
- C. When mounting panels in buildings with 3/4" plywood interior sheathing, certain panels and components may be mounted by screwing these devices into the wall. The maximum weight of a panel mounted with four lag screws cannot exceed 250#. The lag screws must either be 5/16" or 3/8" diameter and be fully threaded.

3.08 ELECTRICAL SERVICE

- A. The electrical service provided for this station will be 240 Volt, 1 Phase, 60 Hertz, 3 Wire.

3.09 CIRCUIT BREAKER (LIGHTING) PANEL

- A. Electrical work and materials shall be in accordance with the applicable sections in Division 26, except as noted herein. If there is a contradiction between this specification and Division 26, the requirements in Division 26 will prevail, unless a variance is approved by the Engineer.
- B. All secondary circuit breakers shall be incorporated into one (1), separate NEMA 1 circuit breaker panel.
- C. There shall be provided, thermal-magnetic trip circuit breakers as follows:
 - 1. One (1) Main Breaker, 50 amps;
 - 2. Auxiliary Circuit Breakers, as follows:
 - 1) 1p, 15amp Meter Equipment
 - 2) 1p, 15amp Lights
 - 3) 1p, 15amp Convenience Outlets
 - 4) 1p, 15amp Dehumidifier
 - 5) 2p, 20amp Heater
 - 6) 1p, 15amp Ventilation Fan
 - 7) Spare

3.10 INTERFACE PANEL

- A. Electrical work and materials shall be in accordance with the applicable sections in Division 26, except as noted herein. If there is a contradiction between this specification and Division 26, the requirements in Division 26 will prevail, unless a variance is approved by the Engineer.
- B. It will be the responsibility of the station manufacturer to provide the following as an adjunct to the meter equipment.
 - 1. 1" entrance conduit complete to interface panel.
 - 2. Size 12" x 12" NEMA 1 interface panel.
 - 3. Separate 120 volt single phase power circuit in conduit to the interface panel.
 - 4. Circuits made up and in conduit from main power panel to interface panel terminal strip.

3.11 SURGE PROTECTION DEVICE

- A. Electrical work and materials shall be in accordance with the applicable sections in Division 26, except as noted herein. If there is a contradiction between this specification and Division 26, the requirements in Division 26 will prevail, unless a variance is approved by the Engineer.
- B. A secondary surge arrester shall be provided. Housing shall be Noryl and be ultrasonically sealed. Valve blocks shall be metal oxide with an insulating ceramic collar. Gap design shall be annular. The lead wire shall be permanently crimped to the upper electrode forming part of the gap structure.
- C. Arresters shall be UL and CSA listed Lightning Protective Devices.

3.12 ELECTRICAL CONDUIT AND WIRING

- A. Electrical work and materials shall be in accordance with the applicable sections in Division 26, except as noted herein. If there is a contradiction between this specification and Division 26, the requirements in Division 26 will prevail, unless a variance is approved by the Engineer.
- B. All service entrance conduits power and signal, shall be rigid steel conduit, individually sized to accept the inbound service conductors and telemetry/telephone/radio cables.
- C. These service entrance conduits shall be installed from the main power panel through the capsule steel sidewall and terminate exterior to the equipment enclosure as a threaded hub. The service entrance exterior conduit connection points shall be capped or plugged for shipment.
- D. All wiring within the equipment enclosure and outside of the panel enclosures shall be run in conduit except where watertight flexible conduit is properly used to connect pump drivers, fan motors, solenoid valves, limit switches, etc., where flexible connections are best utilized.
- E. Devices and appliances where furnished by the original manufacturer and being equipped with a UL approved rubber cord and plug, may be plugged into a receptacle.
- F. Equipment enclosure conduits shall be rigid, heavy wall, Schedule 40 PVC with solvent weld moisture-proof connections, in minimum size 3/4" or larger, sized to handle the type, number and size of equipment conductors to be carried.
- G. The conduiting shall be in compliance with Article 347 of the National Electrical Code and NEMA TC-2, Federal WC-1094A and UL-651 Underwriters Laboratory Specifications.
- H. Where flexible conduit connections are necessary, the conduit used shall be Liquid-tight, flexible, totally nonmetallic, corrosion resistant, nonconductive, U.L. listed conduit sized to handle the type, number and size of equipment conductors to be carried - in compliance with Article 351 of the National Electrical Code.
- I. Control and accessory wiring shall be sized for load, type MTW/AWM (Machine tool wire/appliance wiring material) as set forth in Article 310 and 670 of the National Electrical Code, Schedule 310-13 and NFPA Standard 79 for flame retardant, moisture, heat and oil resistant thermoplastic, copper conductors in compliance with NTMA and as listed by Underwriters Laboratories (AWM), except where accessories are furnished with a manufacturer supplied UL approved rubber cord and plug.

3.13 STATION INTERIOR LIGHTING

- A. Electrical work and materials shall be in accordance with the applicable sections in Division 26, except as noted herein. If there is a contradiction between this specification and Division 26, the requirements in Division 26 will prevail, unless a variance is approved by the Engineer.
- B. There shall be two (2) two-tube, 32 watt per tube, electronic start, enclosed and gasketed, forty-eight (48) inch minimum length fluorescent light fixtures installed within the equipment enclosure. The light switch shall be of the night glow type and be located conveniently in the hatch opening.
- C. Open fluorescent or incandescent fixtures will not be accepted.

3.14 DEHUMIDIFIER

- A. One (1) each.
- B. Capacity 30 pints per 24 hours.
- C. Compressor rated 115 volts, 60 Hz, 4.3 operating amps.
- D. 106 CFM fan, 2 fan speed.
- E. Humidity range 35 to 80% RH, ambient temperature range of 41 to 95 F, Type R410A refrigerant.
- F. Washable filter.
- G. Condensate piped direct to drain.
- H. UL listed rubber cord.

3.15 HEATER

- A. Heaters shall be in accordance with the applicable sections in Division 23, except as noted herein. If there is a contradiction between this specification and Division 23, the requirements in Division 23 will prevail, unless a variance is approved by the Engineer.
- B. One (1) each.
- C. Rating - 10,239 BTU/HR - 3000 watts, 240 volt.
- D. Enclosed resistance wire within steel finned element.
- E. Control - thermostat.
- F. UL listed.

- G. Fan forced.
- H. Hard wired in conduit per UL 400-1.

3.16 EXHAUST FAN

- A. Fans shall be in accordance with the applicable sections in Division 23, except as noted herein. If a there is a contradiction between this specification and Division 23, the requirements in Division 23 will prevail, unless a variance is approved by the Engineer.
- B. One (1) each.
- C. Capacity each 230 cfm at .2 inch static pressure.
- D. Shaded pole motor - squirrel cage blower.
- E. Hard wired in conduit to conduit box on motor per UL 400-1.
- F. 120 volt A.C. operation from wall mount thermostat and HAND/AUTO switch on main control panel.
- G. Hatch installed limit switch to activate exhaust fan whenever the entrance hatch is open.
- H. Exhaust air piping - 3 inch minimum.
- I. Air return piping - 3 inch minimum.
- J. Exhaust and return piping protected by 180° PVC return bend with removable insect screen.

3.17 SUMP PUMP

- A. One (1) each.
- B. Capacity 19 gpm at 15 feet TDH.
- C. Vortex type Impeller - plastic, glass filled with metal insert.
- D. Cast iron motor shell, switch case and pump housing.
- E. UL listed submersible oil filled motor - UL listed rubber power cord - 120 volt AC operation.
- F. Float operated, submersible (NEMA 6) mechanical switch.
- G. Completely submersible, hermetically sealed.
- H. Auto reset thermal overload protection.
- I. PVC pump discharge piping 1 1/2" x 1 1/4" with single check valve - union both sides.
- J. Provision for dewatering drain system for freeze protection.

END OF SECTION

SECTION 220500

COMMON WORK RESULTS FOR PLUMBING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Mechanical sleeve seals.
 - 5. Sleeves.
 - 6. Escutcheons.
 - 7. Grout.
 - 8. Plumbing demolition.
 - 9. Equipment installation requirements common to equipment sections.
 - 10. Painting and finishing.
 - 11. Concrete bases.
 - 12. Supports and anchorages.

1.03 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 - 2. CPVC: Chlorinated polyvinyl chloride plastic.

3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.04 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.

B. Welding certificates.

1.05 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.07 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.03 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
 - 1. ABS Piping: ASTM D 2235.
 - 2. CPVC Piping: ASTM F 493.
 - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - 4. PVC to ABS Piping Transition: ASTM D 3138.
- I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.04 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
 - 1. Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Dresser Industries, Inc.; DMD Div.
 - c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
 - d. JCM Industries.
 - e. Smith-Blair, Inc.
 - f. Viking Johnson.
 - 2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
 - 3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
 - 4. Aboveground Pressure Piping: Pipe fitting.
- B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Manufacturers:
 - a. Eslon Thermoplastics.
- C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Manufacturers:
 - a. Thompson Plastics, Inc.
- D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
 - 1. Manufacturers:
 - a. NIBCO INC.
 - b. NIBCO, Inc.; Chemtrol Div.
- E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.
 - 1. Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Fernco, Inc.
 - c. Mission Rubber Company.
 - d. Plastic Oddities, Inc.

2.05 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.

- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Eclipse, Inc.
 - d. Epco Sales, Inc.
 - e. Hart Industries, International, Inc.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Epco Sales, Inc.
 - d. Watts Industries, Inc.; Water Products Div.
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
1. Manufacturers:
 - a. Calpico, Inc.
 - b. Lochinvar Corp.
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
1. Manufacturers:
 - a. Perfection Corp.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Co., Inc.
 - d. Victaulic Co. of America.

2.06 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Stainless steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.07 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.
- H.

2.08 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 EXECUTION

3.01 PLUMBING DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - 5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.02 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.

- b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - g. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - h. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
 - i. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- L. Sleeves are not required for core-drilled holes.
- M. Permanent sleeves are not required for holes formed by removable PE sleeves.
- N. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- O. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - (1) Seal space outside of sleeve fittings with grout.
 - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- P. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

- Q. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- R. Verify final equipment locations for roughing-in.
- S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.03 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 5. PVC Nonpressure Piping: Join according to ASTM D 2855.
 6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.04 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.05 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.06 PAINTING

- A. Painting of plumbing systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.07 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.

2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section.

3.08 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.09 GROUTING

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION

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BARTLETT & WEST

SECTION 220523

GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.04 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 2. ASME B31.1 for power piping valves.
 - 3. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle, gate, and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 5. Set butterfly valves closed or slightly open.

6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
1. Maintain valve end protection.
 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
 2. Handwheel: For valves other than quarter-turn types.
 3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
 4. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- E. Valve-End Connections:
1. Flanged: With flanges according to ASME B16.1 for iron valves.
 2. Grooved: With grooves according to AWWA C606.
 3. Solder Joint: With sockets according to ASME B16.18.
 4. Threaded: With threads according to ASME B1.20.1.
- F. Valve Bypass and Drain Connections: MSS SP-45.

2.02 BRONZE BALL VALVES

- A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Hammond Valve.
 - d. Legend Valve.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Red-White Valve Corporation.

- h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.

2.03 IRON, SINGLE-FLANGE BUTTERFLY VALVES

- A. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Aluminum-Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Kitz Corporation.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Red-White Valve Corporation.
 - i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: NBR.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Aluminum bronze.

2.04 IRON, GROOVED-END BUTTERFLY VALVES

- A. 175 CWP, Iron, Grooved-End Butterfly Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Tyco Fire Products LP; Grinnell Mechanical Products.
- b. Victaulic Company.
- 2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 175 psig.
 - c. Body Material: Coated, ductile iron.
 - d. Stem: Two-piece stainless steel.
 - e. Disc: Coated, ductile iron.
 - f. Seal: EPDM.

2.05 BRONZE LIFT CHECK VALVES

- A. Class 125, Lift Check Valves with Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Vertical flow.
 - d. Body Material: ASTM B 61 or ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.

2.06 BRONZE SWING CHECK VALVES

- A. Class 125, Bronze Swing Check Valves with Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Kitz Corporation.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Red-White Valve Corporation.
 - i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 3.

- b. CWP Rating: 200 psig.
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: Bronze.

2.07 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Kitz Corporation.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Red-White Valve Corporation.
 - i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.

2.08 IRON, GROOVED-END SWING CHECK VALVES

A. 300 CWP, Iron, Grooved-End Swing Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Tyco Fire Products LP; Grinnell Mechanical Products.
 - b. Victaulic Company.
2. Description:
 - a. CWP Rating: 300 psig.
 - b. Body Material: ASTM A 536, ductile iron.
 - c. Seal: EPDM.
 - d. Disc: Spring-operated, ductile iron or stainless steel.

2.09 BRONZE GATE VALVES

A. Class 125, NRS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Kitz Corporation.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Red-White Valve Corporation.
 - i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron.

2.10 CHAINWHEELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Babbitt Steam Specialty Co.
2. Roto Hammer Industries.
3. Trumbull Industries.

B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
2. Attachment: For connection to valve stems.
3. Sprocket Rim with Chain Guides: Ductile or cast iron, of type and size required for valve. Include zinc coating.
4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 EXECUTION

3.01 EXAMINATION

- ### A.
- Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for gate valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.
- F. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Lift Check Valves: With stem upright and plumb.

3.03 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.04 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball or butterfly valves.
 - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
 - 3. Throttling Service: Ball valves.
 - 4. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
 - b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with spring.
 - c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.

2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.
7. For Grooved-End Steel Piping: Valve ends may be grooved.

3.05 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 PSIG OR LESS)

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two piece, full port, bronze with bronze trim.
3. Bronze Lift Check Valves: Class 125, bronze disc.
4. Bronze Swing Check Valves: Class 125, bronze disc.
5. Bronze Gate Valves: Class 125, NRS.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron, Single-Flange Butterfly Valves: 200 CWP, NBR seat, aluminum-bronze disc.
3. Iron, Grooved-End Butterfly Valves: 175 CWP.
4. Iron Swing Check Valves: Class 125, metal seats.
5. Iron, Grooved-End Swing Check Valves: 300 CWP.

END OF SECTION

SECTION 220529

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.03 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Trapeze pipe hangers.
 - 2. Metal framing systems.
 - 3. Fiberglass strut systems.
 - 4. Pipe stands.
 - 5. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Detail fabrication and assembly of trapeze hangers.
 - 2. Design Calculations: Calculate requirements for designing trapeze hangers.

1.05 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.06 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 PRODUCTS

2.01 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
 - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. Stainless-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.02 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.03 FIBERGLASS PIPE HANGERS

- A. Clevis-Type, Fiberglass Pipe Hangers:
 - 1. Description: Similar to MSS SP-58, Type 1, steel pipe hanger except hanger is made of fiberglass or fiberglass-reinforced resin.
 - 2. Hanger Rods: Continuous-thread rod, washer, and nuts made of stainless steel.
- B. Strap-Type, Fiberglass Pipe Hangers:
 - 1. Description: Similar to MSS SP-58, Type 9 or Type 10, steel pipe hanger except hanger is made of fiberglass-reinforced resin.
 - 2. Hanger Rod and Fittings: Continuous-thread rod, washer, and nuts made of stainless steel.

2.04 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.

- b. Cooper B-Line, Inc.
 - c. Flex-Strut Inc.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut Corporation; Tyco International, Ltd.
 - g. Wesanco, Inc.
- 2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
 - 3. Standard: MFMA-4.
 - 4. Channels: Continuous slotted steel channel with inturned lips.
 - 5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
 - 6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
 - 7. Metallic Coating: Electroplated zinc or Hot-dipped galvanized.
 - 8. Paint Coating: Vinyl, Vinyl alkyd, Epoxy, or Acrylic.
 - 9. Plastic Coating: PVC, Polyurethane, or Epoxy.

2.05 FIBERGLASS STRUT SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Allied Tube & Conduit.
 - 2. Champion Fiberglass, Inc.
 - 3. Cooper B-Line, Inc.
- B. Description: Shop- or field-fabricated pipe-support assembly similar to MFMA-4 for supporting multiple parallel pipes.
 - 1. Channels: Continuous slotted fiberglass channel with inturned lips.
 - 2. Channel Nuts: Fiberglass nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
 - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.06 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless- steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.07 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

- B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Single-Pipe Stand:
 - 1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 - 2. Base: Plastic.
 - 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
 - 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand:
 - 1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
 - 2. Bases: One or more; plastic.
 - 3. Vertical Members: Two or more protective-coated-steel channels.
 - 4. Horizontal Member: Protective-coated-steel channel.
 - 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.08 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.09 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.10 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 EXECUTION

3.01 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.
- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled fiberglass struts.
- F. Fastener System Installation:
1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- G. Pipe Stand Installation:
1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
- H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- J. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- K. Install lateral bracing with pipe hangers and supports to prevent swaying.
- L. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- M. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

3.02 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.03 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.04 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.05 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.06 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

- E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- F. Use stainless-steel pipe hangers, fiberglass pipe hangers, fiberglass strut systems, and stainless-steel or corrosion-resistant attachments for hostile environment applications.
- G. Use padded hangers for piping that is subject to scratching.
- H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24 (DN 100 to DN 600), requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36 (DN 20 to DN 900), requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 (DN 15 to DN 600) if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe erection.
 - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8 (DN 20 to DN 200).
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
 - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
 - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
 - 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8 (DN 10 to DN 200).
 - 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3 (DN 10 to DN 80).
 - 12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
 - 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 - 14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 - 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 - 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 (DN 65 to DN 900) if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
 - 17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30 (DN 25 to DN 750), from two rods if longitudinal movement caused by expansion and contraction might occur.
 - 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24 (DN 65 to DN 600), from single rod if horizontal movement caused by expansion and contraction might occur.

19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 (DN 50 to DN 1050) if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 (DN 50 to DN 600) if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 (DN 50 to DN 750) if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.
- J. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- K. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

- a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
- 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
- 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- L. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 - 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 - 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- M. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 - 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 - 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 - 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 - 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 - 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 - 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 - 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- P. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION

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BARTLETT & WEST

SECTION 220548

VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product:
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component used.
 - a. Annotate to indicate application of each product submitted and compliance with requirements.
 - 3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Shop Drawings:
 - 1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment.
- C. Delegated-Design Submittal: For each vibration isolation device.
 - 1. Include design calculations and details for selecting vibration isolators complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system was examined for excessive stress and that none exists.

1.04 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of vibration isolation device installation for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.
- B. Qualification Data: For professional engineer and testing agency.
- C. Welding certificates.

- D. Field quality-control test reports.

1.05 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

2.02 ELASTOMERIC ISOLATION PADS

- A. Elastomeric Isolation Pads:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Mason Industries.
 - b. Vibration Eliminator Co., Inc.
 - c. Vibration Isolation.
 - d. Vibration Mountings & Controls, Inc.
 - 2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
 - 3. Size: Factory or field cut to match requirements of supported equipment.
 - 4. Pad Material: Oil and water resistant with elastomeric properties.
 - 5. Surface Pattern: Smooth, Ribbed, or Waffle pattern.
 - 6. Infused nonwoven cotton or synthetic fibers.
 - 7. Load-bearing metal plates adhered to pads.
 - 8. Sandwich-Core Material: Resilient and elastomeric.
 - a. Surface Pattern: Any pattern.
- B. Infused nonwoven cotton or synthetic fibers.

2.03 ELASTOMERIC ISOLATION MOUNTS

- A. Double-Deflection, Elastomeric Isolation Mounts:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Mason Industries.
 - b. Vibration Eliminator Co., Inc.
 - c. Vibration Isolation.
 - d. Vibration Mountings & Controls, Inc.
 - 2. Mounting Plates:

- a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
 - b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
3. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.04 OPEN-SPRING ISOLATORS

A. Freestanding, Laterally stable, Open-Spring Isolators:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Mason Industries.
 - b. Vibration Eliminator Co., Inc.
 - c. Vibration Isolation.
 - d. Vibration Mountings & Controls, Inc.
- 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
- 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
- 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
- 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- 6. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig.
- 7. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 VIBRATION-CONTROL DEVICE INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Division 03 Section "Cast-in-Place Concrete." Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- B. Equipment Restraints:
 - 1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.

- C. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- D. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- E. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

3.03 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 - 2. Measure isolator restraint clearance.
 - 3. Measure isolator deflection.
- C. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

SECTION 220553

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

1.03 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 PRODUCTS

2.01 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 4. Fasteners: Stainless-steel rivets or self-tapping screws.
 - 5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

2. Letter Color: White.
 3. Background Color: Black.
 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.02 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black.
- C. Background Color: Yellow.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.03 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

2.04 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.
 - 1. Stencil Material: Fiberboard or metal.
 - 2. Stencil Paint: Exterior, gloss, alkyd enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
 - 3. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1 unless otherwise indicated.

2.05 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data.

2.06 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: 3 by 5-1/4 inches minimum.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Yellow background with black lettering.

PART 3 EXECUTION

3.01 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.02 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.

- B. Locate equipment labels where accessible and visible.

3.03 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09 Section.
- B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, on each piping system.
 - 1. Identification Paint: Use for contrasting background.
 - 2. Stencil Paint: Use for pipe marking.
- C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- D. Pipe Label Color Schedule:
 - 1. Low-Pressure, Compressed-Air Piping:
 - a. Background Color: Red.
 - b. Letter Color: White.
 - 2. Sanitary Waste and Storm Drainage Piping:
 - a. Background Color: Black.
 - b. Letter Color: White.

3.04 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 - 1. Valve-Tag Size and Shape:
 - a. Low-Pressure Compressed Air: 1-1/2 inches, round.
 - 2. Valve-Tag Color:
 - a. Low-Pressure Compressed Air: Natural.
 - 3. Letter Color:
 - a. Low-Pressure Compressed Air: Black.

3.05 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

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BARTLETT & WEST

SECTION 221316

SANITARY WASTE AND VENT PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For solvent drainage system. Include plans, elevations, sections, and details.

1.04 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

PART 2 PRODUCTS

2.01 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.02 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- B. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.
- C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- D. Adhesive Primer: ASTM F 656.
 - 1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Solvent Cement: ASTM D 2564.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 3 EXECUTION

3.01 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Division 31 Section "Earth Moving."

3.02 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping to permit valve servicing.
- C. Install piping at indicated slopes.
- D. Install piping free of sags and bends.
- E. Install fittings for changes in direction and branch connections.
- F. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- G. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- H. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
- I. Install aboveground PVC piping according to ASTM D 2665.
- J. Install underground PVC piping according to ASTM D 2321.

- K. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.03 JOINT CONSTRUCTION

- A. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 - 3. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.04 VALVE INSTALLATION

- A. General valve installation requirements are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- B. Shutoff Valves:
 - 1. Install shutoff valve on each sewage pump discharge.
 - 2. Install gate or full-port ball valve for piping NPS 2 (DN 50) and smaller.
 - 3. Install gate valve for piping NPS 2-1/2 (DN 65) and larger.
- C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

3.05 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hanger and support devices and installation specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
 - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 - 2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
 - 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 - 4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
 - 5. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 6. Install individual, straight, horizontal piping runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
 - 7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 8. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

- E. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches with 3/8-inch rod.
 - 2. NPS 3 (DN 80): 48 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches with 5/8-inch rod.
 - 4. NPS 6 and NPS 8 (DN 150 and DN 200): 48 inches with 3/4-inch rod.
 - 5. NPS 10 and NPS 12 (DN 250 and DN 300): 48 inches with 7/8-inch rod.
- F. Install supports for vertical PVC piping every 48 inches.
- G. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.06 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
 - 1. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
 - 2. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections according to the following unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.07 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.08 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg (250 Pa). Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
 - 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 6. Prepare reports for tests and required corrective action.

3.09 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

3.10 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Underground, soil, waste, and vent piping NPS 4 (DN 100) and smaller shall be the following:
 - 1. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- C. Underground, soil and waste piping NPS 5 (DN 125) and larger shall be the following:
 - 1. Solid-wall PVC pipe; PVC socket fittings; and solvent-cemented joints.

END OF SECTION

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BARTLETT & WEST

SECTION 221513

GENERAL-SERVICE COMPRESSED-AIR PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. CR: Chlorosulfonated polyethylene synthetic rubber.
- C. EPDM: Ethylene-propylene-diene terpolymer rubber.
- D. HDPE: High-density polyethylene plastic.
- E. NBR: Acrylonitrile-butadiene rubber.
- F. PE: Polyethylene plastic.
- G. PVC: Polyvinyl chloride plastic.
- H. Low-Pressure Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures of 150 psig or less.

1.03 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Compressed-air piping and support and installation shall withstand effects of seismic events determined according to SEI/ASCE 7, "Minimum Design Loads for Buildings and Other Structures."

1.04 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Plastic pipes, fittings, and valves.
 - 2. Dielectric fittings.
 - 3. Flexible pipe connectors.
 - 4. Safety valves.
 - 5. Pressure regulators. Include rated capacities and operating characteristics.
 - 6. Automatic drain valves.
 - 7. Filters. Include rated capacities and operating characteristics.
 - 8. Lubricators. Include rated capacities and operating characteristics.
 - 9. Quick couplings.
 - 10. Hose assemblies.

1.05 INFORMATIONAL SUBMITTALS

- A. Brazing and welding certificates.
- B. Qualification Data: For Installers.
- C. Field quality-control test reports.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For general-service compressed-air piping specialties to include in emergency, operation, and maintenance manuals.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Extruded-Tee Outlet Procedure: Qualify operators according to training provided by T-DRILL Industries Inc., for making branch outlets.
 - 2. Pressure-Seal Joining Procedure for Copper Tubing: Qualify operators according to training provided by Viega; Plumbing and Heating Systems.
 - 3. Pressure-Seal Joining Procedure for Steel Piping. Qualify operators according to training provided by Victaulic Company.
- B. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or to AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."
- C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
- D. ASME Compliance:
 - 1. Comply with ASME B31.1, "Power Piping," for high-pressure compressed-air piping.
 - 2. Comply with ASME B31.9, "Building Services Piping," for low-pressure compressed-air piping.

1.08 PROJECT CONDITIONS

- A. Interruption of Existing Compressed-Air Service: Do not interrupt compressed-air service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary compressed-air service according to requirements indicated:
 - 1. Notify Architect no fewer than two days in advance of proposed interruption of compressed-air service.
 - 2. Do not proceed with interruption of compressed-air service without Architect's written permission.

PART 2 PRODUCTS

2.01 PIPES, TUBES, AND FITTINGS

- A. Schedule 40, Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B, black or hot-dip zinc coated with ends threaded according to ASME B1.20.1.
 - 1. Steel Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized seamless steel pipe. Include ends matching joining method.
 - 2. Malleable-Iron Fittings: ASME B16.3, Class 150 or 300, threaded.

3. Malleable-Iron Unions: ASME B16.39, Class 150 or 300, threaded.
 4. Steel Flanges: ASME B16.5, Class 150 or 300, carbon steel, threaded.
 5. Wrought-Steel Butt-Welding Fittings: ASME B16.9, Schedule 40.
 6. Steel Flanges: ASME B16.5, Class 150 or 300, carbon steel.
 7. Grooved-End Fittings and Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - (1) Victaulic Company.
 - b. Grooved-End Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron casting; with grooves according to AWWA C606 and dimensions matching steel pipe.
 - c. Couplings: AWWA C606 or UL 213, for steel-pipe dimensions and rated for 300-psig minimum working pressure. Include ferrous housing sections, gasket suitable for compressed air, and bolts and nuts. Provide EDPM gaskets for oil-free compressed air. Provide NBR gaskets if compressed air contains oil or oil vapor.
- B. Schedule 5, Steel Pipe: ASTM A 135, carbon steel with plain ends and zinc-plated finish.
1. Pressure-Seal Fittings: Listed and labeled by a qualified testing agency and FMG-approved, carbon-steel, pressure-seal housing with O-ring end seals suitable for compressed-air piping and rated for 300-psig minimum working pressure. Provide EDPM seals for oil-free compressed air. Provide NBR seals if compressed air contains oil or oil vapor.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - (1) Victaulic Company.
- C. Transition Couplings for Metal Piping: Metal coupling or other manufactured fitting same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
- D. PVC Pipe: ASTM D 1785, Schedule 40.
1. PVC Fittings: ASTM D 2466, Schedule 40, socket type.
- E. Blue ABS Piping System: Made of ASTM D 3965, ABS-resin modified to provide shatter-resistant pipe for compressed-air service. Pipe and fittings are light blue and sizes are in millimeters.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. IPEX Inc.
 2. Transition Fittings, 20 to 63 mm: Composite union with ABS socket end, CR O-ring, and malleable-iron union nut and threaded end; with construction similar to MSS SP-107, transition union.
 3. Transition Fittings, 90 to 110 mm: Flange assembly with ABS flange, CR gasket, and metal flange of material matching piping to be connected.
 4. Valves, 20 to 63 mm: ABS union ball valve with socket ends.
 5. Valves, 90 to 110 mm: ABS butterfly valve with lever handle.
- F. Green ABS Piping System: Made of ASTM D 3965, ABS-resin modified to provide shatter-resistant pipe for compressed-air service. Pipe and fittings are dark green with SDR of 9.0 and same OD as ASTM A 53/A 53M, steel pipe.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. NIBCO INC.
 - 2. Transition Fittings, NPS 1/2 to NPS 2 (DN 15 to DN 50): Composite union with ABS socket end, CR O-ring, ABS union nut, and brass solder-joint end; with construction similar to MSS SP-107, transition union.
 - 3. Transition Fittings, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): ABS flange, CR gasket, and metal flange of material matching piping to be connected.
 - 4. Valves, NPS 1/2 to NPS 2 (DN 15 to DN 50): Union ball valve with socket ends.
 - 5. Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Union ball valve with flanged ends. Include safety exhaust feature in Part 3 "Valve Applications" Article if required.
- G. HDPE Piping System: Made of ASTM D 1248, HDPE resin to provide shatter-resistant pipe for compressed-air service. Pipe and fittings are dark blue with pipe dimensions about the same OD as ASTM D 3035, PE pipe.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Asahi/America.
 - 2. Transition Fittings, NPS 1/2 to NPS 2 (DN 15 to DN 50): HDPE adapter with one socket end and one end with threaded brass insert.
 - 3. Transition Fittings, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): HDPE flange, CR gasket, and metal flange of material matching piping to be connected.
 - 4. Valves, NPS 1/2 to NPS 3 (DN 15 to DN 80): HDPE union ball valve with socket ends.

2.02 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for compressed-air piping system contents.
- 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- G. Solvent Cements for Joining Plastic Piping:
- 1. ABS Piping: ASTM D 2235.
 - 2. PVC Piping: ASTM D 2564. Include primer complying with ASTM F 656.

2.03 VALVES

- A. Metal Ball, Butterfly, Check, Gate, and Swing Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping."

2.04 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

- B. Dielectric Unions:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Hart Industries International, Inc.
 - d. Jomar International Ltd.
 - e. Matco-Norca, Inc.
 - f. McDonald, A. Y. Mfg. Co.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - h. Wilkins; a Zurn company.
- 2. Description:
 - a. Standard: ASSE 1079.
 - b. Pressure Rating: 250 psig.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous.

- C. Dielectric Flanges:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Matco-Norca, Inc.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - e. Wilkins; a Zurn company.
- 2. Description:
 - a. Standard: ASSE 1079.
 - b. Factory-fabricated, bolted, companion-flange assembly.
 - c. Pressure Rating: 150 psig or 300 psig to suit system pressures.
 - d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

- D. Dielectric-Flange Insulating Kits:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.

- b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
2. Description:
- a. Nonconducting materials for field assembly of companion flanges.
 - b. Pressure Rating: 150 psig.
 - c. Gasket: Neoprene or phenolic.
 - d. Bolt Sleeves: Phenolic or polyethylene.
 - e. Washers: Phenolic with steel backing washers.

2.05 FLEXIBLE PIPE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1. Flex-Hose Co., Inc.
 - 2. Flexicraft Industries.
 - 3. Hyspan Precision Products, Inc.
 - 4. Mercer Rubber Co.
 - 5. Metraflex, Inc.
 - 6. Unaflex, Inc.
 - 7. Universal Metal Hose; a Hyspan Company
- B. Bronze-Hose Flexible Pipe Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
- 1. Working-Pressure Rating: 200 psig minimum.
 - 2. End Connections, NPS 2 (DN 50) and Smaller: Threaded copper pipe or plain-end copper tube.
 - 3. End Connections, NPS 2-1/2 (DN 65) and Larger: Flanged copper alloy.
- C. Stainless-Steel-Hose Flexible Pipe Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
- 1. Working-Pressure Rating: 200 psig minimum.
 - 2. End Connections, NPS 2 (DN 50) and Smaller: Threaded steel pipe nipple.
 - 3. End Connections, NPS 2-1/2 (DN 65) and Larger: Flanged steel nipple.

2.06 SPECIALTIES

- A. Safety Valves: ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," construction; National Board certified, labeled, and factory sealed; constructed of bronze body with poppet-type safety valve for compressed-air service.
- 1. Pressure Settings: Higher than discharge pressure and same or lower than receiver pressure rating.
- B. Air-Main Pressure Regulators: Bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 250-psig inlet pressure, unless otherwise indicated.
- 1. Type: Pilot operated.

- C. Air-Line Pressure Regulators: Diaphragm or pilot operated, bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 200-psig minimum inlet pressure, unless otherwise indicated.
- D. Air-Line Pressure Regulators: Diaphragm operated, aluminum alloy or plastic body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 200-psig minimum inlet pressure, unless otherwise indicated.
- E. Automatic Drain Valves: Stainless-steel body and internal parts, rated for 200-psig minimum working pressure, capable of automatic discharge of collected condensate. Include mounting bracket if wall mounting is indicated.
- F. Coalescing Filters: Coalescing type with activated carbon capable of removing water and oil aerosols; with color-change dye to indicate when carbon is saturated and warning light to indicate when selected maximum pressure drop has been exceeded. Include mounting bracket if wall mounting is indicated.
- G. Mechanical Filters: Two-stage, mechanical-separation-type, air-line filters. Equip with deflector plates, resin-impregnated-ribbon-type filters with edge filtration, and drain cock. Include mounting bracket if wall mounting is indicated.
- H. Air-Line Lubricators: With drip chamber and sight dome for observing oil drop entering air stream; with oil-feed adjustment screw and quick-release collar for easy bowl removal. Include mounting bracket if wall mounting is indicated.
 - 1. Provide with automatic feed device for supplying oil to lubricator.

2.07 QUICK COUPLINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Aeroquip Corporation; Eaton Corp.
 - 2. Bowes Manufacturing Inc.
 - 3. Foster Manufacturing, Inc.
 - 4. Milton Industries, Inc.
 - 5. Parker Hannifin Corp.; Fluid Connectors Group; Quick Coupling Div.
 - 6. Rectus Corp.
 - 7. Schrader-Bridgeport; Amflo Div Schrader-Bridgeport/Standard Thomson.
 - 8. Snap-Tite, Inc.; Quick Disconnect & Valve Division.
 - 9. TOMCO Products Inc.
 - 10. Tuthill Corporation; Hansen Coupling Div.
- B. General Requirements for Quick Couplings: Assembly with locking-mechanism feature for quick connection and disconnection of compressed-air hose.
- C. Automatic-Shutoff Quick Couplings: Straight-through brass body with O-ring or gasket seal and stainless-steel or nickel-plated-steel operating parts.
 - 1. Socket End: With one-way valve and threaded inlet for connection to piping or threaded hose fitting.
 - 2. Plug End: Straight-through type with barbed outlet for attaching hose.
- D. Valveless Quick Couplings: Straight-through brass body with stainless-steel or nickel-plated-steel operating parts.
 - 1. Socket End: With O-ring or gasket seal, without valve, and with barbed inlet for attaching hose.

2. Plug End: With barbed outlet for attaching hose.

2.08 HOSE ASSEMBLIES

- A. Description: Compatible hose, clamps, couplings, and splicers suitable for compressed-air service, of nominal diameter indicated, and rated for 300-psig minimum working pressure, unless otherwise indicated.
1. Hose: Reinforced single- or double-wire-braid, CR-covered hose for compressed-air service.
 2. Hose Clamps: Stainless-steel clamps or bands.
 3. Hose Couplings: Two-piece, straight-through, threaded brass or stainless-steel O-ring or gasket-seal swivel coupling with barbed ends for connecting two sections of hose.
 4. Hose Splicers: One-piece, straight-through brass or stainless-steel fitting with barbed ends for connecting two sections of hose.

PART 3 EXECUTION

3.01 PIPING APPLICATIONS

- A. Compressed-Air Piping between Air Compressors and Receivers: Use the following piping materials for each size range:
1. NPS 2 (DN 50) and Smaller: Schedule 40, black-steel pipe; threaded, malleable-iron fittings; and threaded joints.
 2. NPS 2 (DN 50) and Smaller: Schedule 5, galvanized-steel pipe; pressure-seal fittings; and pressure-sealed joints.
 3. NPS 2 (DN 50) and Smaller: Schedule 40, black-steel pipe; wrought-steel fittings; and welded joints.
 4. NPS 2 (DN 50) and Smaller: Type K or L (Type A or B), copper tube; wrought-copper fittings; and brazed joints.
 5. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Schedule 40, black-steel pipe; threaded, malleable-iron fittings; and threaded joints.
 6. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Schedule 40, black-steel pipe; grooved-end fittings; couplings; and grooved joints.
 7. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Schedule 40, black-steel pipe; wrought-steel fittings; and welded joints.
 8. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Type K or L (Type A or B), copper tube; wrought-copper fittings; and brazed joints.
 9. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Type K or L (Type A or B), copper tube; grooved-end copper fittings; couplings; and grooved joints.
 10. NPS 5 (DN 125) and Larger: Schedule 40, black-steel pipe; threaded, malleable-iron fittings; and threaded joints.
 11. NPS 5 (DN 125) and Larger: Schedule 40, black-steel pipe; grooved-end fittings; couplings; and grooved joints.
 12. NPS 5 (DN 125) and Larger: Schedule 40, black-steel pipe; wrought-steel fittings; and welded joints.
- B. Low-Pressure Compressed-Air Distribution Piping: Use the following piping materials for each size range:
1. NPS 2 (DN 50) and Smaller: Schedule 40, black-steel pipe; threaded, malleable-iron fittings; and threaded joints.

2. NPS 2 (DN 50) and Smaller: Schedule 5, galvanized-steel pipe; pressure-seal fittings; and pressure-sealed joints.
3. NPS 2 (DN 50) and Smaller: Type K or L (Type A or B), copper tube; wrought-copper fittings; and brazed joints.
4. NPS 2 (DN 50) and Smaller: Type K or L (Type A or B), copper tube; press-type fittings; and pressure-sealed joints.
5. NPS 2 (DN 50) and Smaller: 63-mm and smaller, blue ABS pipe and fittings; transition fittings; valves; and solvent-cemented joints.
6. NPS 2 (DN 50) and Smaller: Green ABS pipe and fittings, transition fittings, and valves; and solvent-cemented joints.
7. NPS 2 (DN 50) and Smaller: HDPE pipe, fittings, and valves; and heat-fusion joints.
8. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Schedule 40, black-steel pipe; threaded, malleable-iron fittings; and threaded joints.
9. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Schedule 40, black-steel pipe; grooved-end fittings; couplings; and grooved joints.
10. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Type K or L (Type A or B), copper tube; wrought-copper fittings; and brazed joints.
11. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Type K or L (Type A or B), copper tube; grooved-end copper fittings; couplings; and grooved joints.
12. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Type K or L (Type A or B), copper tube; press-type fittings; and pressure-sealed joints.
13. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): 90- and 110-mm, blue ABS pipe and fittings; transition fittings; and solvent-cemented joints. Include butterfly valves and flanged joints.
14. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): NPS 3 and NPS 4 (DN 80 and DN 100), green ABS pipe and fittings; transition fittings; and solvent-cemented joints. Include ball valves and flanged joints.
15. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): NPS 3 and NPS 4 (DN 80 and DN 100), HDPE pipe and fittings; valves; and heat-fusion joints.
16. NPS 5 and NPS 6 (DN 125 and DN 150): Schedule 40, black-steel pipe; threaded, malleable-iron fittings; and threaded joints.
17. NPS 5 (DN 125) and Larger: Schedule 40, black-steel pipe; grooved-end fittings; couplings; and grooved joints.

C. Drain Piping: Use the following piping materials:

1. NPS 2 (DN 50) and Smaller: Type M (Type C) copper tube; wrought-copper fittings; and brazed or soldered joints.
2. NPS 2 (DN 50) and Smaller: PVC pipe and fittings; and solvent-cemented joints.

3.02 VALVE APPLICATIONS

A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for metal general-duty valves. Use metal valves, unless otherwise indicated.

1. Metal General-Duty Valves: Use valve types specified in "Valve Applications" Article in Division 22 Section "General-Duty Valves for Plumbing Piping" according to the following:
 - a. Low-Pressure Compressed Air: Valve types specified for low-pressure compressed air.
 - b. Equipment Isolation NPS 2 (DN 50) and Smaller: Safety-exhaust, copper-alloy ball valve with exhaust vent and pressure rating at least as great as piping system operating pressure.

- c. Grooved-end valves may be used with grooved-end piping and grooved joints.
- 2. Plastic General-Duty Valves: Provide valves, made by piping manufacturer, that are compatible with piping. Do not use plastic valves between air compressors and receivers.
 - a. Blue ABS Piping System: Ball and butterfly valves.
 - b. Green ABS Piping System: Ball valves.
 - c. HDPE Piping System: Ball valves.

3.03 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping concealed from view and protected from physical contact by building occupants, unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and to coordinate with other services occupying that space.
- E. Install piping adjacent to equipment and machines to allow service and maintenance.
- F. Install air and drain piping with 1 percent slope downward in direction of flow.
- G. Install nipples, flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating, unless otherwise indicated.
- H. Equipment and Specialty Flanged Connections:
 - 1. Use steel companion flange with gasket for connection to steel pipe.
 - 2. Use cast-copper-alloy companion flange with gasket and brazed or soldered joint for connection to copper tube. Do not use soldered joints for connection to air compressors or to equipment or machines producing shock or vibration.
- I. Flanged joints may be used instead of specified joint for any piping or tubing system.
- J. Extended-tee outlets with brazed branch connection may be used for copper tubing, within extruded-tee connection diameter to run tube diameter ratio for tube type, according to Extruded Tee Connections Sizes and Wall Thickness for Copper Tube (Inches) Table in ASTM F 2014.
- K. Install eccentric reducers where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.
- L. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.
- M. Install piping to permit valve servicing.
- N. Install piping free of sags and bends.
- O. Install fittings for changes in direction and branch connections.

3.04 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints for Steel Piping: Join according to AWS D10.12/D10.12M.
- E. Brazed Joints for Copper Tubing: Join according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
- F. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Join according to ASTM B 828 or CDA's "Copper Tube Handbook."
- G. Extruded-Tee Outlets for Copper Tubing: Form branches according to ASTM F 2014, with tools recommended by procedure manufacturer, and using operators qualified according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Use asbestos-free, nonmetallic gasket suitable for compressed air. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.
- I. Grooved Joints: Assemble couplings with housing, gasket, lubricant, and bolts. Join according to AWWA C606 for grooved joints. Do not apply lubricant to prelubricated gaskets.
- J. Heat-Fusion Joints for PE Piping: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657 for socket-fusion joints.
- K. Pressure-Sealed Joints: Join with tools recommended by fitting manufacturer, using operators qualified according to Part 1 "Quality Assurance" Article.
- L. Solvent-Cemented Joints for ABS Piping: Clean and dry joining surfaces. Join according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. Join according to ASME B31.9 for solvent-cemented joints and to ASTM D 2235 Appendix.
- M. Solvent-Cemented Joints for PVC Piping: Clean and dry joining surfaces. Join according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. Apply primer and join according to ASME B31.9 for solvent-cemented joints and to ASTM D 2672.
- N. Dissimilar Metal Piping Material Joints: Use dielectric fittings.

3.05 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping."

- B. Install shutoff valves and unions or flanged joints at compressed-air piping to air compressors.
- C. Install shutoff valve at inlet to each automatic drain valve, filter, lubricator, and pressure regulator.
- D. Install check valves to maintain correct direction of compressed-air flow to and from compressed-air piping specialties and equipment.

3.06 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. NPS 2 (DN 50) and Smaller: Use dielectric unions.
- C. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flanges.
- D. NPS 5 (DN 125) and Larger: Use dielectric flange kits.

3.07 FLEXIBLE PIPE CONNECTOR INSTALLATION

- A. Install flexible pipe connectors in discharge piping and in inlet air piping from remote air-inlet filter of each air compressor.
- B. Install bronze-hose flexible pipe connectors in copper compressed-air tubing.
- C. Install stainless-steel-hose flexible pipe connectors in steel compressed-air piping.

3.08 SPECIALTY INSTALLATION

- A. Install safety valves on receivers in quantity and size to relieve at least the capacity of connected air compressors.
- B. Install air-main pressure regulators in compressed-air piping at or near air compressors.
- C. Install air-line pressure regulators in branch piping to equipment and tools.
- D. Install automatic drain valves on aftercoolers, receivers, and dryers. Discharge condensate onto nearest floor drain.
- E. Install coalescing filters in compressed-air piping at or near air compressors and upstream from mechanical filters. Mount on wall at locations indicated.
- F. Install mechanical filters in compressed-air piping at or near air compressors and downstream from coalescing filters. Mount on wall at locations indicated.
- G. Install air-line lubricators in branch piping to machine tools. Mount on wall at locations indicated.
- H. Install quick couplings at piping terminals for hose connections.
- I. Install hose assemblies at hose connections.

3.09 CONNECTIONS

- A. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment and machine.

- B. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment and machine.

3.10 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.
- B. Vertical Piping: MSS Type 8 or 42, clamps.
- C. Individual, Straight, Horizontal Piping Runs:
 - 1. 100 Feet or Less: MSS Type 1, adjustable, steel clevis hangers.
 - 2. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
- D. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
- E. Base of Vertical Piping: MSS Type 52, spring hangers.
- F. Support horizontal piping within 12 inches of each fitting and coupling.
- G. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- H. Install hangers for Schedule 40, steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1/4 to NPS 1/2 (DN 8 to DN 15): 96 inches with 3/8-inch rod.
 - 2. NPS 3/4 to NPS 1-1/4 (DN 20 to DN 32): 84 inches with 3/8-inch rod.
 - 3. NPS 1-1/2 (DN 40): 12 feet with 3/8-inch rod.
 - 4. NPS 2 (DN 50): 13 feet with 3/8-inch rod.
 - 5. NPS 2-1/2 (DN 65): 14 feet with 1/2-inch rod.
 - 6. NPS 3 (DN 80): 15 feet with 1/2-inch rod.
 - 7. NPS 3-1/2 (DN 90): 16 feet with 1/2-inch rod.
 - 8. NPS 4 (DN 100): 17 feet with 5/8-inch rod.
 - 9. NPS 5 (DN 125): 19 feet with 5/8-inch rod.
 - 10. NPS 6 (DN 150): 21 feet with 3/4-inch rod.
 - 11. NPS 8 (DN 200): 24 feet with 3/4-inch rod.
 - 12. NPS 10 (DN 250): 26 feet with 7/8-inch rod.
 - 13. NPS 12 (DN 300): 30 feet with 7/8-inch rod.
- I. Install supports for vertical, Schedule 40, steel piping every 15 feet.
- J. Install hangers for Schedule 5, steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1/2 (DN 15): 72 inches with 3/8-inch rod.
 - 2. NPS 3/4 (DN 20): 84 inches with 3/8-inch rod.
 - 3. NPS 1 (DN 25): 96 inches with 3/8-inch rod.
 - 4. NPS 1-1/4 (DN 32): 108 inches with 3/8-inch rod.
 - 5. NPS 1-1/2 (DN 40): 10 feet with 3/8-inch rod.

6. NPS 2 (DN 50): 11 feet with 3/8-inch rod.

K. Install supports for vertical, Schedule 5, steel piping every 10 feet.

L. Install vinyl-coated hangers for ABS piping with the following maximum horizontal spacing and minimum rod diameters:

1. All Sizes: Install continuous support for piping with compressed air at normal operating temperature above 100 deg F.
2. NPS 3/8 and NPS 1/2 (DN 10 and DN 15): 30 inches with 3/8-inch rod.
3. NPS 3/4 (DN 20): 38 inches with 3/8-inch rod.
4. NPS 1 (DN 25): 40 inches with 3/8-inch rod.
5. NPS 1-1/4 (DN 32): 45 inches with 3/8-inch rod.
6. NPS 1-1/2 (DN 40): 52 inches with 3/8-inch rod.
7. NPS 2 (DN 50): 58 inches with 3/8-inch rod.
8. NPS 3 (DN 80): 68 inches with 1/2-inch rod.
9. NPS 4 (DN 100): 76 inches with 1/2-inch rod.

M. Install supports for vertical ABS piping every 48 inches.

N. Install vinyl-coated hangers for HDPE piping with the following maximum horizontal spacing and minimum rod diameters:

1. All Sizes: Install continuous support for piping with compressed air at normal operating temperature above 100 deg F.
2. NPS 1/2 (DN 15): 30 inches with 3/8-inch rod.
3. NPS 3/4 (DN 20): 35 inches with 3/8-inch rod.
4. NPS 1 (DN 25): 40 inches with 3/8-inch rod.
5. NPS 1-1/4 (DN 32): 43 inches with 3/8-inch rod.
6. NPS 1-1/2 (DN 40): 49 inches with 3/8-inch rod.
7. NPS 2 (DN 50): 55 inches with 3/8-inch rod.
8. NPS 3 and NPS 4 (DN 80 and DN 100): 96 inches with 1/2-inch rod.

O. Install supports for vertical HDPE piping every 48 inches.

3.11 LABELING AND IDENTIFICATION

A. Label all compressed air piping.

3.12 FIELD QUALITY CONTROL

A. Perform field tests and inspections.

B. Tests and Inspections:

1. Piping Leak Tests for Metal Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen to pressure of 50 psig above system operating pressure, but not less than 150 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.

2. Piping Leak Tests for ABS Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen, at temperature of 110 deg F or less, to pressure of 40 psig above system operating pressure, but not less than 80 psig or more than 120 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
 3. Piping Leak Tests for HDPE Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen, at temperature of 100 deg F or less, to pressure of 40 psig above system operating pressure, but not less than 100 psig or more than 180 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
 4. Repair leaks and retest until no leaks exist.
 5. Inspect filters, lubricators and pressure regulators for proper operation.
- C. Prepare test reports.

END OF SECTION

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BARTLETT & WEST

SECTION 221519

GENERAL-SERVICE PACKAGED AIR COMPRESSORS AND RECEIVERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 DEFINITIONS

- A. Actual Air: Air delivered from air compressors. Flow rate is delivered compressed air measured in acfm.
- B. Standard Air: Free air at 68 deg F and 1 atmosphere before compression or expansion and measured in scfm.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
 - 1. Include diagrams for power, signal, and control wiring.
- C. Delegated-Design Submittal: For compressed-air equipment mounting.
 - 1. Detail fabrication and assembly of supports.
 - 2. Include design calculations for selecting vibration isolators and for designing vibration isolation bases.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For compressed-air equipment to include in emergency, operation, and maintenance manuals.

1.05 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Air-Compressor, Inlet-Air-Filter Elements: Equal to ten percent of amount installed, but no fewer than two units.
 - 2. Belts: Two for each belt-driven compressor.

1.06 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 PRODUCTS

2.01 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASME Compliance: Fabricate and label receivers to comply with ASME Boiler and Pressure Vessel Code.

2.02 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design compressed-air equipment mounting.
- B. Seismic Performance: Compressed-air equipment shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2.03 GENERAL REQUIREMENTS FOR PACKAGED AIR COMPRESSORS AND RECEIVERS

- A. General Description: Factory-assembled, -wired, -piped, and -tested; electric-motor-driven; air-cooled; continuous-duty air compressors and receivers that deliver air of quality equal to intake air.
- B. Control Panels: Automatic control station with load control and protection functions. Comply with NEMA ICS 2 and UL 508.
 - 1. Enclosure: NEMA ICS 6, Type 12 control panel unless otherwise indicated.
 - 2. Motor Controllers: Full-voltage, combination magnetic type with undervoltage release feature and motor-circuit-protector-type disconnecting means and short-circuit protective device.
 - 3. Control Voltage: 120-V ac or less, using integral control power transformer.
 - 4. Motor Overload Protection: Overload relay in each phase.
 - 5. Starting Devices: Hand-off-automatic selector switch in cover of control panel, plus pilot device for automatic control.
 - 6. Automatic control switches to alternate lead-lag compressors for duplex air compressors.
 - 7. Instrumentation: Include discharge-air pressure gage, air-filter maintenance indicator, hour meter, compressor discharge-air and coolant temperature gages, and control transformer.
 - 8. Alarm Signal Device: For connection to alarm system to indicate when backup air compressor is operating.
- C. Receivers: Steel tank constructed according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 - 1. Pressure Rating: At least as high as highest discharge pressure of connected compressors, and bearing appropriate code symbols.
 - 2. Interior Finish: Corrosion-resistant coating.
 - 3. Accessories: Include safety valve, pressure gage, drain, and pressure-reducing valve.
- D. Mounting Frame: Fabricate mounting and attachment to pressure vessel with reinforcement strong enough to resist packaged equipment movement during a seismic event when base is anchored to building structure.

2.04 OIL-FLOODED, ROTARY-SCREW AIR COMPRESSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Kaeser Compressors, Inc.
- B. Compressor(s): Oil-flooded, rotary-screw type with lubricated helical screws and lubricated gear box.
 - 1. Coupling: Nonlubricated, flexible type.
 - 2. Cooling/Lubrication System: Unit-mounted, air-cooled exchanger package prepiped to unit; with air pressure circulation system with coolant stop valve, full-flow coolant filter, and thermal bypass valve.
 - 3. Air Filter: Dry type, with maintenance indicator and cleanable, replaceable filter element.
 - 4. Air/Coolant Receiver and Separation System: 150-psig- rated steel tank with ASME safety valve, coolant-level gage, multistage air-coolant separator element, minimum pressure valve, blowdown valve, discharge check valve, coolant stop valve, full-flow coolant filter, and thermal bypass valve.
 - 5. Capacity Control: Capacity modulation between zero and 100 percent air delivery, with operating pressures between 50 and 100 psig. Include necessary control to hold constant pressure. When air demand is zero, unload compressor by using pressure switch and blowdown valve.
- C. Capacities and Characteristics:
 - 1. Air Compressor(s): single or two stage.
 - 2. Standard-Air Capacity of Each Air Compressor: As required for 30 min fill.
 - 3. Motor (Each Air Compressor):
 - a. Horsepower: 30
 - 4. Electrical Characteristics:
 - a. Volts: 480
 - b. Phase(s): Three.
 - c. Hertz: 60.
 - 5. Receiver: ASME construction steel tank.
 - a. Arrangement: Integral or as specified on drawings.
 - b. Capacity: Standard as packaged equipment or as specified on drawings.
 - c. Interior Finish: Epoxy or galvanized coating.
 - d. Drain: Automatic valve.
 - 6. Enclosure: Steel with sound-attenuating material lining.

2.05 REFRIGERANT COMPRESSED-AIR DRYERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Kaeser Compressors, Inc.
- B. Description: Noncycling, air-cooled, electric-motor-driven unit with steel enclosure and capability to deliver 35 deg F, 100-psig air at dew point. Include automatic ejection of condensate from airstream, step-down transformers, disconnect switches, inlet and outlet pressure gages, thermometers, automatic controls, and filters.

2.06 COMPUTER INTERFACE CABINET

- A. Description:

1. Wall mounting.
2. Welded steel with white enamel finish.
3. Gasketed door.
4. Grounding device.
5. Factory-installed, signal circuit boards.
6. Power transformer.
7. Circuit breaker.
8. Wiring terminal board.
9. Internal wiring capable of interfacing 20 alarm signals.

2.07 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 260510 "Common Motor Requirements."
 1. Enclosure: Totally enclosed, fan cooled, or totally enclosed, air over.
 2. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load does not require motor to operate in service factor range above 1.0.

PART 3 EXECUTION

3.01 EQUIPMENT INSTALLATION

- A. Equipment Mounting:
 1. Install air compressors, aftercoolers, and air dryers on cast-in-place concrete bases using elastomeric pads. Comply with requirements for equipment bases and foundations specified in Division 03 Section "Cast-in-Place Concrete."
 2. Comply with requirements for vibration isolation and control devices specified in Section 220548 "Vibration Controls for Plumbing Piping and Equipment."
- B. Install compressed-air equipment anchored to substrate.
- C. Arrange equipment so controls and devices are accessible for servicing.
- D. Maintain manufacturer's recommended clearances for service and maintenance.
- E. Install the following devices on compressed-air equipment:
 1. Thermometer, Pressure Gage, and Safety Valve: Install on each compressed-air receiver.
 2. Pressure Regulators: Install downstream from air compressors and dryers.
 3. Automatic Drain Valves: Install on aftercoolers, receivers, and dryers. Discharge condensate over nearest floor drain.

3.02 CONNECTIONS

- A. Comply with requirements for piping specified in Division 22 Section "General-Service Compressed-Air Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to machine, allow space for service and maintenance.

3.03 IDENTIFICATION

- A. Identify general-service air compressors and components. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.04 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Check for lubricating oil in lubricated-type equipment.
 - 3. Check belt drives for proper tension.
 - 4. Verify that air-compressor inlet filters and piping are clear.
 - 5. Check for equipment vibration-control supports and flexible pipe connectors, and verify that equipment is properly attached to substrate.
 - 6. Check safety valves for correct settings. Ensure that settings are higher than air-compressor discharge pressure, but not higher than rating of system components.
 - 7. Drain receiver tanks.
 - 8. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 9. Test and adjust controls and safeties.

3.05 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain air compressors, aftercoolers, and air dryers.

END OF SECTION

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BARTLETT & WEST

SECTION 230500

COMMON WORK RESULTS FOR HVAC

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Sleeves.
 - 2. Grout.
 - 3. Equipment installation requirements common to equipment sections.
 - 4. Painting and finishing.
 - 5. Supports and anchorages.

1.03 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. CPVC: Chlorinated polyvinyl chloride plastic.
 - 2. PE: Polyethylene plastic.
 - 3. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.04 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

1.05 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. All costs, regardless of discipline, associated with providing alternate equipment shall be the responsibility of contractor providing equipment. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.07 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

- 1.
2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.03 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 EXECUTION

3.01 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.02 PAINTING

- A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.03 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.04 GROUTING

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.

- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION

SECTION 230513

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

1.03 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of motors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Motor winding failure.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.

2.02 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.03 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Premium efficient, as defined in NEMA MG 1.

- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Class B.
- I. Insulation: Class F.
- J. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.
- L. Provide shaft grounding (diverter) ring on drive end of all vertical motors.
- M. Provide shaft grounding (diverter) ring on drive end and insulated bearing on the non-drive end of all motors 25 hp and larger controlled by variable-frequency motor controllers.

2.04 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

END OF SECTION

SECTION 230529

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.03 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Trapeze pipe hangers.
 - 2. Metal framing systems.
 - 3. Pipe stands.
 - 4. Equipment supports.

1.05 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.06 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 PRODUCTS

2.01 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.
 - c. Thomas & Betts Corporation.
 - d. Unistrut Corporation; Tyco International, Ltd.
2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Metallic Coating: Hot-dipped galvanized.
8. Paint Coating: Alkyd.
9. Plastic Coating: PVC.

B. Non-MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International; a subsidiary of Mueller Water Products Inc.
 - b. ERICO International Corporation.
 - c. Haydon Corporation; H-Strut Division.
 - d. NIBCO INC.
 - e. PHD Manufacturing, Inc.
 - f. PHS Industries, Inc.
2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Coating: Paint.

2.02 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.03 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.04 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 EXECUTION

3.01 HANGER AND SUPPORT INSTALLATION

- A. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- B. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- C. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- D. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- E. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- F. Install lateral bracing with pipe hangers and supports to prevent swaying.
- G. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

- H. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

3.02 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.03 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.04 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.05 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 233423

HVAC POWER VENTILATORS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base fan-performance ratings on actual Project site elevations.
- B. Operating Limits: Classify according to AMCA 99.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound-power ratings.
 - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 4. Material thickness and finishes, including color charts.
 - 5. Dampers, including housings, linkages, and operators.
 - 6. Roof curbs.
 - 7. Fan speed controllers.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Delegated-Design Submittal: For unit hangars and supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - a. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
 - b. Design Calculations: Calculate requirements for selecting vibration isolators[**and seismic restraints**] and for designing vibration isolation bases.

1.04 CLOSEOUT SUBMITTALS

- 1. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.1 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 2. Belts: One set for each belt-driven unit.

1.05 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.
- C. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

1.06 COORDINATION

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided.
- C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 PRODUCTS

2.01 CENTRIFUGAL WALL VENTILATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Broan-NuTone LLC.
 - 2. Broan-NuTone LLC; NuTone Inc.
 - 3. Carnes Company.
 - 4. Greenheck Fan Corporation.
 - 5. Loren Cook Company.
 - 6. PennBarry.
- B. Housing: Heavy-gage, removable, spun-aluminum, dome top and outlet baffle; venturi inlet cone.
- C. Fan Wheel: Aluminum hub and wheel with backward-inclined blades.
- D. Belt Drives:
 - 1. Resiliently mounted to housing.
 - 2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 - 3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 - 4. Pulleys: Cast-iron, adjustable-pitch motor pulley.
 - 5. Fan and motor isolated from exhaust airstream.
- E. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through internal aluminum conduit.
3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
4. Wall Grille: Ring type for flush mounting.
5. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in wall sleeve; factory set to close when fan stops.
6. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.

2.02 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- B. Enclosure Type: Totally enclosed, fan cooled.

2.03 SOURCE QUALITY CONTROL

- A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install power ventilators level and plumb.
- B. Install units with clearances for service and maintenance.
- C. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.02 CONNECTIONS

- A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.03 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices, and those connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Prepare test and inspection reports.

3.04 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Replace fan and motor pulleys as required to achieve design airflow.
- D. Lubricate bearings.

END OF SECTION

SECTION 233716

FIXED LOUVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 DEFINITIONS

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
- B. Horizontal Louver: Louver with horizontal blades (i.e., the axes of the blades are horizontal).
- C. Vertical Louver: Louver with vertical blades (i.e., the axes of the blades are vertical).
- D. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.
- E. Wind-Driven-Rain-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
 - 1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
 - 2. Show mullion profiles and locations.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.
- B. Windborne-debris-impact-resistance test reports.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 - 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
 - 3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

2.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.
 - 1. Wind Loads: Determine loads based on a uniform pressure of 20 lbf/sq. ft., acting inward or outward.
- B. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- D. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

2.3 FIXED, EXTRUDED-ALUMINUM LOUVERS

- A. Horizontal, Drainable-Blade Louver :
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance Inc.; a Mestek company.

- b. American Warming and Ventilating; a Mestek company.
 - c. Cesco Products; a division of Mestek, Inc.
 - d. Greenheck Fan Corporation.
 - e. Industrial Louvers, Inc.
 - f. Louvers & Dampers; a division of Mestek, Inc.
 - g. Pottorff.
 - h. Ruskin Company; Tomkins PLC.
 - i. Approved Equal.
- 2. Louver Depth: 4 inches or as indicated on drawings.
 - 3. Frame and Blade Nominal Thickness: Not less than 0.080 inch for blades and 0.080 inch for frames.
 - 4. Mullion Type: Exposed.
 - 5. Louver Performance Ratings:
 - a. Free Area: Not less than 8.0 sq. ft. for 48-inch- wide by 48-inch- high louver.
 - b. Point of Beginning Water Penetration: Not less than 900 fpm.
 - c. Air Performance: Not more than 0.10-inch wg static pressure drop at 800-fpm free-area intake velocity.
 - d. Air Performance: Not more than 0.15-inch wg static pressure drop at 900-fpm free-area exhaust velocity.
 - 6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.4 LOUVER SCREENS

- A. General: Provide screen at each exterior louver.
 - 1. Screen Location for Fixed Louvers: Interior face.
 - 2. Screening Type: Bird screening except where insect screening is indicated.
- B. Secure screen frames to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches from each corner and at 12 inches o.c.
- C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.
 - 1. Metal: Same type and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.
 - 2. Finish: Mill finish unless otherwise indicated.
 - 3. Type: Rewirable frames with a driven spline or insert.
- D. Louver Screening for Aluminum Louvers:
 - 1. Bird Screening: Flattened, expanded aluminum, 3/4 by 0.050 inch thick.
 - 2. Insect Screening: Aluminum, 18-by-16 mesh, 0.012-inch wire.

2.5 BLANK-OFF PANELS

- A. Insulated, Blank-Off Panels: Laminated panels consisting of an insulating core surfaced on back and front with metal sheets and attached to back of louver.
 - 1. Thickness: 2 inches.
 - 2. Metal Facing Sheets: Galvanized-steel sheet, not less than 0.028-inch nominal thickness.

3. Insulating Core: Rigid, glass-fiber-board insulation or extruded-polystyrene foam.
4. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard extruded-aluminum-channel frames, not less than 0.080-inch nominal thickness, with corners mitered and with same finish as panels.
5. Seal perimeter joints between panel faces and louver frames with gaskets or sealant.
6. Panel Finish: Same type of finish applied to louvers, but black color.
7. Attach blank-off panels with sheet metal screws.

2.6 MATERIALS

- A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Galvanized-Steel Sheet: ASTM A 653/A 653M, G60 zinc coating, mill phosphatized.
- D. Fasteners: Use types and sizes to suit unit installation conditions.
 1. Use Phillips head screws for exposed fasteners unless otherwise indicated.
 2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
 3. For fastening galvanized steel, use hot-dip-galvanized steel or 300 series stainless-steel fasteners.
 4. For fastening stainless steel, use 300 series stainless-steel fasteners.
 5. For color-finished louvers, use fasteners with heads that match color of louvers.
- E. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed for masonry, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
- F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.7 FABRICATION

- A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.
 1. Continuous Vertical Assemblies: Fabricate units without interrupting blade-spacing pattern unless horizontal mullions are indicated.
 2. Horizontal Mullions: Provide horizontal mullions at joints unless continuous vertical assemblies are indicated.
- C. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

- D. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
 - 1. Frame Type: Exterior flange for all masonry construction. Interior flange for all other types of construction unless otherwise indicated.
- E. Include supports, anchorages, and accessories required for complete assembly.
- F. Provide vertical mullions of type and at spacings indicated, but not more than is recommended by manufacturer, or 72 inches o.c., whichever is less.
 - 1. Exposed Mullions: Where indicated, provide units with exposed mullions of same width and depth as louver frame. Where length of louver exceeds fabrication and handling limitations, provide interlocking split mullions designed to permit expansion and contraction.
 - 2. Exterior Corners: Prefabricated corner units with mitered and welded blades and with semirecessed mullions at corners.
- G. Provide subsills made of same material as louvers or extended sills for recessed louvers.
- H. Join frame members to each other and to fixed louver blades with fillet welds concealed from view unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.8 ALUMINUM FINISHES

- A. Finish louvers after assembly.
- B. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
- C. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
 - 1. Color: As selected by Architect from full range of industry colors and color densities.

2.9 GALVANIZED-STEEL SHEET FINISHES

- A. Finish louvers after assembly.
- B. Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating compatible with the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas and repair according to ASTM A 780.
- C. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 2 mils.
 - 1. Color and Gloss: As selected by Architect from manufacturer's full range.

2.10 CONTROL DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cesco Products; a division of Mestek, Inc.
 2. Greenheck Fan Corporation.
 3. Nailor Industries Inc.
 4. Ruskin Company.
- B. Low-leakage rating, with linkage outside air stream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
- C. Frames:
1. Hat shaped.
 2. 0.094-inch- thick, galvanized sheet steel.
 3. Mitered and welded corners.
- D. Blades:
1. Multiple blade with maximum blade width of 8 inches.
 2. Parallel- and opposed-blade design.
 3. [Galvanized-steel] [Stainless steel] [Aluminum].
 4. 0.064 inch thick single skin or 0.0747-inch- thick dual skin.
 5. Blade Edging: Closed-cell neoprene.
 6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.
- E. Blade Axles: 1/2-inch-diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
1. Operating Temperature Range: From minus 40 to plus 200 deg F.
- F. Bearings:
1. Molded synthetic or Stainless-steel sleeve.
 2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 3. Thrust bearings at each end of every blade.
- G. Motor Operator:
1. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - a. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - b. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
 - c. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 - d. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
 - e. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
 - f. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
 - g. Electrical Connection: 115 V, single phase, 60 Hz.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

- A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Contractor to provide stainless steel frame around opening for louver installation. Frame to cover entire opening for louver.
- E. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- F. Protect unpainted galvanized and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.
- G. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required.
- H. Coordinate with electrical contractor for connections of control damper operators. Verify with Electrical contractor voltage requirements.

3.4 ADJUSTING AND CLEANING

- A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

- C. Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION

SECTION 238239

UNIT HEATERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 DEFINITIONS

- A. BAS: Building automation system.
- B. CWP: Cold working pressure.
- C. PTFE: Polytetrafluoroethylene plastic.
- D. TFE: Tetrafluoroethylene plastic.

1.03 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Plans, elevations, sections, and details.
 - 2. Location and size of each field connection.
 - 3. Details of anchorages and attachments to structure and to supported equipment.
 - 4. Equipment schedules to include rated capacities, operating characteristics, furnished specialties, and accessories.
 - 5. Location and arrangement of piping valves and specialties.
 - 6. Location and arrangement of integral controls.
 - 7. Wiring Diagrams: Power, signal, and control wiring.
- C. Samples for Initial Selection: Finish colors for units with factory-applied color finishes.
- D. Samples for Verification: Finish colors for each type of cabinet unit heater and wall and ceiling heaters indicated with factory-applied color finishes.
- E. Field quality-control test reports.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For cabinet unit heaters to include in emergency, operation, and maintenance manuals.

1.05 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Cabinet Unit Heater Filters: Furnish one spare filter for each filter installed.

1.06 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

PART 2 PRODUCTS

2.01 WALL AND CEILING HEATERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Berko Electric Heating; a division of Marley Engineered Products.
 - 2. Chromalox, Inc.; a division of Emerson Electric Company.
 - 3. Indeeco.
 - 4. Markel Products; a division of TPI Corporation.
 - 5. Marley Electric Heating; a division of Marley Engineered Products.
 - 6. QMark Electric Heating; a division of Marley Engineered Products.
 - 7. Trane.
- B. Description: An assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.
- C. Cabinet:
 - 1. Front Panel: Stamped-steel louver or Extruded-aluminum bar grille, with removable panels fastened with tamperproof fasteners.
 - 2. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.
 - 3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Surface-Mounting Cabinet Enclosure: Steel with finish to match cabinet.
- E. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high temperature protection. Provide integral circuit breaker for overcurrent protection.
- F. Fan: Aluminum propeller directly connected to motor.

1. Motor: Permanently lubricated. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
- G. Controls: Unit-mounted thermostat. Low-voltage relay with transformer kit.
- H. Electrical Connection: Factory wire motors and controls for a single field connection with disconnect switch.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for electrical connections to verify actual locations before unit heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install wall boxes in finished wall assembly; seal and weatherproof. Joint-sealant materials and applications are specified in Division 07 Section "Joint Sealants."
- B. Install cabinet unit heaters to comply with NFPA 90A.
- C. Install propeller unit heaters level and plumb.
- D. Suspend cabinet unit heaters from structure with elastomeric hangers. Suspend propeller unit heaters from structure with all-thread hanger rods and elastomeric hangers. Hanger rods and attachments to structure are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Vibration hangers are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- E. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.
- F. Install new filters in each fan-coil unit within two weeks of Substantial Completion.

3.03 CONNECTIONS

- A. Comply with safety requirements in UL 1995.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.04 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

3.05 ADJUSTING

A. Adjust initial temperature set points.

B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

END OF SECTION

SECTION 260500

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Electrical equipment coordination and installation.
 - 2. Sleeves for raceways and cables.
 - 3. Sleeve seals.
 - 4. Grout.
 - 5. Common electrical installation requirements.

1.03 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.04 SUBMITTALS

- A. Product Data: For sleeve seals.

1.05 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

PART 2 PRODUCTS

2.01 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

2.02 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 3. Pressure Plates: Stainless steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.03 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 EXECUTION

3.01 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

- E. Right of Way: Give to piping systems installed at a required slope.

3.02 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Cut sleeves to length for mounting flush with both surfaces of walls.
- E. Extend sleeves installed in floors 2 inches above finished floor level.
- F. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- G. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- H. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- I. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- J. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.03 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

END OF SECTION

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BARTLETT & WEST

SECTION 260510

COMMON MOTOR REQUIREMENTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

1.03 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of motors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Motor winding failure.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in plumbing equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.
- C. Comply with IEEE 841 for severe-duty motors.

2.02 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.03 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.

- B. Manufacturers:
 - 1. US Motor
 - 2. General Electric Company
 - 3. Westinghouse
 - 4. Approved Equal.
- C. Efficiency: Premium efficient, as defined in NEMA MG 1.
- D. Service Factor: 1.15.
- E. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
- F. Multispeed Motors: Separate winding for each speed.
- G. Rotor: Random-wound, squirrel cage.
- H. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- I. Temperature Rise: Class B.
- J. Insulation: Class F.
- K. Peak Voltage Rating of stator wiring to be a minimum of 2,200 volts.
- L. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- M. Enclosure Material: Cast iron frame and end bells.
- N. Thermal Protection: Comply with NEMA MG 1.
- O. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.
- P. Provide shaft grounding (diverter) ring on drive end of all vertical motors.
- Q. Provide shaft grounding (diverter) ring on drive end and insulated bearing on the non-drive end of all motors 25 hp and larger controlled by variable-frequency motor controllers.

2.04 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

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BARTLETT & WEST

SECTION 260519

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 DEFINITIONS

- A. VFC: Variable frequency controller.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Field quality-control reports.

1.05 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 PRODUCTS

2.01 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Alcan Products Corporation; Alcan Cable Division.
 - 2. Alpha Wire.
 - 3. Belden Inc.
 - 4. Encore Wire Corporation.
 - 5. General Cable Technologies Corporation.
 - 6. Southwire Incorporated.
- B. Aluminum and Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.
- C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN-2-THWN-2 [Type XHHW-2] [Type USE] [and] [Type SO].
- D. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for metal-clad cable, Type MC with ground wire.

2.02 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Hubbell Power Systems, Inc.
 - 3. O-Z/Gedney; a brand of the EGS Electrical Group.
 - 4. 3M; Electrical Markets Division.
 - 5. Tyco Electronics.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.03 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

PART 3 EXECUTION

3.01 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN-2-THWN-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN-2-THWN-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-2-THWN-2, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.
- E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-2-THWN-2, single conductors in raceway.
- F. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.
- G. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

3.03 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

- B. Complete raceway installation between conductor and cable termination points according to Division 26 Section "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."
- G. Complete cable tray systems installation according to Division 26 Section "Cable Trays for Electrical Systems" prior to installing conductors and cables.

3.04 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

3.05 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.06 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Division 26 Section "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.07 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspection.
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
 - 2. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger.

Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.

- a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
- b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

D. Test and Inspection Reports: Prepare a written report to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

E. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 260519

SECTION 260526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.03 INFORMATIONAL SUBMITTALS

- A. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:
 - 1. Ground rods.
 - 2. Ground rings.
 - 3. Grounding arrangements and connections for separately derived systems.
 - 4. Grounding for sensitive electronic equipment.
- B. Qualification Data: For testing agency and testing agency's field supervisor.
- C. Field quality-control test reports.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:
 - 1. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - a. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems based on NFPA 70B.
 - (1) Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
 - (2) Include recommended testing intervals.

1.05 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Burndy; Part of Hubbell Electrical Systems.
2. Dossert; AFL Telecommunications LLC.
3. ERICO International Corporation.
4. Fushi Copperweld Inc.
5. Galvan Industries, Inc.; Electrical Products Division, LLC.
6. Harger Lightning and Grounding.
7. ILSCO.
8. O-Z/Gedney; A Brand of the EGS Electrical Group.
9. Robbins Lightning, Inc.
10. Siemens Power Transmission & Distribution, Inc.

2.02 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application
- B. Comply with UL 467 for grounding and bonding materials and equipment

2.03 CONDUCTORS

- A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
1. Solid Conductors: ASTM B 3.
 2. Stranded Conductors: ASTM B 8.
 3. Tinned Conductors: ASTM B 33.
 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross-section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.04 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.05 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet.

PART 3 EXECUTION

3.01 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.
 - 1. Bury at least 24 inches below grade.
 - 2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
 - 2. Where indicated on both sides of doorways, route bus up to top of doorframe, across top of doorway, and down; connect to horizontal bus.
- E. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.

3.02 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.03 GROUNDING AT THE SERVICE

- A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator

3.04 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.
- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.
- D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

3.05 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits.
 - 3. Receptacle circuits.
 - 4. Single-phase motor and appliance branch circuits.
 - 5. Three-phase motor and appliance branch circuits.
 - 6. Flexible raceway runs.
 - 7. Armored and metal-clad cable runs.
 - 8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
- C. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.
- D. Metallic Fences: Comply with requirements of IEEE C2.
 - 1. Grounding Conductor: Bare copper, not less than No. 8 AWG.
 - 2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
 - 3. Barbed Wire: Strands shall be bonded to the grounding conductor.

3.06 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Common Ground Bonding with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
 - 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- E. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
- F. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each indicated item, extending around the perimeter of building.
 - 1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
 - 2. Bury ground ring not less than 24 inches from building foundation.

3.07 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:
1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 4. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- E. Grounding system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.
- G. Report measured ground resistances that exceed the following values:
1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
 2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
 4. Power Distribution Units or Panelboards Serving Electronic Equipment: 1 ohm.
 5. Substations and Pad-Mounted Equipment: 5 ohms.
 6. Manhole Grounds: 10 ohms.
- H. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 260529

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.03 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.04 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.
 - 2. Nonmetallic slotted support systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze hangers. Include Product Data for components.
 - 2. Steel slotted channel systems. Include Product Data for components.
 - 3. Nonmetallic slotted channel systems. Include Product Data for components.
 - 4. Equipment supports.

1.05 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.06 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

- B. Comply with NFPA 70.

PART 2 PRODUCTS

2.01 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Atkore International.
 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 5. Channel Dimensions: Selected for applicable load criteria.
- B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch diameter holes at a maximum of 8 inches o.c., in at least 1 surface.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.
 2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
 3. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
 4. Rated Strength: Selected to suit applicable load criteria.
- C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- D. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - (1) Hilti Inc.
 - (2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - (3) MKT Fastening, LLC.
 - (4) Simpson Strong-Tie Co., Inc.
2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - (1) Cooper B-Line, Inc.
 - (2) Hilti, Inc.
 - (3) ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - (4) MKT Fastening, LLC.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.02 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 EXECUTION

3.01 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where it's Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.02 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
1. To Wood: Fasten with lag screws or through bolts.
 2. To New Concrete: Bolt to concrete inserts.
 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 4. To Existing Concrete: Expansion anchor fasteners.
 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
 6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 7. To Light Steel: Sheet metal screws.
 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.04 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

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SECTION 260533

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.

1.03 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

1.04 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Structural members in the paths of conduit groups with common supports.
 - 2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.
- B. Qualification Data: For professional engineer.
- C. Source quality-control test reports.

PART 2 PRODUCTS

2.01 METAL CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Allied Tube & Conduit.
 - 3. Anamet Electrical, Inc.
 - 4. Electri-Flex Company.
 - 5. O-Z/Gedney.
 - 6. Wheatland Tube Company.
- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. ARC: Comply with ANSI C80.5 and UL 6A.
- E. IMC: Comply with ANSI C80.6 and UL 1242.
- F. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
 - 1. Comply with NEMA RN 1.
 - 2. Coating Thickness: 0.040 inch, minimum.
- G. EMT: Comply with ANSI C80.3 and UL 797.
- H. FMC: Comply with UL 1; zinc-coated steel.
- I. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- J. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
 - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
 - 2. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: Setscrew or compression.
 - 3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
 - 4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints
- K. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.02 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Anamet Electrical, Inc.
 - 3. Arnco Corporation.
 - 4. CANTEX Inc.
 - 5. CertainTeed Corporation.
 - 6. Condux International, Inc.
 - 7. Electri-Flex Company.
 - 8. Lamson & Sessions; Carlon Electrical Products.
 - 9. RACO; Hubbell.
 - 10. Thomas & Betts Corporation.
- B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application
- C. ENT: Comply with NEMA TC 13 and UL 1653.

- D. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- E. LFNC: Comply with UL 1660.
- F. Rigid HDPE: Comply with UL 651A.
- G. Continuous HDPE: Comply with UL 651B.
- H. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D 3485.
- I. RTRC: Comply with UL 1684A and NEMA TC 14.
- J. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- K. Fittings for LFNC: Comply with UL 514B.
- L. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.03 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Wiremold / Legrand.
- C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell Incorporated.
 - b. Panduit Corp.
 - c. Wiremold / Legrand.

2.04 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Technologies Company; Cooper Crouse-Hinds.
 - 2. EGS/Appleton Electric.
 - 3. Erickson Electrical Equipment Company.
 - 4. Hoffman.
 - 5. Hubbell Incorporated.
 - 6. O-Z/Gedney.
 - 7. RACO; Hubbell.
 - 8. Robroy Industries.

9. Spring City Electrical Manufacturing Company.
 10. Thomas & Betts Corporation.
 11. Wiremold / Legrand.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- F. Metal Floor Boxes:
1. Material: Cast metal or sheet metal.
 2. Type: Fully adjustable.
 3. Shape: Rectangular.
 4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Nonmetallic Floor Boxes: Nonadjustable, round.
1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- H. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- I. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- J. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1, cast aluminum with gasketed cover.
- K. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- L. Device Box Dimensions: 4 inches square by 2-1/8 inches deep or 4 inches by 2-1/8 inches by 2-1/8 inches deep.
- M. Gangable boxes are prohibited.
- N. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 2. Nonmetallic Enclosures: Plastic.
 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- O. Cabinets:
1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 2. Hinged door in front cover with flush latch and concealed hinge.
 3. Key latch to match panelboards.

4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.05 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC."
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of polymer concrete.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. Nordic Fiberglass, Inc.
 - d. Oldcastle Precast, Inc; Christy Concrete Products
 - e. Synertech Moulded Products, Inc.
2. Standard: Comply with SCTE 77.
3. Color of Frame and Cover: Gray.
4. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
5. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.

6. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
7. Cover Legend: Molded lettering, "ELECTRIC."
8. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
9. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.06 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
 1. Tests of materials shall be performed by an independent testing agency.
 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 EXECUTION

3.01 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
 1. Exposed Conduit: Rigid steel conduit.
 2. Concealed Conduit, Aboveground: EMT.
 3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
 1. Exposed, Not Subject to Physical Damage: EMT.
 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 3. Exposed and Subject to Severe Physical Damage: Rigid steel conduit. Raceway locations include the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 - d. Gymnasiums.
 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 6. Damp or Wet Locations: Rigid steel conduit.
 7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, nonmetallic in damp or wet locations.
- C. Minimum Raceway Size: 1/2-inch trade size.

- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
 - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 - 3. EMT: Use setscrew or compression, cast-metal fittings. Comply with NEMA FB 2.10.
 - 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- G. Install surface raceways only where indicated on Drawings.
- H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.02 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Complete with requirements in Division 26 Section "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches of enclosures to which attached.
- I. Raceways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Arrange raceways to keep a minimum of 2 inches of concrete cover in all directions.
 - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.

5. Change from ENT to RNC, Type EPC-40-PVC, rigid steel conduit, or IMC before rising above the floor.
- J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- K. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- L. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- N. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- O. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- P. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- Q. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- R. Surface Raceways:
1. Install surface raceway with a minimum 2-inch radius control at bend points.
 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- S. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- T. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where an underground service raceway enters a building or structure.
 3. Where otherwise required by NFPA 70.
- U. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- V. Expansion-Joint Fittings:
1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of

aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.

2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces: Connected with the Outdoors without Physical Separation: 125 deg F temperature change.
 - d. Attics: 135 deg F temperature change.
3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

W. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

X. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

Y. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

Z. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

AA. Locate boxes so that cover or plate will not span different building finishes.

BB. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

CC. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

DD. Set metal floor boxes level and flush with finished floor surface.

3.03 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Division 31 Section "Earth Moving."

3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
 - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits but a minimum of 6 inches below grade. Align planks along centerline of conduit.
7. Underground Warning Tape: Comply with requirements in Division 26 Section "Identification for Electrical Systems."

3.04 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install hand holes and boxes with bottom below the frost line.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.
- F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.05 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

SECTION 260553

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 ACTION SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.03 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.04 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 PRODUCTS

2.01 POWER RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

- B. Colors for Raceways Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage and system or service type.
- C. Colors for Raceways Carrying Circuits at More Than 600 V:
 - 1. Black letters on an orange field.
 - 2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch high letters on 20-inch centers.
- D. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- E. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- F. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- G. Tape and Stencil for Raceways Carrying Circuits More Than 600 V: 4-inch wide black stripes on 10-inch centers diagonally over orange background that extends full length of raceway or duct and is 12 inches wide. Stop stripes at legends.

2.02 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- C. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil- thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the cable diameter such that the clear shield overlaps the entire printed legend.
- D. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.03 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil- thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the conductor diameter such that the clear shield overlaps the entire printed legend.

- C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.04 FLOOR MARKING TAPE

- A. 2-inch wide, 5-mil pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.05 UNDERGROUND-LINE WARNING TAPE

- A. Tape:
 - 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- B. Color and Printing:
 - 1. Comply with ANSI Z535.1 through ANSI Z535.5.
 - 2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE,.
 - 3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.
- C. Tag: Type I :
 - 1. Pigmented polyolefin, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
 - 2. Thickness: 4 mils.
 - 3. Weight: 18.5 lb/1000 sq. ft..
 - 4. 3-Inch Tensile According to ASTM D 882: 30 lbf and 2500 psi.
- D. Tag: Type II:
 - 1. Multilayer laminate consisting of high-density polyethylene scrim coated with pigmented polyolefin, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
 - 2. Thickness: 12 mils.
 - 3. Weight: 36.1 lb/1000 sq. ft..
 - 4. 3-Inch Tensile According to ASTM D 882: 400 lbf, and 11,500 psi.
- E. Tag: Type ID:
 - 1. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.

2. Overall Thickness: 5 mils.
3. Foil Core Thickness: 0.35 mil.
4. Weight: 28 lb/1000 sq. ft..
5. 3-Inch Tensile According to ASTM D 882: 70 lbf, and 4600 psi.

F. Tag: Type IID:

1. Reinforced, detectable three-layer laminate, consisting of a printed pigmented woven scrim, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
2. Overall Thickness: 8 mils.
3. Foil Core Thickness: 0.35 mil.
4. Weight: 34 lb/1000 sq. ft..
5. 3-Inch Tensile According to ASTM D 882: 300 lbf, and 12,500 psi.

2.06 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Baked-Enamel Warning Signs:
 1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
 2. 1/4-inch grommets in corners for mounting.
 3. Nominal size, 7 by 10 inches.
- D. Metal-Backed, Butyrate Warning Signs:
 1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.
 2. 1/4-inch grommets in corners for mounting.
 3. Nominal size, 10 by 14 inches.
- E. Warning label and sign shall include, but are not limited to, the following legends:
 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.07 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.
 1. Engraved legend with black letters on white face.
 2. Punched or drilled for mechanical fasteners.
 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

- B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.
- C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

2.08 EQUIPMENT IDENTIFICATION LABELS

- A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.
- B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.
- C. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.
- D. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.
- E. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.09 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
 - 3. Temperature Range: Minus 40 to plus 185 deg F.
 - 4. Color: Black except where used for color-coding.
- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
 - 3. Temperature Range: Minus 40 to plus 185 deg F.
 - 4. Color: Black.
- C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
 - 3. UL 94 Flame Rating: 94V-0.
 - 4. Temperature Range: Minus 50 to plus 284 deg F.
 - 5. Color: Black.

2.10 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.
- G. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- I. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
 - 1. Outdoors: UV-stabilized nylon.
 - 2. In Spaces Handling Environmental Air: Plenum rated.
- J. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.
- K. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.02 IDENTIFICATION SCHEDULE

- A. Concealed Raceways, Duct Banks, and More Than 600 V, within Buildings: Tape and stencil 4-inch wide black stripes on 10-inch centers over orange background that extends full length of raceway or duct and is 12 inches wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch high black letters on 20-inch centers. Stop stripes at legends. Apply to the following finished surfaces:
 - 1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.
 - 2. Wall surfaces directly external to raceways concealed within wall.
 - 3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

- B. Accessible Raceways, Armored and Metal-Clad Cables, More Than 600 V: Self-adhesive vinyl labels. Install labels at 30-foot maximum intervals.
- C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl label. Install labels at 30-foot maximum intervals.
- D. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
 - 1. Emergency Power.
 - 2. Power.
 - 3. UPS.
- E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
 - 1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.
 - a. Color shall be factory applied.
 - b. Colors for 208/120-V Circuits:
 - (1) Phase A: Black.
 - (2) Phase B: Red.
 - (3) Phase C: Blue.
 - c. Colors for 480/277-V Circuits:
 - (1) Phase A: Brown.
 - (2) Phase B: Orange.
 - (3) Phase C: Yellow.
 - d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- F. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- G. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.
- H. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
 - 1. Limit use of underground-line warning tape to direct-buried cables.
 - 2. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- I. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
 - 1. Comply with 29 CFR 1910.145.

2. Identify system voltage with black letters on an orange background.
 3. Apply to exterior of door, cover, or other access.
 4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
- K. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- L. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch high letters for emergency instructions at equipment used for power transfer.
- M. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Labeling Instructions:
 - a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch high letters on 1-1/2-inch high label; where two lines of text are required, use labels 2 inches high.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label. Stenciled legend 4 inches high.
 - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 - d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
 2. Equipment to Be Labeled:
 - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Switchboards.
 - e. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
 - f. Enclosed switches.
 - g. Enclosed circuit breakers.
 - h. Enclosed controllers.
 - i. Variable-speed controllers.
 - j. Remote-controlled switches, dimmer modules, and control devices.
 - k. Monitoring and control equipment.

END OF SECTION

SECTION 262200

LOW-VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 ACTION SUBMITTALS

- A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring.

1.03 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.04 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.
- C. Source Limitations: Obtain each transformer type through one source from a single manufacturer.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.06 COORDINATION

- A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Acme Electric Corporation.
 - 2. Eaton Electrical Sector; Eaton Corporation; Cutler-Hammer Products.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Sola/Hevi-Duty.
 - 5. Square D Co./Groupe Schneider NA; Schneider Electric.

2.02 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Cores: Grain-oriented, non-aging silicon steel.
- C. Coils: Continuous windings without splices except for taps.
 - 1. Internal Coil Connections: Brazed or pressure type.
 - 2. Coil Material: Copper.

2.03 DISTRIBUTION TRANSFORMERS

- A. Comply with NEMA ST 20, and list and label as complying with UL 1561.
- B. Provide transformers that are constructed to withstand seismic forces specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- C. Cores: One leg per phase.
- D. Enclosure: Ventilated, NEMA 250, Type 2.
 - 1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
- E. Enclosure: Ventilated, NEMA 250, Type 3R.
 - 1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
- F. Transformer Enclosure Finish: Comply with NEMA 250.
 - 1. Finish Color: Gray.
- G. Taps for Transformers Smaller Than 3 kVA: One 5 percent tap above normal full capacity.
- H. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.

- I. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.
- J. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.
- K. Energy Efficiency for Transformers Rated 15 kVA and Larger:
 - 1. Complying with NEMA TP 1, Class 1 efficiency levels.
 - 2. Tested according to NEMA TP 2.
- L. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for nonsinusoidal load current-handling capability to the degree defined by designated K-factor.
 - 1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
 - 2. Indicate value of K-factor on transformer nameplate.
- M. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.
 - 1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
 - 2. Include special terminal for grounding the shield.
 - 3. Shield Effectiveness:
 - a. Capacitance between Primary and Secondary Windings: Not to exceed 33 picofarads over a frequency range of 20 Hz to 1 MHz.
 - b. Common-Mode Noise Attenuation: Minimum of minus 120 dBA at 0.5 to 1.5 kHz; minimum of minus 65 dBA at 1.5 to 100 kHz.
 - c. Normal-Mode Noise Attenuation: Minimum of minus 52 dBA at 1.5 to 10 kHz.
- N. Wall Brackets: Manufacturer's standard brackets.
- O. Fungus Proofing: Permanent fungicidal treatment for coil and core.
- P. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.
- Q. Low-Sound-Level Requirements: Maximum sound levels, when factory tested according to IEEE C57.12.91, as follows:
 - 1. 9 kVA and Less: 40 dBA.
 - 2. 30 to 50 kVA: 45 dBA.
 - 3. 51 to 150 kVA: 50 dBA.
 - 4. 151 to 300 kVA: 55 dBA.
 - 5. 301 to 500 kVA: 60 dBA.
 - 6. 501 to 750 kVA: 62 dBA.
 - 7. 751 to 1000 kVA: 64 dBA.

2.04 IDENTIFICATION DEVICES

- A. Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems."

2.05 SOURCE QUALITY CONTROL

- A. Test and inspect transformers according to IEEE C57.12.91.
- B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.
 - 1. Brace wall-mounting transformers as specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions.

3.03 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.04 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- C. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- E. Remove and replace units that do not pass tests or inspections and retest as specified above.
- F. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.
 - 1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
 - 2. Perform 2 follow-up infrared scans of transformers, one at 4 months and the other at 11 months after Substantial Completion.
 - 3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.
- G. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.05 ADJUSTING

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Connect buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.
- C. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.06 CLEANING

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION

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BARTLETT & WEST

SECTION 262416

PANELBOARDS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 DEFINITIONS

- A. SVR: Suppressed voltage rating.
- B. TVSS: Transient voltage surge suppressor.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Include evidence of NRTL listing for series rating of installed devices.
 - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 7. Include wiring diagrams for power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

- A. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. Include the following:
 - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.06 MAINTENANCE MATERIAL SUBMITTALS

- 1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- a. Keys: Two spares for each type of panelboard cabinet lock.
- b. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types: Two spares for each panelboard.
- c. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
- d. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.07 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with NEMA PB 1.
- F. Comply with NFPA 70.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.09 PROJECT CONDITIONS

- A. Environmental Limitations:
 - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding minus 22 deg F to plus 104 deg F.
 - b. Altitude: Not exceeding 6600 feet.
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6600 feet.

- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Engineer no fewer than two days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Owner's written permission.
3. Comply with NFPA 70E.

1.10 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
1. Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."
- B. Enclosures: Flush- and surface-mounted cabinets.
1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b. Outdoor Locations: NEMA 250, Type 3R.
 - c. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
 5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
 6. Finishes:
 - a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Same finish as panels and trim.

- c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.
- 7. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.
- C. Incoming Mains Location: Top and bottom.
- D. Phase, Neutral, and Ground Buses:
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
 - 3. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
 - 4. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
 - 5. Split Bus: Vertical buses divided into individual vertical sections.
- E. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Main and Neutral Lugs: Mechanical type.
 - 3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
 - 4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 - 5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 - 6. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 - 7. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.
- F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.
- G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- H. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include size and type of allowable upstream and branch devices, listed and labeled for series-connected short-circuit rating by an NRTL.
- I. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.02 PERFORMANCE REQUIREMENTS

- A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 1.

2.03 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. Siemens Energy & Automation, Inc.
 3. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
1. For doors more than 36 inches high, provide two latches, keyed alike.
- D. Mains: As Indicated
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
- G. Branch Overcurrent Protective Devices: Fused switches.
- H. Contactors in Main Bus: NEMA ICS 2, Class A, electrically or mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
 2. External Control-Power Source: 120-V branch circuit.
- I. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features: Based on Square D Power Logic Series 800 or Cutler Hammer IQ Data
1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
 - a. Phase Currents, Each Phase: Plus or minus 1 percent.
 - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
 - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
 - d. Megawatts: Plus or minus 2 percent.
 - e. Megavars: Plus or minus 2 percent.
 - f. Power Factor: Plus or minus 2 percent.
 - g. Frequency: Plus or minus 0.5 percent.
 - h. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent; accumulated values unaffected by power outages up to 72 hours.
 - i. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from five to 60 minutes.
 - j. Contact devices to operate remote impulse-totalizing demand meter.
 2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.
 3. Must be capable of connection to SCADA system, coordinate with controls contractor.

2.04 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. Siemens Energy & Automation, Inc.
 3. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: As indicated.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Contactors in Main Bus: NEMA ICS 2, Class A, electrically or mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
 2. External Control-Power Source: 120-V branch circuit.
- F. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- G. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

2.05 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. Siemens Energy & Automation, Inc.
 3. Square D; a brand of Schneider Electric.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.
 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
 6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).

7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - e. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."
 - f. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
 - g. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
 - h. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
 - i. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
 - j. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 - k. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
 - l. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
 - m. Handle Padlocking Device: Fixed attachment for locking circuit breaker handle in off position.
 - n. Handle Clamp: Loose attachment for holding circuit breaker handle in on position.
- C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
 1. Fuses, and Spare-Fuse Cabinet: Comply with requirements specified in Division 26 Section "Fuses."
 2. Fused Switch Features and Accessories: Standard ampere ratings and number of poles.
 3. Auxiliary Contacts: One normally open and normally closed contact(s) that operate with switch handle operation.

2.06 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- C. Mount top of trim 72 inches above finished floor unless otherwise indicated.
- D. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- E. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
- F. Install filler plates in unused spaces.
- G. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- H. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- I. Comply with NECA 1.

3.03 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.04 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- E. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
 - c. Instruments and Equipment:
 - (1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- F. Panelboards will be considered defective if they do not pass tests and inspections.
- G. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.05 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

3.06 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION

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BARTLETT & WEST

SECTION 262713
ELECTRICITY METERING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 DEFINITIONS

- A. KY Pulse: Term used by the metering industry to describe a method of measuring consumption of electricity that is based on a relay opening and closing in response to the rotation of the disk in the meter.
- B. PC: Personal computer.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For electricity-metering equipment.
 - 1. Dimensioned plans and sections or elevation layouts.
 - 2. Wiring Diagrams: For power, signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features.

1.04 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Application and operating software documentation.
 - 2. Software licenses.
 - 3. Software service agreement.
 - 4. Hard copies of manufacturer's operating specifications, design user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy Submittal.

1.06 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, store, and handle modular meter center according to NECA 400.

1.08 COORDINATION

- A. Electrical Service Connections: Coordinate with utility company and components they furnish as follows:
 - 1. Comply with requirements of utilities providing electrical power services.
 - 2. Contact Utility and obtain all requirements for getting permanent service to the facility.
 - 3. Coordinate installation and connection of utilities and services, including provision for electricity-metering components.

1.09 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning with Substantial Completion, provide software support for two years.
- B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
 - 1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade his computer equipment if necessary.

PART 2 PRODUCTS

2.01 EQUIPMENT FOR ELECTRICITY METERING BY UTILITY COMPANY

- A. Meters will be furnished by utility company, coordinate with Utility for location and requirements.
- B. Current-Transformer Cabinets: Comply with requirements of electrical-power utility company. Electrical contractor to provide cabinets when cabinets are required by Utility.
- C. Meter Sockets: Comply with requirements of electrical-power utility company.
- D. Meter Sockets: Steady-state and short-circuit current ratings shall meet indicated circuit ratings.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Comply with equipment installation requirements in NECA 1.
- B. Install meters furnished by utility company. Install raceways and equipment according to utility company's written requirements. Provide empty conduits for metering leads and extend grounding connections as required by utility company.
- C. Electrical Contractor is responsible for getting new electrical service connected to the facility.
- D. Electrical Contractor is responsible for contacting the Electrical Utility and getting all requirements for new electrical service to facility and/or site.
- E. Electrical Contractor is to comply with all electrical utility regulations and provide all conduit, trenching/backfill and connections as required by electrical utility.

- F. Electrical contractor is to contact, coordinate and pay all fees required to provide electrical service to facility.

3.02 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
 - 1. Series Combination Warning Label: Self-adhesive type, with text as required by NFPA 70.
 - 2. Equipment Identification Labels: Adhesive film labels with clear protective overlay.

3.03 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Connect a load of known kilowatt rating, 1.5 kW minimum, to a circuit supplied by metered feeder.
 - 2. Turn off circuits supplied by metered feeder and secure them in off condition.
 - 3. Run test load continuously for eight hours minimum, or longer, to obtain a measurable meter indication. Use test-load placement and setting that ensures continuous, safe operation.
 - 4. Check and record meter reading at end of test period and compare with actual electricity used, based on test-load rating, duration of test, and sample measurements of supply voltage at test-load connection. Record test results.
- C. Electricity metering will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Electric Utility: Water Pumping and Intake Facilities
Monty Caudle
La Plata Electric Association
P.O. Box 2750
Durango, CO 81302
970-382-7191

END OF SECTION

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BARTLETT & WEST

SECTION 262726

WIRING DEVICES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. TVSS: Transient voltage surge suppressor.
- F. UTP: Unshielded twisted pair.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 2. Cord and Plug Sets: Match equipment requirements.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
 - 1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
 - 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 - 3. Leviton Mfg. Company Inc. (Leviton).
 - 4. Pass & Seymour/Legrand (Pass & Seymour).
- B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.02 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
 - 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
 - 2. Devices shall comply with the requirements in this Section.

2.03 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 5351 (single), CR5352 (duplex).
 - b. Hubbell; HBL5351 (single), HBL5352 (duplex).
 - c. Leviton; 5891 (single), 5352 (duplex).
 - d. Pass & Seymour; 5361 (single), 5362 (duplex).

2.04 GFCI RECEPTACLES

- A. General Description:
 - 1. Straight blade, feed-through type.
 - 2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
 - 3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; VGF20.
 - b. Pass & Seymour; 2095.

2.05 HAZARDOUS (CLASSIFIED) LOCATION RECEPTACLES

- A. Wiring Devices for Hazardous (Classified) Locations: Comply with NEMA FB 11 and UL 1010.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper Crouse-Hinds.
 - b. EGS/Appleton Electric.
 - c. Killark; a division of Hubbell Inc.

2.06 CORD AND PLUG SETS

- A. Description:

1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
3. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.07 TOGGLE SWITCHES

- A. Comply with NEMA WD 1, UL 20, and FS W-S-896.
- B. Switches, 120/277 V, 20 A:
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Single Pole:
 - (1) Cooper; AH1221.
 - (2) Hubbell; HBL1221.
 - (3) Leviton; 1221-2.
 - (4) Pass & Seymour; CSB20AC1.
 - b. Two Pole:
 - (1) Cooper; AH1222.
 - (2) Hubbell; HBL1222.
 - (3) Leviton; 1222-2.
 - (4) Pass & Seymour; CSB20AC2.
 - c. Three Way:
 - (1) Cooper; AH1223.
 - (2) Hubbell; HBL1223.
 - (3) Leviton; 1223-2.
 - (4) Pass & Seymour; CSB20AC3.

2.08 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
 1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Material for Finished Spaces: 0.035-inch- thick, satin-finished stainless steel.
 3. Material for Unfinished Spaces: Galvanized steel.
 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant die-cast aluminum with lockable cover.

2.09 FINISHES

- A. Device Color:

1. Wiring Devices Connected to Normal Power System: Gray, unless otherwise indicated or required by NFPA 70 or device listing.

B. Wall Plate Color: For plastic covers, match device color.

PART 3 EXECUTION

3.01 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:

1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtail existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.
2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.02 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.03 FIELD QUALITY CONTROL

A. Perform the following tests and inspections.

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

C. Test straight blade convenience outlets in patient-care areas and hospital-grade convenience outlets for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz.

D. Wiring device will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION

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BARTLETT & WEST

SECTION 262813

FUSES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
 - 1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
 - 2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
 - 3. Current-limitation curves for fuses with current-limiting characteristics.
 - 4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
 - 5. Coordination charts and tables and related data.
 - 6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.03 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

1.04 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Comply with UL 248-11 for plug fuses.

1.05 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.06 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Bussmann, Inc.
 - 2. Ferraz Shawmut, Inc.
 - 3. Littelfuse, Inc.

2.02 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

2.03 SPARE-FUSE CABINET

- A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
 - 1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
 - 2. Finish: Gray, baked enamel.
 - 3. Identification: "SPARE FUSES" in 1-1/2-inch high letters on exterior of door.
 - 4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 FUSE APPLICATIONS

A. Cartridge Fuses:

1. Service Entrance: Class RK1, fast acting or As indicated.
2. Feeders: Class RK1, fast acting or As indicated.
3. Motor Branch Circuits: Class RK1, time delay or As indicated.
4. Other Branch Circuits: Class RK1, fast acting or As indicated.
5. Control Circuits: Class CC, fast acting.

3.03 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install spare-fuse cabinet(s).

3.04 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION

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BARTLETT —
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SECTION 262816

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.02 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 4. Include evidence of NRTL listing for series rating of installed devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
 - 6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Wiring Diagrams: For power, signal, and control wiring.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. Include the following:
 - 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 - 2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.05 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Fuse Pullers: Two for each size and type.

1.06 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with NFPA 70.

1.07 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
 2. Altitude: Not exceeding 6600 feet.
- B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 1. Notify Engineer no fewer than seven days in advance of proposed interruption of electric service.
 2. Indicate method of providing temporary electric service.
 3. Do not proceed with interruption of electric service without Owner's written permission.
 4. Comply with NFPA 70E.

1.08 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 PRODUCTS

2.01 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. Siemens Energy & Automation, Inc.
 3. Square D; a brand of Schneider Electric.

- B. Type HD, Heavy Duty, Single Throw, 240 or 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Type HD, Heavy Duty, Six Pole, Single Throw, 240 or 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Type HD, Heavy Duty, Double Throw, 240 or 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- E. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
 - 5. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switchblades open.
 - 6. Hookstick Handle: Allows use of a hookstick to operate the handle.
 - 7. Lugs: Mechanical type, suitable for number, size, and conductor material.
 - 8. Service-Rated Switches: Labeled for use as service equipment.
 - 9. Accessory Control Power Voltage: Remote mounted and powered; As indicated.

2.02 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. Siemens Energy & Automation, Inc.
 - 3. Square D; a brand of Schneider Electric.
- B. Type HD, Heavy Duty, Single Throw, 240 or 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Type HD, Heavy Duty, Six Pole, Single Throw, 240 or 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Type HD, Heavy Duty, Double Throw, 240 or 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- E. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
4. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switchblades open.
5. Hookstick Handle: Allows use of a hookstick to operate the handle.
6. Lugs: Mechanical type, suitable for number, size, and conductor material.
7. Accessory Control Power Voltage: Remote mounted and powered; As indicated.

2.03 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. Siemens Energy & Automation, Inc.
 3. Square D; a brand of Schneider Electric.
- B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- E. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
 1. Instantaneous trip.
 2. Long- and short-time pickup levels.
 3. Long- and short-time time adjustments.
 4. Ground-fault pickup level, time delay, and I^2t response.
- F. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- G. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.
- H. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
- I. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).
- J. Features and Accessories:
 1. Standard frame sizes, trip ratings, and number of poles.
 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.

4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system, specified in Division 26 Section "Electrical Power Monitoring and Control."
6. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
7. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
8. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
9. Alarm Switch: One NO contact that operates only when circuit breaker has tripped.
10. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
11. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
12. Electrical Operator: Provide remote control for on, off, and reset operations.
13. Accessory Control Power Voltage: Integrally mounted, self-powered.

2.04 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 2. Outdoor Locations: NEMA 250, Type 3R.
 3. Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
 4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
 5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

- D. Install fuses in fusible devices.
- E. Comply with NECA 1.

3.03 IDENTIFICATION

- A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.04 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- E. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
 - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- F. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- G. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.05 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges.

END OF SECTION

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SECTION 262923

VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 DEFINITIONS

- A. BAS: Building automation system.
- B. CE: Conformance Europeene (European Compliance).
- C. CPT: Control power transformer.
- D. EMI: Electromagnetic interference.
- E. LED: Light-emitting diode.
- F. NC: Normally closed.
- G. NO: Normally open.
- H. OCPD: Overcurrent protective device.
- I. PID: Control action, proportional plus integral plus derivative.
- J. RFI: Radio-frequency interference.
- K. VFC: Variable-frequency motor controller.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type and rating of VFC indicated.
 - 1. Include dimensions and finishes for VFCs.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For each VFC indicated.
 - a. Include mounting and attachment details.
 - b. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - c. Include diagrams for power, signal, and control wiring.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For VFCs to include in emergency, operation, and maintenance manuals.

Include the following:

- a. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and MCP trip settings.
- b. Manufacturer's written instructions for setting field-adjustable overload relays.
- c. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
- d. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
- e. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate, full-load currents.
- f. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

1.05 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
 3. Indicating Lights: Two of each type and color installed.
 4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
 5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

1.06 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. If stored in space that is not permanently enclosed and air conditioned, remove loose packing and flammable materials from inside controllers and install temporary electric heating, with at least 250 W per controller.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, including clearances between VFCs, and adjacent surfaces and other items.

1.08 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace VFCs that fail in materials or workmanship within specified warranty period.
1. Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ABB Power Distribution, Inc.; ABB Control, Inc., Subsidiary (Model ACH 550).
 2. Eaton Electrical Sector; Eaton Corporation; Cutler-Hammer Business Unit (smaller than 100 HP - Model HVX9000, 100 HP and larger – Model CPX9000).
 3. Rockwell Automation, Inc; Allen-Bradley Brand (Model 700).

2.02 SYSTEM DESCRIPTION

- A. General Requirements for VFCs:
1. VFCs and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508A.
- B. Application: Constant torque and variable torque.
- C. VFC Description: Variable-frequency motor controller, consisting of power converter that employs pulse-width-modulated inverter, factory built and tested in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.
1. Units suitable for operation of NEMA MG 1, Design A and Design B motors, as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."
 2. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
 3. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.
- D. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.
1. Units serving motors smaller than 100 HP shall be 6-pulse or 18-pulse type VFC.
 2. Units serving motors 100 HP and larger shall be 18-pulse VFC.
- E. Output Rating: Three phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range.
- F. Unit Operating Requirements:
1. Input AC Voltage Tolerance: Plus 10 and minus 10 percent of VFC input voltage rating.
 2. Input AC Voltage Unbalance: Not exceeding 3 percent.
 3. Input Frequency Tolerance: Plus or minus 3 percent of VFC frequency rating.
 4. Minimum Efficiency: 96 percent at 60 Hz, full load.
 5. Minimum Displacement Primary-Side Power Factor: 96 percent under any load or speed condition.
 6. Minimum Short-Circuit Current (Withstand) Rating: 65 kA.

7. Ambient Temperature Rating: Not less than 32 deg F and not exceeding 104 deg F.
 8. Humidity Rating: Less than 95 percent (noncondensing).
 9. Altitude Rating: Not exceeding 3300 feet.
 10. Vibration Withstand: Comply with NEMA ICS 61800-2.
 11. Overload Capability: 1.1 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.
 12. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.
 13. Speed Regulation: Plus or minus 5 percent.
 14. Output Carrier Frequency: Selectable; 0.5 to 15 kHz.
 15. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.
- G. Inverter Logic: Microprocessor based, 32 bit, isolated from all power circuits.
- H. Isolated Control Interface: Allows VFCs to follow remote-control signal over a minimum 40:1 speed range.
1. Signal: Pneumatic.
- I. Internal Adjustability Capabilities:
1. Minimum Speed: 5 to 25 percent of maximum rpm.
 2. Maximum Speed: 80 to 100 percent of maximum rpm.
 3. Acceleration: 0.1 to 999.9 seconds.
 4. Deceleration: 0.1 to 999.9 seconds.
 5. Current Limit: 30 to minimum of 150 percent of maximum rating.
- J. Self-Protection and Reliability Features:
1. Surge Suppression: Factory installed as an integral part of the VFC, complying with UL 1449 SPD, Type 1 or Type 2.
 2. Surge Suppression: Field-mounted surge suppressors complying with Division 26 Section "Surge Protection for Low-Voltage Electrical Power Circuits," UL 1449 SPD, Type 2.
 3. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
 4. Under- and overvoltage trips.
 5. Inverter overcurrent trips.
 6. VFC and Motor-Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFC overtemperature and motor-overload alarm and trip; settings selectable via the keypad.
 7. Critical frequency rejection, with three selectable, adjustable deadbands.
 8. Instantaneous line-to-line and line-to-ground overcurrent trips.
 9. Loss-of-phase protection.
 10. Reverse-phase protection.
 11. Short-circuit protection.
 12. Motor overtemperature fault.
- K. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bidirectional autospeed

search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.

- L. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Autospeed Search" feature is available and engaged.
- M. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load
- N. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.
- O. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.
- P. Input Line Conditioning: Integral 5 percent impedance line reactors to reduce the harmonics to the power line and protection from AC line transients. Impedance may be accomplished with dual (positive and negative DC bus) reactors or AC line reactors. AC line reactors are required if only one DC reactor utilized. Additional conditioning or filtering as determined by THD/TDD analysis performed by VFC manufacturer.
- Q. VFC Output Filtering: As determined by THD/TDD analysis performed by VFC manufacturer. dV/dt output filter comprised of three-phase load reactor and resistor/capacitor clipping circuit shall be provide for all VFCs serving submersible motors.
- R. Integral Disconnecting Means: NEMA KS 1, fusible switch with pad-lockable, door-mounted handle mechanism.
 - 1. Disconnect Rating: Not less than 115 percent of VFC input current rating.
 - 2. Disconnect Rating: Not less than 115 percent of NFPA 70 motor full-load current rating or VFC input current rating, whichever is larger.
 - 3. Auxiliary Contacts: NO or NC, arranged to activate before switch blades open.
 - 4. Auxiliary contacts "a" and "b" arranged to activate with circuit-breaker handle.
 - 5. NO alarm contact that operates only when circuit breaker has tripped.

2.03 CONTROLS AND INDICATION

- A. Status Lights: Door-mounted LED indicators displaying the following conditions:
 - 1. Power on.
 - 2. Run.
 - 3. Overvoltage.
 - 4. Line fault.
 - 5. Overcurrent.
 - 6. External fault.
- B. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English-language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.
 - 1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.

2. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.
 - a. Control Authority: Supports at least four conditions: Off, local manual control at VFC, local automatic control at VFC, and automatic control through a remote source.
- C. Historical Logging Information and Displays:
1. Real-time clock with current time and date.
 2. Running log of total power versus time.
 3. Total run time.
 4. Fault log, maintaining last four faults with time and date stamp for each.
- D. Indicating Devices: Digital display mounted flush in VFC door and connected to display VFC parameters including, but not limited to:
1. Output frequency (Hz).
 2. Motor speed (rpm).
 3. Motor status (running, stop, fault).
 4. Motor current (amperes).
 5. Motor torque (percent).
 6. Fault or alarming status (code).
 7. PID feedback signal (percent).
 8. DC-link voltage (V dc).
 9. Set point frequency (Hz).
 10. Motor output voltage (V ac).
- E. Control Signal Interfaces:
1. Electric Input Signal Interface:
 - a. A minimum of two programmable analog inputs: Operator-selectable "x"- to "y"-mA dc.
 - b. A minimum of six multifunction programmable digital inputs.
 2. Pneumatic Input Signal Interface: 3 to 15 psig.
 3. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BAS or other control systems:
 - a. 0- to 10-V dc.
 - b. 4- to 20-mA dc.
 - c. Potentiometer using up/down digital inputs.
 - d. Fixed frequencies using digital inputs.
 4. Output Signal Interface: A minimum of one programmable analog output signal (operator-selectable "x"- to "y"-mA dc), which can be configured for any of the following:
 - a. Output frequency (Hz).
 - b. Output current (load).
 - c. DC-link voltage (V dc).
 - d. Motor torque (percent).
 - e. Motor speed (rpm).

- f. Set point frequency (Hz).
- 5. Remote Indication Interface: A minimum of two programmable dry-circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
 - a. Motor running.
 - b. Set point speed reached.
 - c. Fault and warning indication (overtemperature or overcurrent).
 - d. PID high- or low-speed limits reached.
- F. PID Control Interface: Provides closed-loop set point, differential feedback control in response to dual feedback signals. Allows for closed-loop control of fans and pumps for pressure, flow, or temperature regulation.
 - 1. Number of Loops: One.
- G. BAS Interface: Factory-installed hardware and software shall interface with BAS to monitor, control, display, and record data for use in processing reports. VFC settings shall be retained within VFC's nonvolatile memory.
 - 1. Hardwired Points:
 - a. Monitoring: On-off status.
 - b. Control: On-off operation.
 - 2. Communication Interface: Comply with ASHRAE 135. Communication shall interface with BAS to remotely control and monitor lighting from a BAS operator workstation. Control features and monitoring points displayed locally at lighting panel shall be available through the BAS.

2.04 LINE CONDITIONING AND FILTERING

- A. Input Line Conditioning: Based on the manufacturer's harmonic analysis study and report, provide input filtering, as required, to limit total demand (harmonic current) distortion and total harmonic voltage demand at the defined point of common coupling to meet IEEE 519 recommendations.
- B. Output Line Conditioning: Provide dV/dt output filter comprised of three-phase load reactor and resistor/capacitor clipping circuit.

2.05 OPTIONAL FEATURES

- A. Communication Port: RS-232 port, USB 2.0 port, or equivalent connection capable of connecting a printer and a notebook computer.

2.06 ENCLOSURES

- A. VFC Enclosures: NEMA 250, to comply with environmental conditions at installed location.
 - 1. Dry and Clean Indoor Locations: Type 1.
 - 2. Outdoor Locations: Type 3R.
 - 3. Other Wet or Damp Indoor Locations: Type 4.
 - 4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.

2.07 ACCESSORIES

- A. General Requirements for Control-Circuit and Pilot Devices: NEMA ICS 5; factory installed in VFC enclosure cover unless otherwise indicated.

1. Push Buttons: Covered.
 2. Pilot Lights: Push to test.
 3. Selector Switches: Rotary type.
 4. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.
- B. Reversible NC/NO bypass contactor auxiliary contact(s).
- C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.
- D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.
- E. Supplemental Digital Meters:
- F. Breather and drain assemblies, to maintain interior pressure and release condensation in NEMA 250, **Type 12** enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- G. Space heaters, with NC auxiliary contacts, to mitigate condensation in NEMA 250, Type 12 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- H. Cooling Fan and Exhaust System: For NEMA 250, Type 12; UL 508 component recognized: Supply fan, with composite intake and exhaust grills and filters; 120-V ac; obtained from integral CPT.
- I. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.
- J. Spare control-wiring terminal blocks; wired.

2.08 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect VFCs according to requirements in NEMA ICS 61800-2.
1. Test each VFC while connected to its specified motor.
 2. Verification of Performance: Rate VFCs according to operation of functions and features specified.
- B. VFCs will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas, surfaces, and substrates to receive VFCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.
- B. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.

- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Wall-Mounting Controllers: Install with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."
- B. Floor-Mounting Controllers: Install VFCs on 4-inch nominal thickness concrete base. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in each fusible-switch VFC.
- E. Install fuses in control circuits if not factory installed. Comply with requirements in Division 26 Section "Fuses."
- F. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors are installed.
- G. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- H. Comply with NECA 1.

3.03 CONTROL WIRING INSTALLATION

- A. Install wiring between VFCs and remote devices and facility's central-control system. Comply with requirements in Division 26 Section "Control-Voltage Electrical Power Cables."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect hand-off-automatic switch and other automatic-control devices where applicable.
 - 1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.
 - 2. Connect selector switches with control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.04 IDENTIFICATION

- A. Identify VFCs, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 2. Label each VFC with engraved nameplate.
 3. Label each enclosure-mounted control and pilot device.
- B. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

3.05 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections
- D. Acceptance Testing Preparation:
1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.
 2. Test continuity of each circuit.
- E. Tests and Inspections:
1. Inspect VFC, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
 2. Test insulation resistance for each VFC element, component, connecting motor supply, feeder, and control circuits.
 3. Test continuity of each circuit.
 4. Verify that voltages at VFC locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Architect before starting the motor(s).
 5. Test each motor for proper phase rotation.
 6. Perform each electrical test and visual and mechanical inspection, except optional tests, stated in NETA ATS. Certify compliance with test parameters.
 7. Correct malfunctioning units on-site, where possible, and retest to demonstrated compliance; otherwise, replace with new units and retest.
 8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- F. VFCs will be considered defective if they do not pass tests and inspections.
- G. Prepare test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.06 ADJUSTING

- A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

- B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.
- C. Adjust the trip settings of instantaneous-only circuit breakers and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to 6 times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed 8 times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Owner before increasing settings.
- D. Set the taps on reduced-voltage autotransformer controllers.
- E. Set field-adjustable pressure switches.

3.07 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.
- B. Replace VFCs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.08 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel personnel to adjust, operate, reprogram, and maintain VFCs.

END OF SECTION

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SECTION 263213

ENGINE GENERATORS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 DEFINITIONS

- A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.
- B. LP: Liquid petroleum.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:
 - 1. Thermal damage curve for generator.
 - 2. Time-current characteristic curves for generator protective device.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
 - 2. Design Calculations: Signed and sealed by a qualified professional engineer. Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
 - 3. Vibration Isolation Base Details: Signed and sealed by a qualified professional engineer. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.
 - 4. Wiring Diagrams: Power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Source quality-control test reports.
 - 1. Certified summary of prototype-unit test report.
 - 2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
 - 3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
 - 4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
 - 5. Report of sound generation.

6. Report of exhaust emissions showing compliance with applicable regulations.
 7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.
- C. Field quality-control test reports.
- D. Warranty: Special warranty specified in this Section.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. Additional to items include the following:
1. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.

1.06 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
 2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
 3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
1. Maintenance Proximity: Not more than four hours' normal travel time from Installer's place of business to Project site.
 2. Engineering Responsibility: Preparation of data for vibration isolators and seismic restraints of engine skid mounts, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 200 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.
- C. Testing Agency Qualifications: An agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL), and that is acceptable to authorities having jurisdiction.
1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- D. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- F. Comply with ASME B15.1.
- G. Comply with NFPA 37.
- H. Comply with NFPA 70.

- I. Comply with NFPA 99.
- J. Comply with UL 2200.
- K. Engine Exhaust Emissions: Comply with applicable state and local government requirements.
- L. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

1.08 PROJECT CONDITIONS

- A. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
 - 1. Ambient Temperature: Minus 15 to plus 40 deg C.
 - 2. Relative Humidity: 0 to 95 percent.
 - 3. Altitude: Sea level to 1000 feet.
- B. Unusual Service Conditions: Engine-generator equipment and installation are required to operate under the following conditions:
 - 1. High altitude service condition. Approximate altitude : 7000 ft

1.09 COORDINATION

- A. Coordinate size and location of concrete bases for package engine generators.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

1.11 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Kohler Co.
 - 2. Onan/Cummins Power Generation; Industrial Business Group.
 - 3. Spectrum Detroit Diesel.

2.02 ENGINE-GENERATOR SET

- A. Factory-assembled and -tested, engine-generator set.
- B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.
 - 1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.
- C. Capacities and Characteristics:
 - 1. Power Output Ratings: Nominal ratings as indicated.
 - 2. Output Connections: Three-phase, four wire.
 - 3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.
- D. Generator-Set Performance:
 - 1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
 - 2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
 - 3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
 - 4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
 - 5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
 - 6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
 - 7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
 - 8. Start Time: Comply with NFPA 110, Type 10, system requirements.

2.03 ENGINE

- A. Fuel: Fuel oil, Grade DF-2.
- B. Rated Engine Speed: 1800 rpm.
- C. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm.
- D. Lubrication System: The following items are mounted on engine or skid:
 - 1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
 - 2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.

3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- E. Engine Fuel System:
1. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
 2. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.
 3. Dual Natural Gas with LP-Gas Backup (Vapor-Withdrawal) System:
 - a. Carburetor.
 - b. Secondary Gas Regulators: One for each fuel type.
 - c. Fuel-Shutoff Solenoid Valves: One for each fuel source.
 - d. Flexible Fuel Connectors: One for each fuel source.
- F. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.
- G. Governor: Adjustable isochronous, with speed sensing.
- H. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.
1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
 2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
 3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
 4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
 5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
 - a. Rating: 50-psig maximum working pressure with coolant at 180 deg F, and noncollapsible under vacuum.
 - b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.
- I. Cooling System: Closed loop, liquid cooled, with remote radiator and integral engine-driven coolant pump.
1. Configuration: Horizontal air discharge.
 2. Radiator Core Tubes: Aluminum.
 3. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
 4. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
 5. Fan: Driven by multiple belts from engine shaft.
 6. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.

7. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
- J. Muffler/Silencer: Industrial type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
 1. Minimum sound attenuation of 12 dB at 500 Hz.
 2. Sound level measured at a distance of 25 feet from exhaust discharge after installation is complete shall be 87 dBA or less.
- K. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.
- L. Starting System: 12-V electric, with negative ground.
 1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
 2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
 3. Cranking Cycle: As required by NFPA 110 for system level specified.
 4. Battery: Adequate capacity within ambient temperature range specified in Part 1 "Project Conditions" Article to provide specified cranking cycle at least twice without recharging.
 5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
 6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in Part 1 "Project Conditions" Article. Include accessories required to support and fasten batteries in place.
 7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
 8. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:
 - a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
 - b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
 - c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
 - d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
 - e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
 - f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.04 FUEL OIL STORAGE

- A. Comply with NFPA 30.

- B. Base-Mounted Fuel Oil Tank: Factory installed and piped, complying with UL 142 fuel oil tank. Features include the following:
1. Tank level indicator.
 2. Capacity: 150 gallons.
 3. Vandal-resistant fill cap.
 4. Containment Provisions: Comply with requirements of authorities having jurisdiction.

2.05 CONTROL AND MONITORING

- A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.
- B. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.
- C. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.
- D. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1 system, and the following:
1. AC voltmeter.
 2. AC ammeter.
 3. AC frequency meter.
 4. DC voltmeter (alternator battery charging).
 5. Engine-coolant temperature gage.
 6. Engine lubricating-oil pressure gage.
 7. Running-time meter.
 8. Ammeter-voltmeter, phase-selector switch(es).
 9. Generator-voltage adjusting rheostat.
 10. Fuel tank derangement alarm.
 11. Fuel tank high-level shutdown of fuel supply alarm.
 12. Generator overload.
- E. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.
- F. Common Remote Audible Alarm: Signal the occurrence of any events listed below without differentiating between event types. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset.

1. Engine high-temperature shutdown.
 2. Lube-oil, low-pressure shutdown.
 3. Overspeed shutdown.
 4. Remote emergency-stop shutdown.
 5. Engine high-temperature prealarm.
 6. Lube-oil, low-pressure prealarm.
 7. Fuel tank, low-fuel level.
 8. Low coolant level.
- G. Remote Alarm Annunciator: Comply with NFPA 99. An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.
- H. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.06 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Generator Circuit Breaker: Molded-case, thermal-magnetic type; 100 percent rated; complying with NEMA AB 1 and UL 489.
1. Tripping Characteristic: Designed specifically for generator protection.
 2. Trip Rating: Matched to generator rating.
 3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
 4. Mounting: Adjacent to or integrated with control and monitoring panel.
 5. Shunt Trip: Connected to trip switch when signaled by generator protector or by other protective devices.
- B. Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output, integrate generator heating effect over time, and predict when thermal damage of alternator will occur. When signaled by generator protector or other generator-set protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from load circuits. Protector shall perform the following functions:
1. Initiates a generator overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.
 2. Under single or three-phase fault conditions, regulates generator to 300 percent of rated full-load current for up to 10 seconds.
 3. As overcurrent heating effect on the generator approaches the thermal damage point of the unit, protector switches the excitation system off, opens the generator disconnect device, and shuts down the generator set.
 4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.
- C. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground-fault. Integrate ground-fault alarm indication with other generator-set alarm indications.

2.07 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H or Class F.
- D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.
- E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- F. Enclosure: Dripproof.
- G. Instrument Transformers: Mounted within generator enclosure.
- H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.
 - 1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.
- I. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.
- J. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
- K. Subtransient Reactance: 12 percent, maximum.

2.08 LOAD BANK

- A. Description: Permanent, outdoor, weatherproof, remote-controlled, forced-air-cooled, resistive and reactive unit capable of providing a balanced 3-phase, delta-connected load to generator set at 100 percent rated-system capacity, at 80 percent power factor, lagging. Unit may be composed of separate resistive and reactive load banks controlled by a common control panel. Unit shall be capable of selective control of load in 25 percent steps and with minimum step changes of approximately 5 and 10 percent available.
- B. Reactive Load Elements: Epoxy-encapsulated reactor coils.
- C. Load-Bank Heat Dissipation: Integral fan with totally enclosed motor shall provide uniform cooling airflow through load elements. Airflow and coil operating current shall be such that, at maximum load, with ambient temperature at the upper end of specified range, load-bank elements operate at not more than 50 percent of maximum continuous temperature rating of resistance elements.
- D. Load Element Switching: Remote-controlled contactors switch groups of load elements. Contactor coils are rated 120 V. Contactors shall be located in a separate NEMA 250, Type 3R enclosure within load-bank enclosure, accessible from exterior through hinged doors with tumbler locks.
- E. Contactor Enclosures: Heated by thermostatically controlled strip heaters to prevent condensation.
- F. Load-Bank Enclosures: NEMA 250, Type 3R, complying with NEMA ICS 6. Louvers at cooling-air intake and discharge openings shall prevent entry of rain and snow. Openings for airflow shall be screened with 1/2-inch- square, galvanized-steel mesh. Reactive load bank shall include automatic shutters at air intake and discharge.

- G. Protective Devices: Power input circuits to load banks shall be fused, and fuses shall be selected to coordinate with generator circuit breaker. Fuse blocks shall be located in contactor enclosure. Cooling airflow and overtemperature sensors shall automatically shut down and lock out load bank until manually reset. Safety interlocks on access panels and doors shall disconnect load power, control, and heater circuits. Fan motor shall be separately protected by overload and short-circuit devices. Short-circuit devices shall be noninterchangeable fuses with 200,000-A interrupting capacity.
- H. Remote-Control Panel: Separate from load bank in NEMA 250, Type 1 enclosure with a control power switch and pilot light, and switches controlling groups of load elements.
- I. Control Sequence: Control panel may be preset for adjustable single-step loading of generator during automatic exercising.

2.09 OUTDOOR GENERATOR-SET ENCLOSURE

- A. Description: Vandal-resistant, weatherproof steel housing, wind resistant up to 100 mph. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.
- B. Description: Prefabricated or preengineered walk-in enclosure with the following features:
 - 1. Construction: Galvanized-steel, metal-clad, integral structural-steel-framed building erected on concrete foundation.
 - 2. Structural Design and Anchorage: Comply with ASCE 7 for wind loads.
 - 3. Space Heater: Thermostatically controlled and sized to prevent condensation.
 - 4. Louvers: Equipped with bird screen and filter arranged to permit air circulation when engine is not running while excluding exterior dust, birds, and rodents.
 - 5. Hinged Doors: With padlocking provisions.
 - 6. Ventilation: Louvers equipped with bird screen and filter arranged to permit air circulation while excluding exterior dust, birds, and rodents.
 - 7. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine-generator-set components.
 - 8. Design sound levels shall be 78 dBA, as measured at a distance of 23 feet (7 m) around the housing in a free field environment. Additional wall and insulation thickness, plus air discharge and intake hoods or sound attenuators shall be installed to meet design sound levels.
- C. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.
 - 1. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.
 - 2. Automatic Dampers: At engine cooling-air inlet and discharge. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.
- D. Interior Lights with Switch: Factory-wired, vaporproof-type fixtures within housing; arranged to illuminate controls and accessible interior. Arrange for external electrical connection.
 - 1. AC lighting system and connection point for operation when remote source is available.
 - 2. DC lighting system for operation when remote source and generator are both unavailable.
- E. Convenience Outlets: Factory wired, GFCI. Arrange for external electrical connection.

2.10 VIBRATION ISOLATION DEVICES

A. Restrained Spring Isolators: Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ace Mountings Co., Inc.
 - b. Isolation Technology, Inc.
 - c. Kinetics Noise Control, Inc.
 - d. Mason Industries, Inc.
 - e. Vibration Eliminator Co., Inc.
 - f. Vibration Isolation.
 - g. Vibration Mountings & Controls, Inc.
2. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.
 - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
 - b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
3. Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.11 FINISHES

- A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.12 SOURCE QUALITY CONTROL

- A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.
- B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
 2. Full load run.
 3. Maximum power.
 4. Voltage regulation.
 5. Transient and steady-state governing.

6. Single-step load pickup.
7. Safety shutdown.
8. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
9. Report factory test results within 10 days of completion of test.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.
- B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.
- B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.
- C. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.03 CONNECTIONS

- A. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.04 IDENTIFICATION

- A. Identify system components according to Division 26 Section "Identification for Electrical Systems."

3.05 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- C. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:
1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
 3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
 - a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
 - b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
 - c. Verify acceptance of charge for each element of the battery after discharge.
 - d. Verify that measurements are within manufacturer's specifications.
 4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
 5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
 6. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg. Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
 7. Exhaust Emissions Test: Comply with applicable government test criteria.
 8. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
 9. Harmonic-Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.
 10. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four locations on the property line, and compare measured levels with required values.
- E. Coordinate tests with tests for transfer switches and run them concurrently.
- F. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.
- G. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- H. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
- I. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

- J. Remove and replace malfunctioning units and retest as specified above.
- K. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.
- L. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- M. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each power wiring termination and each bus connection. Remove all access panels so terminations and connections are accessible to portable scanner.
 - 1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan 11 months after date of Substantial Completion.
 - 2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 3. Record of Infrared Scanning: Prepare a certified report that identifies terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.06 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 263213

SECTION 264113

LIGHTNING PROTECTION FOR STRUCTURES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For air terminals and mounting accessories.
 - 1. Layout of the lightning protection system, along with details of the components to be used in the installation.
 - 2. Include indications for use of raceway, data on how concealment requirements will be met, and calculations required by NFPA 780 for bonding of grounded and isolated metal bodies.

1.03 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer and manufacturer. Include data on listing or certification by UL.
- B. Certification, signed by Contractor, that roof adhesive is approved by manufacturer of roofing material.
- C. Field quality-control reports.
- D. Comply with recommendations in NFPA 780, Annex D, "Inspection and Maintenance of Lightning Protection Systems," for maintenance of the lightning protection system.
- E. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features, including the following:
 - 1. Ground rods.
 - 2. Ground loop conductor.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Certified by UL, trained and approved for installation of units required for this Project.
- B. System Certificate:
 - 1. UL Master Label.
 - 2. UL Master Label Recertification.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 780, "Definitions" Article.

1.05 COORDINATION

- A. Coordinate installation of lightning protection with installation of other building systems and components, including electrical wiring, supporting structures and building materials, metal bodies requiring bonding to lightning protection components, and building finishes.
- B. Coordinate installation of air terminals attached to roof systems with roofing manufacturer and Installer.
- C. Flashings of through-roof assemblies shall comply with roofing manufacturers' specifications.

PART 2 PRODUCTS

2.01 LIGHTNING PROTECTION SYSTEM COMPONENTS

- A. Comply with UL 96 and NFPA 780.
- B. Roof-Mounted Air Terminals: NFPA 780, Class I, copper unless otherwise indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Preferred Lightning Protection.
 - b. Robbins Lightning, Inc.
 - 2. Air Terminals More than 24 Inches Long: With brace attached to the terminal at not less than half the height of the terminal.
 - 3. Single-Membrane, Roof-Mounted Air Terminals: Designed specifically for single-membrane roof system materials. Comply with requirements in roofing Sections.
- C. Main and Bonding Conductors: Copper.
- D. Ground Loop Conductor: The same size and type as the main conductor except tinned.
- E. Ground Rods: Copper-clad steel; 3/4 inch in diameter by 10 feet long.
- F. Heavy-Duty, Stack-Mounted, Lightning Protection Components: Solid copper.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install lightning protection components and systems according to UL 96A and NFPA 780.
- B. Install conductors with direct paths from air terminals to ground connections. Avoid sharp bends.
- C. Conceal the following conductors:
 - 1. System conductors.
 - 2. Down conductors.
 - 3. Interior conductors.
 - 4. Conductors within normal view of exterior locations at grade within 200 feet of building.
- D. Cable Connections: Use crimped or bolted connections for all conductor splices and connections between conductors and other components. Use exothermic-welded connections in underground portions of the system.

- E. Cable Connections: Use exothermic-welded connections for all conductor splices and connections between conductors and other components.
 - 1. Exception: In single-ply membrane roofing, exothermic-welded connections may be used only below the roof level.
- F. Air Terminals on Single-Ply Membrane Roofing: Comply with roofing membrane and adhesive manufacturer's written instructions.
- G. Bond extremities of vertical metal bodies exceeding 60 feet in length to lightning protection components.
- H. Ground Loop: Install ground-level, potential equalization conductor and extend around the perimeter of area or item indicated.
 - 1. Bury ground ring not less than 24 inches from building foundation.
 - 2. Bond ground terminals to the ground loop.
 - 3. Bond grounded building systems to the ground loop conductor within 12 feet of grade level.
- I. Bond lightning protection components with intermediate-level interconnection loop conductors to grounded metal bodies of building at 60-foot intervals.

3.02 CORROSION PROTECTION

- A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.
- B. Use conductors with protective coatings where conditions cause deterioration or corrosion of conductors.

3.03 FIELD QUALITY CONTROL

- A. Notify Architect at least 48 hours in advance of inspection before concealing lightning protection components.
- B. UL Inspection: Meet requirements to obtain a UL Master Label for system.
- C. LPI System Inspection: Meet requirements to obtain an LPI System Certificate.

END OF SECTION 264113

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SECTION 264313

TRANSIENT-VOLTAGE SUPPRESSION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 DEFINITIONS

- A. ATS: Acceptance Testing Specifications.
- B. SVR: Suppressed voltage rating.
- C. TVSS: Transient voltage surge suppressor(s), both singular and plural; also, transient voltage surge suppression.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating weights, electrical characteristics, furnished specialties, and accessories.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Product Certificates: For TVSS devices, from manufacturer.
- C. Field quality-control reports.
- D. Warranties: Sample of special warranties.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For TVSS devices to include in emergency, operation, and maintenance manuals.

1.06 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Replaceable Protection Modules: One of each size and type installed.

1.07 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency, and marked for intended location and application.
- C. Comply with IEEE C62.41.2 and test devices according to IEEE C62.45.
- D. Comply with NEMA LS 1.
- E. Comply with UL 1283 and UL 1449.
- F. Comply with NFPA 70.

1.08 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Engineer no fewer than two days in advance of proposed electrical service interruptions.
 - 2. Do not proceed with interruption of electrical service without Owner's written permission.
- B. Service Conditions: Rate TVSS devices for continuous operation under the following conditions unless otherwise indicated:
 - 1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
 - 2. Operating Temperature: 30 to 120 deg F.
 - 3. Humidity: 0 to 85 percent, noncondensing.
 - 4. Altitude: Less than 20,000 feet above sea level.

1.09 COORDINATION

- A. Coordinate location of field-mounted TVSS devices to allow adequate clearances for maintenance.
- B. Coordinate TVSS devices with Division 26 Section "Electrical Power Monitoring and Control."

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.
- B. Special Warranty for Cord-Connected, Plug-in Surge Suppressors: Manufacturer's standard form in which manufacturer agrees to repair or replace electronic equipment connected to circuits protected by surge suppressors.

PART 2 PRODUCTS

2.01 SERVICE ENTRANCE SUPPRESSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ABB USA.
 - 2. Advanced Protection Technologies Inc. (APT).
 - 3. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

4. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 5. LEA International.
 6. Liebert Corporation; a division of Emerson Network Power.
 7. Siemens Energy & Automation, Inc.
 8. Square D; a brand of Schneider Electric.
- B. Surge Protection Devices:
1. Comply with UL 1449.
 2. Modular design (with field-replaceable modules).
 3. Fuses, rated at 200-kA interrupting capacity.
 4. Fabrication using bolted compression lugs for internal wiring.
 5. Integral disconnect switch.
 6. Redundant suppression circuits.
 7. Redundant replaceable modules.
 8. Arrangement with copper bus bars and for bolted connections to phase buses, neutral bus, and ground bus.
 9. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
 10. LED indicator lights for power and protection status.
 11. Audible alarm, with silencing switch, to indicate when protection has failed.
 12. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
 13. Four-digit transient-event counter set to totalize transient surges.
- C. Peak Single-Impulse Surge Current Rating: 240 kA per mode/480 kA per phase.
- D. Minimum single impulse current ratings, using 8-by-20-mic.sec waveform described in IEEE C62.41.2
1. Line to Neutral: 70,000 A.
 2. Line to Ground: 70,000 A.
 3. Neutral to Ground: 50,000 A.
- E. Protection modes and UL 1449 SVR for grounded wye circuits with 3-phase, 4-wire circuits shall be as follows:
1. Line to Neutral: 800 V for 480Y/277 V, 400 V for 208Y/120 V.
 2. Line to Ground: 800 V for 480Y/277 V, 400 V for 208Y/120 V.
 3. Neutral to Ground: 800 V for 480Y/277 V, 400 V for 208Y/120 V.
- F. Protection modes and UL 1449 SVR for 240/120 V, single-phase, 3-wire circuits shall be as follows:
1. Line to Neutral: 400 V.
 2. Line to Ground: 400 V.
 3. Neutral to Ground: 400 V.
- G. Protection modes and UL 1449 SVR for 240/120-V, 3-phase, 4-wire circuits with high leg shall be as follows:

1. Line to Neutral: 400 V, 800 V from high leg.
2. Line to Ground: 400 V, 800 V from high leg.
3. Neutral to Ground: 400 V.

H. Protection modes and UL 1449 SVR for 240 V, 480 V, or 600 V, 3-phase, 3-wire, delta circuits shall be as follows:

1. Line to Line: 2000 V for 480 V, 1000 V for 240 V.
2. Line to Ground: 2000 V for 480 V, 1000 V for 240 V.

2.02 PANELBOARD SUPPRESSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB USA.
2. Advanced Protection Technologies Inc. (APT).
3. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
4. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
5. LEA International.
6. Liebert Corporation; a division of Emerson Network Power.
7. Siemens Energy & Automation, Inc.
8. Square D; a brand of Schneider Electric.

B. Surge Protection Devices:

1. Non-modular.
2. LED indicator lights for power and protection status.
3. Audible alarm, with silencing switch, to indicate when protection has failed.
4. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.

C. Surge Protection Devices:

1. Comply with UL 1449.
2. Modular design (with field-replaceable modules).
3. Short-circuit current rating complying with UL 1449, and matching or exceeding the panelboard short-circuit rating and redundant suppression circuits; with individually fused metal-oxide varistors.
4. Fuses, rated at 200-kA interrupting capacity.
5. Fabrication using bolted compression lugs for internal wiring.
6. Integral disconnect switch.
7. Redundant suppression circuits.
8. Redundant replaceable modules.
9. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
10. LED indicator lights for power and protection status.
11. Audible alarm, with silencing switch, to indicate when protection has failed.

12. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
 13. Four-digit transient-event counter set to totalize transient surges.
- D. Peak Single-Impulse Surge Current Rating: 120 kA per mode/240 kA per phase.
- E. Minimum single impulse current ratings, using 8-by-20-mic.sec waveform described in IEEE C62.41.2:
1. Line to Neutral: 70,000 A.
 2. Line to Ground: 70,000 A.
 3. Neutral to Ground: 50,000 A.
- F. Protection modes and UL 1449 SVR for grounded wye circuits with 3-phase, 4-wire circuits shall be as follows:
1. Line to Neutral: 800 V for 480Y/277 V, 400 V for 208Y/120 V.
 2. Line to Ground: 800 V for 480Y/277 V, 400 V for 208Y/120 V.
 3. Neutral to Ground: 800 V for 480Y/277 V, 400 V for 208Y/120 V.
- G. Protection modes and UL 1449 SVR for 240/120-V, single-phase, 3-wire circuits shall be as follows:
1. Line to Neutral: 400 V.
 2. Line to Ground: 400 V.
 3. Neutral to Ground: 400 V.
- H. Protection modes and UL 1449 SVR for 240/120-V, 3-phase, 4-wire circuits with high leg shall be as follows:
1. Line to Neutral: 400 V, 800 V from high leg.
 2. Line to Ground: 400 V, 800 V from high leg.
 3. Neutral to Ground: 400 V.
- I. Protection modes and UL 1449 SVR for 240 V, 480 V, or 600 V, 3-phase, 3-wire, delta circuits shall be as follows:
1. Line to Line: 2000 V for 480 V, 1000 V for 240 V.
 2. Line to Ground: 1500 V for 480 V, 800 V for 240 V.

2.03 ENCLOSURES

- A. Indoor Enclosures: NEMA 250 Type 1.
- B. Outdoor Enclosures: NEMA 250 Type 3R.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install TVSS devices at service entrance on load side, with ground lead bonded to service entrance ground.

- B. Install TVSS devices for panelboards and auxiliary panels with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
 - 1. Provide multiple, 30-A circuit breaker as a dedicated disconnecting means for TVSS unless otherwise indicated.

3.02 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
 - 1. Verify that electrical wiring installation complies with manufacturer's written installation requirements.
- C. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, "Surge Arresters, Low-Voltage Surge Protection Devices" Section. Certify compliance with test parameters.
 - 2. After installing TVSS devices but before electrical circuitry has been energized, test for compliance with requirements.
 - 3. Complete startup checks according to manufacturer's written instructions.
- E. TVSS device will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

3.03 STARTUP SERVICE

- A. Do not energize or connect service entrance equipment or panelboards to their sources until TVSS devices are installed and connected.
- B. Do not perform insulation resistance tests of the distribution wiring equipment with the TVSS installed. Disconnect before conducting insulation resistance tests, and reconnect immediately after the testing is over.

3.04 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to maintain TVSS devices.

END OF SECTION

SECTION 265119

LED INTERIOR LIGHTING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Arrange in order of luminaire designation.
 - 2. Include data on features, accessories, and finishes.
 - 3. Include physical description and dimensions of luminaires.
 - 4. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
 - 5. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing and Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps and accessories identical to those indicated for the lighting fixture as applied in this Project.
 - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
 - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.05 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
 - 3. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.06 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.
- C. Provide luminaires from a single manufacturer for each luminaire type.
- D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.08 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- D. Recessed Fixtures: Comply with NEMA LE 4.
- E. Bulb shape complying with ANSI C79.1.
- F. Lamp base complying with ANSI C81.61.

- G. CRI of 80. CCT of 3500 K.
- H. Rated minimum lamp life of 35,000 hours.
- I. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- J. Internal driver.
- K. Nominal Operating Voltage: 120 V ac.
 - 1. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

2.02 MATERIALS

- A. Metal Parts:
 - 1. Free of burrs and sharp corners and edges.
 - 2. Sheet metal components shall be steel unless otherwise indicated.
 - 3. Form and support to prevent warping and sagging.
- B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- C. Diffusers and Globes:
 - 1. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - 2. Glass: Annealed crystal glass unless otherwise indicated.
 - 3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- D. Housings:
 - 1. Extruded-aluminum housing and heat sink.
- E. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 - 1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage, and coating.
 - c. CCT and CRI for all luminaires.

2.03 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.04 LUMINAIRE FIXTURE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.
- D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.03 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Provide support for luminaire without causing deflection of ceiling or wall.
 - 4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.
- E. Flush-Mounted Luminaire Support:
 - 1. Secured to outlet box.
 - 2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
 - 3. Trim ring flush with finished surface.
- F. Wall-Mounted Luminaire Support:
 - 1. Attached to a minimum 20 gauge backing plate attached to wall structural members.
 - 2. Do not attach luminaires directly to gypsum board.
- G. Ceiling-Mounted Luminaire Support:

1. Ceiling mount with two 5/32-inch-diameter aircraft cable supports adjustable to 120 inches.
2. Ceiling mount with pendant mount with 5/32-inch-diameter aircraft cable supports adjustable to 120 inches.
3. Ceiling mount with hook mount.

H. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

- I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.04 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

- B. Luminaire will be considered defective if it does not pass operation tests and inspections.

- C. Prepare test and inspection reports.

END OF SECTION 265119

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SECTION 265619
LED EXTERIOR LIGHTING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color rendering index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of luminaire.

1.04 FIELD CONDITIONS

- A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.
- B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Package aluminum poles for shipping according to ASTM B 660.
- B. Store poles on decay-resistant-treated skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- C. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

1.06 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.

1. Warranty Period for Luminaires: Five years from date of Substantial Completion.
2. Warranty Period for Metal Corrosion: Five years from date of Substantial Completion.
3. Warranty Period for Color Retention: Five years from date of Substantial Completion.
4. Warranty Period for Poles: Repair or replace lighting poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than three years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- D. UL Compliance: Comply with UL 1598 and listed for wet location.
- E. Lamp base complying with ANSI C81.61.
- F. CRI of 80. CCT of 3500 K.
- G. L70 minimum lamp life of 35,000 hours.
- H. Nominal Operating Voltage: 120 V ac.
- I. Lamp Rating: Lamp marked for outdoor use and in enclosed locations.
- J. Source Limitations: Obtain luminaires from single source from a single manufacturer.
- K. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.02 LUMINAIRE TYPES

- A. Refer to Schedule on Drawings.

2.03 MATERIALS

- A. Metal Parts: Free of burrs and sharp corners and edges.
- B. Sheet Metal Components: Corrosion-resistant aluminum or Stainless steel. Form and support to prevent warping and sagging.
- C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.
- D. Diffusers and Globes:

1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 2. Glass: Annealed crystal glass unless otherwise indicated.
 3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- F. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
1. White Surfaces: 85 percent.
 2. Specular Surfaces: 83 percent.
 3. Diffusing Specular Surfaces: 75 percent.
- G. Housings:
1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
 2. Provide filter/breather for enclosed luminaires.

2.04 FINISHES

- A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.
- C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
 3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
 4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.
 - a. Color: Bronze.

2.05 GENERAL REQUIREMENTS FOR SUPPORT COMPONENTS

- A. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.
- B. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
1. Materials: Shall not cause galvanic action at contact points.
 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.

3. Anchor-Bolt Template: Steel.

PART 3 EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

- A. Comply with NECA 1.
- B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- C. Install lamps in each luminaire.
- D. Fasten luminaire to structural support.
- E. Supports:
 1. Sized and rated for luminaire weight.
 2. Able to maintain luminaire position after cleaning and relamping.
 3. Support luminaires without causing deflection of finished surface.
 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- F. Wall-Mounted Luminaire Support:
 1. Attached to a minimum 1/8 inch backing plate attached to wall structural members.
- G. Wiring Method: Install cables in raceways. Conceal raceways and cables.
- H. Install luminaires level, plumb, and square with finished grade unless otherwise indicated.
- I. Coordinate layout and installation of luminaires with other construction.
- J. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.
- K. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.02 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.03 FIELD QUALITY CONTROL

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- B. Perform the following tests and inspections:
 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

- 2. Verify operation of photoelectric controls.
- C. Luminaire will be considered defective if it does not pass tests and inspections.
- D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 265619

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BARTLETT — *&* — **WEST**

SECTION 310000

EARTHWORK

PART 1 GENERAL

1.01 WORK INCLUDED

- A. This section includes the site preparation activities and defines certain items and aspects of earthwork relative to other work.

1.02 GENERAL

- A. Definition: Earthwork is defined as all excavation, trenching, fill, backfill, site preparation, subgrade preparation and other appurtenant work.
- B. Classification: Excavation shall be unclassified, and the term "excavation" shall include all material encountered without regard to its physical properties, characteristics or composition.
- C. Limits of the Work:
1. Earthwork shall not extend beyond the areas of excavation, embankment or other construction shown on the drawings.
 2. Excavations for new construction shall not undercut existing footings and foundations.
- D. Safety and Protection:
1. Shoring, sheeting and bracing shall be provided as required to protect the work and workmen from damage or injury by caving or sloughing.
 2. Laws and ordinances regulating health and safety measures shall be strictly observed.

1.03 REFERENCES

- A. American Society for Testing and Materials (ASTM):

D 698	Moisture-Density Relations of Soils Using 5.5 lb. (2.5 kg) Rammer and a 12 inch (304.8 mm) Drop.
D 1556	Density of Soil In Place by the Sand-Cone Method.
D 1557	Moisture-Density Relations of Soils Using 10 lb. (4.54 kg) Rammer and a 18 inch (457 mm) Drop.
D 2167	Density of Soil In Place by the Rubber Balloon Method.
D 2922	Test Methods for Density of Soil and Soil Aggregate In Place by Nuclear Methods (Shallow Depth).
D4318	Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
D4546	Test Method for One-Dimensional Swell/Settlement Potential of Cohesive Soils.

- B. American Association of State Highway and Transportation Officials (AASHTO):

M 6	Fine Aggregate for Portland Cement Concrete.
T 99	Moisture Density Relations of Soils, Using a 5.5 lb. (2.5 kg) Rammer and a 12 inch (305 mm) Drop.
T180	Moisture-Density Relations of Soils Using 10 lb. (4.54 kg) Rammer and a 18 inch (457 mm) Drop.

C. Military Standard (MIL-STD-619):

MIL-STD-619B

Unified Soil Classification System for Roads, Airfields, Embankments and Foundations.

D. Federal Register - Occupational Safety and Health Administration (OSHA)

29CFR Part 1926

Occupation Safety and Health Standards - Excavations.

1.04 SUBMITTALS

- A. General: Submit information and samples to the Engineer for review as specified herein in accordance with the Section entitled "Submittals".
- B. Bedding and Backfill Materials: The Contractor shall notify the Engineer of the off-site sources of bedding and backfill materials, and submit to the Engineer detailed information of the materials to be used including but not limited to a sieve analysis and Proctor Curve.

1.05 QUALITY CONTROL

- A. Prior to the placement of any excavated or borrowed soils, each type of soil approved for fill or backfill shall have a Standard Proctor Curve developed to indicate the moisture-density relationship required to obtain maximum density.
- B. A qualified soils engineer or geologist selected by the Contractor; approved by the Engineer and paid for by the Contractor shall be responsible for developing all required proctor curves and in-place soil density testing. The results shall be submitted to the Engineer for approval and used in determining proper compaction of the soils placed.
- C. Density tests shall be taken at the frequency indicated in the table below and at all road and street crossings. The Engineer has the authority to require the Contractor to perform additional test locations based upon field conditions. The Engineer shall determine the exact location of all tests. Field tests for density and moisture content performed by the Contractor are for the sole purpose of assisting the Engineer in determining that the specified density is being obtained. All density testing for all backfill shall be performed using Soil Proctor Curves provided by the Contractor. The Engineer has the authority and right to not accept backfill based on the results of these tests, but the results of the tests do not waive the responsibilities of the Contractor to ultimately guarantee the density and stability of the fill material. When test results indicate that compaction is not as specified, the material shall be removed, replaced, and recompacted to meet specification requirements at no expense to the Owner. Subsequent tests on recompacted areas shall be performed to determine conformance with specification requirements at the Contractor's expense.

<u>Materials</u>	<u>Minimum Test Frequency</u>
Fill and Backfill	1 per lift per 500 square feet
Subgrade	1 per lift per 2,500 square feet
Embankment	1 per lift per 500 cubic yards
Trenches	1 per lift per 150 linear feet

In no case shall the frequency exceed 200 feet horizontal and 1-foot vertical intervals.

- D. Periodically, the Resident Project Representative may test backfill for density using Soil Proctor Curves provided by the Contractor. The results of these compaction tests will only be provided to the Contractor at his request. However, the Contractor shall be provided these results for informational purposes only and they, in no way, alter the Contractor's ultimate responsibility for compaction requirements. The Engineer has the right not to accept backfill based on the results of these tests, but the results of the tests

in no way waives the responsibilities of the Contractor to guarantee the density and stability of the material.

- E. Field density of soils shall be determined by ASTM Methods D1556, D2167 or D2922.
- F. Degree of compaction is a percentage of the maximum density obtained by the test procedure presented in ASTM Method D 1557 or AASHTO-T180 (Proctor) as a percent of laboratory maximum density.

1.06 SUBSURFACE INFORMATION

- A. Subsurface boring logs report by Trautner Geotech, Inc. is available for review with the Engineer.
- B. The Contractor shall satisfy himself as to the character and amount of different soil materials, groundwater and the subsurface conditions to be encountered in the work to be performed. Information and data, when furnished, are for the Contractor's general information. However, it is expressly understood that any interpretation or conclusion drawn there from is totally the responsibility of the Contractor. Engineer and Owner assume no liability for the accurateness of the data reported or the materials used.

1.07 PROTECTION AND REMOVAL OF UTILITY LINES

- A. Existing pipelines and electric cables that are shown on the Drawings or the locations of which are made known to the Contractor prior to excavation operations, shall be protected from damage during excavation and backfilling, and if damaged shall be repaired by the Utility company at Contractor's expense. Any existing pipelines and electric, telephone, coaxial or fiber optic cables that are to remain and that are not shown on the Drawings or the locations of which are not known to the Contractor in sufficient time to avoid damage if inadvertently damaged during excavation shall be repaired by the Utility Company and an adjustment in payment will be made in accordance with the General Conditions.

PART 2 PRODUCTS

2.01 EARTH FILL MATERIALS

- A. Fill material used for compacted impervious material shall consist of excess suitable impervious material obtained from on-site suitable excavations or suitable imported clay or silt material. Excess suitable material obtained from structure and trench excavation shall be used for the construction of fills and embankments. Additional material shall be provided as required under sub-section 2.03 – Borrow Material.
- B. All material placed in fills and embankments shall be free from rocks, stones, or shale particles larger than 2 inches, frozen matter, brush, stumps, vegetation, logs, roots, debris, and organic or other deleterious materials. The material for fill shall have a liquid limit less than 45 percent and a plasticity index less than 25 as determined by ASTM D4318. No rocks or stones shall be placed in the upper 18 inches of any fill or embankment. Rocks or stones within the allowable size limit, incorporated in the remainder of fills and embankments, shall be distributed so that they do not congregate or interfere with proper compaction.
- C. Fill material shall be limited to materials classified as SC, ML, and CL by the Unified Soils Classification.

2.02 EXCAVATED MATERIALS

- A. Topsoil obtained by stripping and suitable for finish grading where arable soil is required shall be stockpiled in a location approved by the Engineer.
- B. Excavated material approved for embankment, fill or backfill shall be placed in areas receiving embankment or stored for future use in a location approved by the Engineer.

- C. If the Contractor deems it necessary to obtain additional area for stockpiling materials, it shall be obtained at no additional cost to the Owner.

2.03 BORROW MATERIAL

- A. Where suitable materials, including topsoil, are not available in sufficient quantity from all required excavations under this contract, approved materials shall be obtained from approved sources on and off site at the Contractor's responsibility and expense. The necessary clearing and grubbing of borrow areas, disposal and removing of debris therefrom, the developing of sources including any access roads for hauling, the necessary right-of-way, and the satisfactory drainage of the borrow areas shall be considered as incidental items to borrow excavation.
- B. Material obtained for fill shall be approved by the Engineer. Fill material shall be limited to materials specified in Section 2.01 - Earth Fill Materials.

2.04 TOPSOIL

- A. Topsoil shall be the top few inches of field or pasture loam having a good supply of humus along with a high degree of fertility. Acceptable topsoil shall be a fertile, friable, and loamy soil of uniform quality with a loose crumbly structure, free from materials such as roots, hard clods, stiff clay, fill material, stone with any dimension greater than 1 inch, and similar impurities, relatively free from grass, roots, weeds, and other objectionable plant material.
- B. Soils from ditch bottoms, drained ponds or eroded areas are not acceptable. Soils supporting growth of noxious weeds, as defined by The Colorado Seed Act, or undesirable weeds are not acceptable. Topsoil handled too wet or soggy are unacceptable.

2.05 DISPOSAL OF UNSUITABLE OR EXCESS MATERIAL

- A. Material not suitable for embankment, fill or backfill or excess suitable material not wanted by the Owner shall be disposed of off site at a location provided by the Contractor. Transportation and disposal of such material shall be provided by the Contractor and shall be at the Contractors expense.
- B. Excess excavated suitable material in excess of the backfill or grading requirements not used for any purpose associated with the completion of the work shall remain the property of the Owner and shall be delivered by the Contractor to a site designated by the Owner or Engineer within a 10 mile radius of the project site.

2.06 GRAVEL BASE

- A. Gravel base for all concrete structures shall be clean, crushed, nonporous rock as graded below or sand-gravel:
 - 1. Crushed, nonporous rock maximum particle size shall be No. 6 per AASHTO M43.
 - 2. Aggregates shall be washed, tested and conform to gradation as required by CDOT Standard Specification for State Road and Bridge Construction. Aggregates for Underdrain Installation, Type UD-1 (Section 703).

2.07 BUILDING BACKFILL

- A. Backfill within building shall be limited to materials classified as SC, ML and CL by MIL-STD-619 or Class 1 Structure Backfill per CDOT.

2.08 SOIL SEALANT

- A. Soil sealant shall be dry, crushed Bentonite "Econoseal X" by Black Hills Bentonite Co., Mills, Wyoming or approved equal.

2.09 FILTER FABRIC

- A. Filter fabric shall be a pervious sheet of nonwoven needle punched fabric. Weight of fabric shall be at least 5.0 ounces per square yard. The water flow rates shall be approximately 110 gallons per minute per square foot. Fabric shall have a minimum puncture resistance of 100 pounds, a minimum grab tensile strength of 120 pounds and be resistant to freeze-thaw cycles, soil chemicals and ultraviolet light exposure. Filter fabric shall be CONTECH C 70NW, Mirafi Type 140N, or approved equal.

PART 3 EXECUTION

3.01 WETLAND BEST MANAGEMENT PRACTICES AND MITIGATION OF ADVERSE IMPACTS

- A. See the Section entitled "Temporary Environmental Controls" for these requirements.

3.02 SITE PREPARATION

- A. Clearing and Grubbing:
 - 1. The site of the work shall be cleared of all trash and debris which may be found on the site.
 - 2. Grass and weeds shall be mowed to a height of not more than three inches and raked into windrows or piles.
 - 3. Trees noted to be removed shall be removed to a minimum depth of 2 feet 0 inches below the surface of the finished grade.
 - 4. All materials accumulated by clearing and grubbing operations shall be disposed of at an offsite location to be provided by the Contractor.
- B. Stripping:
 - 1. Strip topsoil to a depth of not less than four inches from all areas to be covered by buildings, pavement, curb and gutter or other construction.
 - 2. Material obtained by stripping shall be stockpiled for use in finish grading or areas not covered by construction.

3.03 EXCAVATION FOR STRUCTURES

- A. The structures have been designed to be constructed by open cut and constructed in a dry condition. All dewatering shall be provided at the Contractor's expense.
- B. The entire area to be covered by the structures shall be excavated as shown by details on the drawings to elevations of the footings, foundations and floor slabs.
- C. Footings, foundations and floor slabs shall be excavated to neat lines as shown on drawings, and shall be formed as required by site conditions.
- D. Sheet piling may be used in lieu of open cut. If sheet piling is utilized, the piling must be removed as the backfill is replaced. In no event shall it be left in place permanently.

3.04 FILL WITHIN STRUCTURES

- A. Approved fill shall be placed at optimum moisture content in lifts of not more than 6 inches loose lift and

compacted to at least 95 percent of Laboratory Maximum Density. Fill shall be placed up to the bottom of the structural floor slabs, with allowance for capillary water barrier (gravel sub-base) and/or concrete mud mat as specified or shown on the drawings, to the elevations shown.

3.05 CAPILLARY WATER BARRIER

- A. Subgrade under floor slab shall be finished off smooth after the required density as specified above is achieved to the proper elevation.
- B. Capillary water barrier shall be placed directly on the subgrade and compacted with a minimum of two passes of a plate-type vibratory compactor.
- C. The minimum compacted thickness of the capillary water barrier shall be 4-inches unless noted otherwise in the Drawings.

3.06 BACKFILL FOR STRUCTURE FOUNDATION WALLS, GRADE BEAMS AND FOOTINGS

- A. Backfill shall be brought up on each side of the foundation wall concurrently. After foundation walls, grade beams and footings have cured, forms have been removed, and all trash has been removed, backfill shall be placed at optimum moisture content in lifts of not more than 6 inches loose lifts and compacted to at least 95 percent of Laboratory Maximum Density.
- B. Backfill for areas not to be paved shall be placed to within 6 inches of the finished grade. The top 6 inches shall be topsoil.

3.07 AREA GRADING

- A. Under pavement, pads and sidewalks, excavate and fill to grades and contours shown on the Drawings, making allowance for thickness of pavement, pads and sidewalks.
- B. General Fill:
 - 1. Excavate and fill to grades and contours shown on the Drawings making allowance for the placing of a minimum of 6 inches of topsoil.
 - 2. Areas receiving embankment or topsoil shall be scarified to a depth of 6 inches and recompact at optimum moisture content to at least 90 percent of Laboratory Maximum Density.
 - 3. Fill material shall be approved earth free of stones larger than 6 inches diameter and suitable for compaction. Fill material shall be placed at optimum moisture content in lifts not to exceed 6 inches loose lift and compacted to at least 90 percent of Laboratory Maximum Density.
 - 4. Topsoil shall be placed in a 6 inch lift and not compacted.

3.08 SUBGRADE PREPARATION FOR PAVEMENT, PADS, SIDEWALKS AND CURBS

- A. Subgrade preparation shall extend one (1) foot beyond the back of curb line or edge of pavement, whichever is appropriate. Sidewalk replacement subgrade preparation shall be limited to width of sidewalk and form limits.
- B. The subgrade shall be free of organic material, trash and debris, and rocks larger than 3 inches in diameter. Subgrade shall not be frozen while construction is in progress.
- C. Scarify the upper six (6) inches of the subgrade and compact to 95% of the maximum density at optimum moisture, plus or minus 3%, in accordance with AASHTO T180 (Modified Proctor). The subgrade material shall be properly "worked" and installed to provide a stable road base, absent of shrinkage or swell potential. The subgrade shall be maintained within the proper moisture content limits until the curb & gutter and pavement is placed. Mechanical tamping may be utilized or required for certain areas. If

the subgrade contains excess moisture the subgrade shall be aerated or removed and replaced with new material so that moisture limits fall within limits of the standard proctor. The prepared subgrade shall support the weight of vehicles and equipment without producing ruts in the surface, and shall be maintained until pavement has been placed thereon. The Engineer may require proof rolling of the subgrade surface. Proof rolling shall be provided at no additional cost to the Owner.

- D. The elevations and cross sections of the subgrade surface shall be thoroughly checked immediately prior to the pavement placement. All high and low places shall be removed and filled with suitable material and mechanically tamped. All subgrades shall be checked not less than 100 feet in advance of paving operation. Any damage or irregularities to the subgrade during paving operations shall be repaired prior to placing of additional pavement.

3.09 CONTROL OF WATER

A. Surface Water:

1. Surface water shall be diverted to prevent entry to trenches and excavations for structures.
2. In the event surface water does accumulate in trenches and other excavations, the excavations shall be dewatered as necessary to permit the proper execution of the work. Dewatering shall be provided at no additional cost to the Owner.

B. Ground Water: Where ground water is encountered, trenches and other excavations shall be dewatered as necessary to permit the proper execution of the work.

1. The Contractor shall provide pumps, well points, and other appurtenant equipment necessary to remove and maintain water at such a level as to permit construction in a dry condition as specified except where authorized tremie concrete construction Work is shown or permitted. The groundwater level shall be controlled so as to permit the placing of sewer lines and structure foundations, curing of concrete, and the maintenance of supporting foundations and adjacent Work and structures. The dewatering system and points of discharge shall be subject to permitting, reviews, and acceptance by the Engineer before installation. Disposal of water to any surface water body will require silt screens.
2. The Contractor shall use dewatering systems that include automatic starting devices, and standby pumps that will ensure continuous dewatering in the event of an outage of one or more pumps. He shall be totally responsible for protecting structures from flotation until final acceptance of the Work. The Contractor shall also modify the dewatering system during the course of construction to satisfy faults, legitimate complaints, or legal requirements.

3.10 FINISH GRADING

- A. After construction is completed, areas requiring finish grading shall be cleared of all building materials, equipment and debris and a minimum depth of 6 inches of topsoil placed. The 6 inches of topsoil is included in and not added to the final grade indicated on the plans. Surfaces shall be smooth and suitable for planting or sodding.

3.11 PROTECTION

- A. Subgrade shall be repaired from action of the elements or others. Any settlement or erosion that occurs prior to the placing of the pavement thereon, shall be repaired and the specific lines, grades and cross section re-established. Any subgrade that has become unacceptable shall be reworked as necessary to restore the subgrade to shape, tolerance, density, and moisture content range for such density, immediately prior to the placing of the pavement. The Contractor shall protect all existing improvements from damage resulting from his subgrade operation. Any improvements damaged shall be repaired or replaced at no additional expense to the Owner.

3.12 FILTER FABRIC

- A. The filter fabric shall be installed as indicated on the drawings and shall be laid with a minimum 1.5 foot overlap at all seams.

END OF SECTION

SECTION 311000

SITE CLEARING

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Removal of surface debris, trees, shrubs, other plant life, aggregate surfacing, curbs, pavement and topsoil in the areas to be excavated, filled, paved or planted as shown on the Drawings and as specified herein.

1.02 DEFINITIONS

- A. Clearing shall consist of the cutting, removal and satisfactory disposal of all trees, stumps, brush, shrubs, rubbish, pavement, curbs, aggregate surfacing, and any other objectionable material within the designated areas.
- B. Grubbing shall consist of the removal and disposal of all stumps larger than 1-½ inches in diameter and other objectionable material to a depth of at least 18 inches below the ground surface.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 PROTECTION OF ADJACENT AREAS

- A. Contractor shall limit the removal of trees, shrubs, native upland vegetation, and riparian vegetation to the minimum required to accomplish the Work. All areas disturbed by the Contractor's operation shall be restored following completion of the Work.
- B. The Contractor shall protect areas shown on the Drawings or designated by the Engineer to remain protected from damage by construction operations by erecting suitable barriers or other acceptable means. Areas outside the limits of construction as shown on the Drawings shall be protected and no equipment or materials shall be stored or allowed to damage these areas.
- C. Locate, identify, and protect utilities indicated to remain from damage.
- D. Protect trees, plant growth, and features designated to remain as final landscaping.
- E. Protect benchmarks, survey control points, and existing structures from damage or displacement.

3.02 SITE PREPARATION

- A. Clearing and Grubbing:
 - 1. The site of the work shall be cleared of all trash and debris found on the site.
 - 2. Grass and weeds shall be mowed to a height of not more than three inches and rakes into windrows or piles.
 - 3. Trees noted to be removed shall be removed to a minimum depth of 2 feet 0 inches below the surface of the finished grade.
 - 4. All materials accumulated by clearing and grubbing operations shall be disposed of at an offsite location to be provided by the Contractor.
 - 5. Backfill all excavated depressions with approved material and grade to drain.

B. Stripping:

1. Scrape areas clean of all brush, grass, weeds, roots, and other materials.
2. Strip to a depth of approximately 6 inches or to a sufficient depth to remove excessive roots in heavy vegetation or brush areas and as required to segregate topsoil.
3. Strip topsoil to a depth of not less than four inches from all areas to be covered by buildings, pavement, curb and gutter or other construction.
4. Material obtained by stripping shall be stockpiled for use in finish grading or areas not covered by construction. Do not mix with foreign materials.
5. Stockpile topsoil in areas designated where it will not interfere with construction operations or existing facilities. Stockpiled topsoil shall be reasonably free of subsoil, debris, and stones larger than 2-inch diameter.
6. Do not excavate wet topsoil.

3.03 GRADE AROUND TREES

- A. Trenching: Where trenching is required around trees which are to remain, avoid cutting the tree roots by careful hand tunneling under or around the roots. Avoid injury to or prolonged exposure of roots.
- B. Raising Grades: Where existing grade at a tree is below the new finished grade and fill not exceeding 16 inches is required, place 1 to 2 inches of clean, washed gravel directly around the tree trunk. Extend gravel out from trunk on all sides of at least 18 inches and finish 2 inches above finished grade at tree. Install gravel before earth fill is placed. Do not leave new earth fill in contact with any tree trunks.
- C. Lowering Grades: Regrade by hand to elevation required around existing trees in areas where new finished grade is to be lower. As required, cut the roots cleanly 3 inches below finished grade and cover scars with tree paint.

3.04 DISPOSAL

- A. All roots, vegetation and other removals shall be removed from the site and disposed of by the Contractor. Burning of any material on the site will be allowed with the proper permits.

END OF SECTION

SECTION 312210

SITE GRADING

PART 1 GENERAL

1.01 WORK INCLUDED

- A. The Contractor shall perform grading Work within the limits, elevations and grades indicated on the Drawings and as specified herein.

1.02 QUALITY CONTROL

- A. The site shall be graded to the required elevations. Spot elevations and grade contours are shown on the Drawings and the finished surfaces shall be uniformly sloped between these locations.
- B. Suitable excavated material shall be used in the formation of embankments and fill areas as shown on the Drawings. The Contractor shall provide all additional fill material required to complete the embankments.

PART 2 PRODUCTS

2.01 TOPSOIL

- A. Topsoil shall be as specified in the "Earthwork" Section, free from materials such as roots, hard clods, stiff clay, fill material, stone with any dimension greater than 1 inch, and similar impurities, relatively free from grass, roots, weeds, and other objectionable plant material. The Contractor shall determine the volume of material required for the work.

2.02 FILL

- A. Suitable fill material shall be as specified in the "Earthwork" Section, free from vegetation, organic material or muck. Broken concrete shall not be used in the fill. All fill material shall be provided by the Contractor from any excess suitable on-site material or from off-site sources, borrow areas or other sources for this material, all being reviewed by the Engineer prior to use. The Contractor shall determine the volume of material required for the work.

PART 3 EXECUTION

3.01 PREPARATION

- A. Identify required lines, levels, contours, and datum. Protect benchmarks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- B. Locate, identify, and protect from damage utilities indicated to remain. Protect above and below-grade utilities indicated to remain.
- C. Notify respective utility company to remove and relocate utilities as required.
- D. Protect plant life, lawns, and other features remaining as portion of final landscaping.

3.02 SUBSOIL EXCAVATION

- A. Excavate subsoil from areas to be further excavated, relandscaped, or regarded, or from borrow areas, if noted on Drawings.

- B. Do not excavate wet subsoil unless authorized in writing by the Engineer. If approved, wet material shall be excavated and processed to obtain optimum moisture content.
- C. When excavating through roots, perform Work by hand and cut roots with sharp axe.
- D. Remove excess subsoil not intended for reuse, from site.
- E. Stability. Replace damaged or displaced subsoil as specified for fill.

3.03 STOCKPILING

- A. Stockpile materials on site.
- B. Stockpile in sufficient quantities to meet project schedule and requirements.
- C. Separate differing materials with dividers or stockpile apart to prevent mixing.
- D. Prevent intermixing of soil types or contamination.
- E. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

3.04 FILLING

- A. Fill areas to contours and elevations with unfrozen materials.
- B. Place fill material on continuous layers and compact in accordance with the "Earthwork" Section.
- C. Maintain optimum moisture content of fill materials to attain required compaction density.
- D. Slope grade away from building minimum 2 inches in 10 feet, unless noted otherwise.
- E. Make grade changes gradual. Blend slope into level areas.
- F. Remove surplus fill materials from site.

3.05 TOPSOIL PLACEMENT

- A. Distribute topsoil, not less than 6-inches deep, over required areas without compaction, other than that obtained with spreading equipment.
- B. Shape cuts, fills, and embankments and all other areas that have been disturbed or damaged by the construction operations to contours indicated. Grade to match contours of adjacent areas and permit good, natural drainage and provide gentle mound over trenches.
- C. After topsoil has been spread, clear surface of stones or other objects larger than 1 inch in thickness or diameter and all other objects that might interfere with planting and maintenance operations.
- D. Protect topsoiled areas from the elements until grass is established and repair eroded areas as required.
- E. Keep paved areas clean. Promptly remove topsoil or other dirt dropped upon surfacing.
- F. Use of graders or other power equipment will be permitted for final grading and dressing of slopes, provided the result is uniform and equivalent to handwork. All surfaces shall be sloped to drain away from structures and graded to secure effective drainage. Unless otherwise indicated a slope of at least one percent shall be provided.

- G. The completed surface shall be within 0.1 foot of the elevations shown on the Drawings, unless otherwise directed by the Engineer. Minor adjustments to line and grade may be required as the work progresses in order to satisfy field conditions.

3.06 PROTECTION OF THE WORK

- A. Maintenance. Protect newly graded and topsoiled areas from actions of the elements. Fill and repair settling or erosion occurring prior to landscaping and reestablish grades to the required elevations and slopes.
- B. Settlement Correction. Under provisions of the guarantee, Contractor is responsible for correcting any settlement of backfill and damages created thereby within one year after final acceptance of the work. Make repairs within 10 days from and after due notification by Owner of backfill settlement and resulting damage. Make own arrangements for access to the site for purposes of repair.

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— **& WEST**

SECTION 312309

BLASTING

PART 1 GENERAL

1.01 DESCRIPTION

- A. This work consists of blasting, scaling, excavation, and disposal of all materials in the excavation areas in accordance with these specifications and in conformity with the limits, lines and grades shown on the plans or as established in the field by the Engineer.
- B. The use of explosives during construction shall be as specified herein. However, no blasting will be permitted which, in the blasting supervisor's judgment or the judgment of the Owner's Representative, may be detrimental to existing facilities or pipelines. Additionally, **no blasting will be permitted on lands owned by the United States of America, including those managed by the US Bureau of Reclamation.**
- C. The determination for the use of explosives remains the sole responsibility of the Contractor. The Contractor shall comply with all laws, ordinances, applicable safety code requirements, and regulations relative to the handling, storage and use of explosives and the protection of life and property. The Contractor shall be responsible for all damage caused by his blasting operations.
- D. The Contractor shall utilize controlled blasting techniques for all excavations to reduce overbreak and to control slope contour. The Contractor shall conduct the work in a manner that ensures the safety of employees, Owner's and Engineer's personnel, adjacent properties, and the public.
- E. The Contractor shall be liable for all injuries to, or death of, persons, or damage to property caused by a blast or explosive, and he agrees by submission of a bid to indemnify and hold the Owner, its officers, agents, employees, volunteers and project consultants harmless from any and all liability claims, costs, expenses including expenses of investigation and defending against the same in regard thereto.
- F. Blasting may be proposed by the Contractor as a means of excavating rock, but may not be allowed in certain instances. At least 28 calendar days in advance of any proposed blasting, Contractor shall submit to the Engineer a request for permission to blast that includes a general description of the proposed blasting activities, and the approximate location(s) and volume(s) of rock to be removed by blasting. The request shall be submitted in accordance with the Section entitled "Submittals". If the request for blasting is not authorized, then rock must be removed by means other than blasting. If the request for blasting is authorized, then the procedures for blasting shall conform to the requirements described herein.
- G. The Contractor shall prevent damage outside the excavation limits, and shall prevent rocks and blast debris from entering adjacent streams, or properties. All damages resulting from rock excavation operations shall be repaired, and items replaced to the satisfaction of the Engineer, at the Contractor's expense.
- H. Before delivery of any explosives on-site, the Contractor shall have obtained blasting endorsement on his public liability and property damage insurance policy. A copy of the endorsement shall be provided to the Owner as part of the blasting plan.

1.02 PERMITS AND SAFETY ORDERS

- A. Prior to any blasting, obtain the blasting permits required by La Plata County, the State of Colorado and any applicable agency having jurisdiction and comply with requirements for posted signs, advanced warning, and permitting to use blasting. Notify the fire district, local fire department, and

utilities in the general blast area. Submit a copy of permits required to the Owner's Representative prior to drilling for blasting.

- B. Whenever blasting operations are in progress, explosives shall be stored, handled and used as provided in: the Explosives Regulations of the Colorado State Division of Oil and Public Safety 7 C.C.R. 1101-9; the Federal Occupational Safety and Health Act of 1970 and the Construction Safety Act of 1969, as amended; Safe Explosives Act, Title XI, Subtitle C of Public Law 107-296, Interim Final Rule; and Organized Crime Control Act of 1970, Title XI, Public Law 91-452, Approved October 15, 1970, as amended.
- C. Comply with the requirements specified in the Colorado Department of Labor Division of Oil and Public Safety Explosives Statutes.
- D. Ensure that deliveries of explosives to worksites comply with rules and regulations issued by the Department of Transportation (DOT) and the Transportation Security Administration (TSA) for commercial transportation of explosives pursuant to the mandates of the USA Patriot Act of 2001. Under TSA rules, commercial drivers with hazardous materials endorsement shall undergo a personal background records check, training, and testing.
- E. Comply with applicable provisions of OSHA of 1970, 29 U.S.C., Section 651 et seq., including safety and health regulations for construction.
- F. Blasting and Explosives:
 - 1. U.S. Code of Federal Regulations (CFR):
 - a. CFR 27, U.S. Department of Justice, Alcohol, Tobacco, and Firearms (ATF), Explosives Division, 27 CFR Part 555, Implementation of the Safe Explosives Act, Title XI, Subtitle C of Public Law 107-296, Interim Final Rule.
 - b. Organized Crime Control Act of 1970, Title XI, Public Law 91-452, Approved October 15, 1970, as amended.
 - c. CFR 49, Parts 100-177 (DOT RSPA), 301-399 (DOT FHA).
 - d. Federal OSHA of 1970, as amended.
 - e. Construction Safety Act of 1969, as amended.
 - 2. State Agencies:
 - a. Colorado Department of Labor Division of Oil and Public Safety Explosives Statutes
 - 3. Nonregulating Industry Support Organizations:
 - a. Vibration Subcommittee of the International Society of Explosive Engineers (ISEE), blast monitoring equipment operation standards (1999).
 - b. Institute of Makers of Explosives (IME) Safety Library Publications (SLPs).

1.03 DEFINITIONS

- A. Air Blast: A transient air pressure impulse generated by explosions.
- B. Air-Overpressure: Temporary changes in ambient air pressure caused by blasting. Air-overpressure is expressed in units of psi or dB or dBL (linear decibel scale). Measurements for blasting are made with microphones having a flat frequency response for over-pressure in the 2 to 200 Hz range. A-weight or C-weight microphones shall not be used for these measurements.
- C. Blast Consultant: The Blast Consultant shall be a person with extensive knowledge of noise vibration, and visual impacts of blasting operations, and who is specialized in the detonation of explosives, particularly in the field of rock quarry operations. The Blast Consultant shall be provided by the Contractor.

1. The Blast Consultant must have at least 10 years of experience in construction blasting. They must be able to demonstrate involvement in at least five (5) projects with blasting within 200 feet of residential structures.
- D. Blast Control Specialist: Person authorized to act on behalf of the Contractor and licensed by the State or local regulatory agency to possess, transport, and use explosives.
- E. Charge-per-Delay: For vibration control, any charges firing within any 8-millisecond time period are considered to have a cumulative effect on vibration and air-overpressure effects. Therefore, the maximum charge-per-delay (W) is the sum of the weight of all charges firing within any 8-millisecond time period. For example, if two 10-lb. Charges fire at 100 ms and one 15-lb charge fires at 105 ms, the maximum charge per delay would be 35 lbs.
- F. Controlled Blasting. The use of explosives and blasting accessories in carefully spaced and aligned drill holes to produce a free surface or shear plane along the controlled blast line.
- G. Controlled Blast Line. The single row of holes used to achieve the results of all controlled blasting methods including trim blasting, line drilling, and pre-splitting.
- H. Delay: A distinct pause of pre-determined time between detonations of single charges or groups of charges.
- I. Final Wall Face. The remaining slope surface after all excavation is complete.
- J. Fly Rock: Debris that is ejected or propelled through air by blast.
- K. Frequency: Ground vibration oscillation at peak event, expressed in Hertz.
- L. Line Drilling. A controlled blasting method, which includes a single row of closely spaced, unloaded, small diameter drilled holes providing a plane of weakness in the rock mass to which the primary blast can break.
- M. Occupied Building: Structure on or off construction limits that is occupied by humans or livestock.
- N. Peak Ground Particle Velocity (PGPV): Maximum of three (3) velocity components measured in three (3) mutually perpendicular directions (vertical, horizontal and transverse) at a point. Velocity units are expressed in inches per second (ips).
- O. Pre-splitting. A controlled blasting method involving a single row of drilled holes which are loaded and fired before any holes in the main excavation are fired.
- P. Primary Initiation: The method whereby the blaster initiates the blast(s) from a remote and safe location. Primary initiation systems use pneumatic tubing or shock-tubes to convey firing energy from blasters to blast locations.
- Q. Production Blasting. The controlled use of explosives and blasting accessories in carefully spaced and aligned drill holes to provide a distribution of charge that will excavate the rock to the required limits and minimize overbreak, stressing and fracturing of the rock beyond the design lines.
- R. Production Holes: Blast holes in the main body of the rock mass being removed by drilling and blasting.
- S. Prohibited Persons: Persons prohibited from handling or possessing explosive materials as defined by the seven categories described in Section 555.11 of 27 CFR (ATF Rules).
- T. Residential Building: Includes single and multiple family dwellings, hotels, motels and any other structure containing sleeping quarters.

- U. Scaled Distance (Ds): A factor describing relative vibration energy based on distance and charge-per-delay. For ground vibration control and prediction purposes, Ds is obtained by dividing the distance of concern (D) by the square root of the charge-per-delay (W), $D_s = D/\sqrt{W}$. Minimum scaled distance limits are used to establish charge weights and the units of Ds are $\text{ft}\sqrt{\text{lb}}$.
- V. Stemming: Crushed stone, tamped clay or other inert earth material placed in the unloaded collar area of blastholes for the purpose of confining explosive charges and limiting rock movement and air-overpressure (airblast).
- W. Sub-drilling: The portion of the blasthole that is drilled below or beyond the desired excavation depth or limit. Subdrilling is generally required to prevent the occurrence of high or tight areas of unfractured rock between blastholes.
- X. Trial Blast. A blast or series of blasts to assist in determining the combination of blast parameters that are most appropriate to achieve the desired result as described in this special provision.
- Y. Trim (Cushion) Blasting. A controlled blasting method involving the drilling of a single row of holes which are loaded with light, decoupled, well distributed charges and are fired either after the main excavation is removed or in the last delay of a single blast.

1.04 SUBMITTALS

- A. Qualifications of Blast Control Specialist.
- B. Copies of all Colorado Blasting Licenses (must be current), including proper initiation system and construction blasting endorsements, for all blasters overseeing blasting operations.
- C. Copies of all current insurance policies.
- D. Copy of blaster's license for each blasting supervisor.
- E. Layout and design of onsite explosive storage magazines, permanent and/or mobile.
- F. Project specific blasting control plan and blasting safety plan before starting any blasting work. Do not perform any drilling or blasting work until the Contractor's safety plan and blasting control plan for such operations have been submitted and reviewed by the Owner's Representative.
- G. Pre-Blast Survey
- H. Submit after-blast reports.
- I. Submit seismic monitoring procedure.

1.05 PRE-BLAST CONDITION SURVEY

- A. A detailed pre-blast survey shall be performed and written and electronic copies provided before the commencement of any blasting operations.
- B. Make surface and/or subsurface investigations, with written consent of the structure owner to determine, as required, the current or pre-blast integrity of the structures within the plan area influenced by the blasting operations. Structures are defined as any man-made site improvement both above and below ground and may include, but not necessarily be limited to: buildings, dams, utilities and the like.
- C. Conduct any necessary seismic and acoustic tests and investigations of potential seismic and acoustic effects which may be generated by blasting operations. The results of the tests shall be

used to establish the maximum charge weight limits per delay period, the maximum number of delay elements for a single blast, powder factors and other possible contingent items.

- D. The charge weight limits, determined from the seismic and acoustic tests, shall be set at a level that will assure a 95% probability that peak particle velocities shall not exceed one (1.0) inch per second peak ground particle velocity at a distance of 100 feet from any blast. In areas where houses, businesses and structures do not encroach within 500 feet, the allowable charge may be increased such that peak ground particle velocities shall not exceed two (2.0) inches per second at a distance of 100 feet from any blast.
- E. At least one or two areas along the pipeline alignment, reasonably remote from sensitive conditions, will be set or designated for conducting the seismic and acoustic tests. Test shots will be conducted in these areas until adequate data has been collected to provide reasonable assurance that designated charge weight limits will exhibit reasonable validity for the entire project.
- F. The Contractor shall arrange for a pre-blast survey of any nearby buildings, structure, or utilities that may potentially be at risk from blasting damage. The survey method used shall be acceptable to the Contractor's insurance company. The Contractor shall be responsible for any damage resulting from blasting. The pre-blast survey shall be made available to the Engineer for review two weeks before any blasting begins. Occupants of local buildings shall be notified by the Contractor prior to the commencement of blasting.
- G. The pre-blast survey shall consist of walking the entire alignment and specific locations where blasting operations will be performed. The survey shall consist of video, still pictures and written descriptions of existing roads, signage, culverts, houses, buildings, structures, utility structures, etc. to provide a detailed account of an existing conditions. The listing and criteria shall be submitted to the Engineer for review and approval as part of the submittal requirements.
- H. The pre-blast survey shall be done on all buildings and structures with 600 feet of the blasting area. The pre-blast survey shall product the following as a minimum requirement:
 - 1. Diagrams and information as required to accurately show the building or structure existing conditions.
 - 2. Photographs of existing damage.
 - 3. Comprehensive video of the entire structure.
- I. Pre-blast surveys shall be completed by a qualified person, who has experience in blasting, rock excavation, foundation design, and building design and construction.

1.06 BLASTING CONTROL PLAN

- A. The blasting control plan shall contain sufficient information to describe the proposed blast and the material and equipment to be utilized. The blasting plan shall include the following information:
- B. Graphical and written descriptions of general location, orientation, number, diameter, depth of blast holes, and calculated powder factor. Show details of controlled blasting techniques. Include plan and vertical section drawings showing all hole locations, spacing, diameter, and loading details for typical blast holes charges. Indicate explosive types, amounts, priming method, initiator types, delay periods and locations, charge firing times, stemming type and quantities, and typical charge weights.
- C. Manufacturer's data on material and equipment including type of explosive, cartridge size, detonator, blasting monitors (both air and vibration), and other equipment required to perform the blast.
- D. Total weight of explosive in the blast and maximum weight per hole and charge weight per delay period.
- E. The sequencing, type, and manufacturer of the delays used.

- F. Provisions to ensure that fly rock does not result from the blasting operations.
- G. Methods to prevent overblasting and loosening of blocks of rock not indicated to be removed or disturbed.
- H. Anticipated vibration levels and peak particle velocities at locations specified by the Owner/Engineer.
- I. Anticipated blast decibel level at nearest dwelling.
- J. Description of the methods of monitoring for blast-induced ground vibration and air-blast overpressure.
- K. Description of the preblast inspection procedure.
- L. Plans for preventing overbreak or ground shifting that could threaten adjacent buried utilities. Plan shall include calculations showing predicted levels of vibration not exceeding the specified values.
- M. Methods of drilling, including equipment descriptions, and hole placement and alignment techniques.
- N. Hole Charging Methods: Primer makeup, placement of charges and inert stemming, and method of securing detonators until tie-in.
- O. Initiation system hook-up methods and method of primary initiation.
- P. Methods for preventing spills or losses of explosives, drilling fluids, oil, or any other pollutants to ground during handling and hole charging operations. Include details of containment and contingency plans for quickly and effectively cleaning up any spilled materials.
- Q. Method of disposal of explosives packaging materials.
- R. Copies of blasting permits, blasters' licenses, and explosives transporters' commercial driver's licenses with Hazmat endorsements.
- S. The blasting control plan shall indicate the type and method of instrumentation proposed to determine the ground motion particle velocity and air blast overpressure. The description shall include the manufacturer and model of the instrumentation and the source of the instrumentation (rented or owned and by whom). Include copies of calibration certificates issued by the equipment maker that confirm the instruments and transducers have been calibrated within the last 12 months.
- T. Design of drilling and blasting patterns, explosive types, and quantities shall be at the Contractor's choice; provided, that non-electric initiation devices shall be used and the ground motion limitations as specified herein are met with respect to explosive detonated per delay period; and provided further, that non-nitroglycerin explosive types are used in wet ground conditions, unless the dynamite is phlegmatized (i.e. PowerDitch 1000).
- U. Acceptance of the Contractor's Blasting Control Plan shall not relieve the Contractor of any of his responsibility under the Contract for assuring the complete safety of his operation with respect to adjacent improvements so as to not aggravate the existing structural conditions or cause damage, or for the successful completion of the work in conformity with the requirements of the Drawings and Standard Specifications. Such approval shall not operate to waive any of the requirements of the Standard Specifications nor relieve the Contractor of any regulation or permit obligation thereunder

1.07 BLASTING SAFETY PLAN

- A. A minimum of 21 days prior to the commencement of any work involving explosives, including drilling, submit a complete "Safety Plan for the Use of Explosives." A blasting safety plan simply stating, "all regulations will be followed" will not be acceptable. Blasting safety plan shall include:

- B. A complete list of authorities having jurisdiction over operations involving the transportation, storage, handling, and use of explosives.
- C. A printed copy of applicable federal, state, and local regulations governing the use and storage of explosives for this work.
- D. Copies of required blasting permits regarding explosive use and storage.
- E. Copies of state of Colorado blasting licenses, including proper initiation system and construction blasting endorsements, for all blasters overseeing blasting operations.
- F. A list of at least three previous projects of similar character, successfully completed. List shall include contact names and phone numbers of the Owner's responsible project manager or engineer.
- G. A complete description of the clearing and guarding procedures that will be used to ensure personnel, staff, visitors, and other persons are at safe locations during blasting. This information shall include details regarding visible warning signs or flags, audible warning signals, method of determining blast areas (areas affected by any potentially harmful blast effects), access blocking methods, guard placement and guard release procedures, primary initiation method, and the system by which the blaster-in-charge will communicate with site security guards.
- H. A detailed description of how explosives will be kept in day storage boxes when onsite and transported and used at the various project work areas. Plans shall explain how day storage magazines and explosive transport vehicles will satisfy applicable ATF, OSHA, federal, CAL/OSHA, and county regulations. This plan shall also indicate how explosives will be inventoried, secured, and guarded to prevent theft or unauthorized use of explosives.
- I. Include material safety data sheets (MSDS) and specific details about hazard communication programs for employees.
- J. Equipment that will be used to monitor the approach of lightning storms and, in the event of such, evacuation and site security plans.
- K. Detailed contingency plans for handling of misfires caused by cutoffs or other causes.

1.08 CONDUCT OF BLASTING OPERATIONS

- A. A minimum of 14 days prior to commencement of any blasting operations, provide notification to Owner of impending blast in order for Owner to notify the community.
- B. A blasting supervisor licensed by the State of Colorado, Division of Oil and Public Safety, and acceptable to the Owner's Representative shall be on the site and in immediate charge of the blasting operations. The license of the supervising blaster(s) shall contain endorsements for construction blasting and use of nonelectric initiation systems. Such supervisor shall have no less than five years of continuous experience in controlled blasting on projects of similar character. Submit a written description of the education and experience of this supervisor to the Owner's Representative. The description shall be specific and include references who are able to verify the details.
- C. Retain the services of an outside consultant, as necessary, regarding the prediction and control of ground vibration and air overpressure. Such consultant shall not be in the employ of the Contractor and shall be subject to the approval of the Owner's Representative. Submit the consultant's qualifications to the Owner's Representative in writing as part of the blasting control plan.

1.09 CONTROLLED BLASTING

- A. Material which would classify as rock and which requires drilling and blasting to remove will be

accomplished by controlled blasting. Controlled blasting is defined as the establishment of a free surface or shear plane in rock along the lines of the specified backslope by the controlled usage of explosives and blasting accessories in appropriately aligned and spaced drill holes.

- B. The Contractor shall perform short test lines of holes consisting of presplit or cushion blasting if changes in conditions warrant, to determine the loading, spacing and depth or lift required to obtain desired PGPV, air blast pressures and excavation geometry. These tests will be monitored by the Blast Consultant using Contractor supplied seismographs. As part of the blasting plan, the Contractor shall prepare graphs depicting the PGPV as function of the distance from the detonation point, for each explosion loading. Explosive loading for production blasting will then be selected from the graph to limit PGPV to less than two inches per second measured next to the closest structure adjacent to the blast.

1.10 OWNER'S REPRESENTATIVE (PROJECT MANAGER) OVERSIGHT

- A. The Contractor shall submit a copy of the Blast Consultant-approved general blast plan description and a copy of each Blast Consultant-approved individual blast plan to the Engineer and the Project Manager prior to blasting. The Contractor shall also submit a copy of their CDOT-approved traffic control plan to the Engineer and Project Manager prior to any blasting.

1.11 REPORTS AND RECORDS

- A. Prepare and maintain on site reports and records necessary for prosecution of the work, which shall be accessible to the Owner's Representative during normal working hours. Include the blast reports for any blasting work. Keep accurate records of each blast. Blasting records shall be available to the Owner's Representative at all times and shall contain the following data as a minimum:
 - B. Blast identification by numerical and chronological sequence.
 - C. Locations (referenced to pipeline stationing), dates, and times of blasts.
 - D. Type of material blasted.
 - E. Number of holes, burden, and spacing.
 - F. Diameter and depth of holes.
 - G. Height or length of stemming.
 - H. Types of explosives used.
 - I. Types of caps and delay periods used.
 - J. Total amount of explosives used.
 - K. Maximum amount of explosives per delay period of 9 milliseconds or greater.
 - L. Powder factor (pounds of explosive per cubic yard of material blasted).
 - M. Method of firing and type of circuit.
 - N. Weather conditions (including wind direction).
 - O. Direction and distance to nearest structure or position of concern.
 - P. Type and method of instrumentation.

- Q. Location and placement of instruments.
- R. Instrumentation records and calculations for determination of ground motion particle velocity or for charge size based on scaled distance.
- S. An ongoing log-log plot of both vibration and air blast data. The Contractor or his consultant shall maintain an ongoing log-log plot of both ground vibration and air blast overpressures and shall submit an updated plot to the Owner's Representative after each blast, highlighting the newest data.
- T. Measures taken to limit air overpressure and fly rock.
- U. Any unusual circumstances or occurrences during blast.
- V. Name of Contractor.
- W. Name, license number, and signature of responsible blaster-in-charge.
- X. Summary report of complaints including complaints regarding blasting-related damage.
- Y. Method of notifying other Contractor's personnel onsite of a scheduled blast.
- Z. Within 24 hours after each blast, submit to the Owner's Representative a summary report addressing the above items for compilation in a three-ring binder and have the Contractor's current blast reports so compiled and available for immediate review by authorities having jurisdiction, including the Owner and the Owner's Representative.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Provide materials and equipment for blasting operations. Materials usage, including transportation and storage, shall conform to applicable regulatory agency requirements.
- B. Non-detonating and low explosives rock blasting methods are acceptable and will not require as stringent blasting criteria and monitoring as high explosives.

2.02 SEISMOGRAPHS

- A. Provide a minimum of two portable seismographs for use on the project at all times. The seismographs shall produce a permanent record and shall meet the following technical standards
 - 1. Equipment for onsite and offsite particle velocity and air overpressure monitoring shall be four-channel units (one overpressure and three seismic channels) capable of digitally storing collected data.
 - 2. Equipment shall be capable of printing ground motion time histories and summaries of peak motion intensities and frequencies. Printed report records shall also include date, time of recording, operator name, instrument number, and date of last calibration.
 - 3. Instruments shall have a flat frequency response between 2 and 250 hertz for particle velocity and from 2 to 200 hertz for air overpressure.
 - 4. The digitizing sampling rate for PPV and air overpressure measurements shall be at least 1,024 samples per second.
 - 5. Seismographs used for offsite compliance monitoring shall be capable of recording overpressure from 88 to 148 dBL and particle velocity from 0.05 to 5.0 inches per second.
 - 6. Systems shall be capable of providing printed event reports that include all peak measurements, frequencies, and complete waveform plots.

7. Seismographs shall have adequate memory to digitally record events of the blast-induced motion lasting up to five seconds.
8. Seismograph software systems shall be capable of saving backup copies of all event files on removable disks in file formats supported by software that can open and interpret stored data. Upon request of the Owner's Representative, provide a licensed copy of the appropriate software and monitoring data files to the Owner.

2.03 VIBRATION AND AIR OVERPRESSURE MONITORING EQUIPMENT

- A. Vibration and air overpressure measuring equipment shall be used in accordance with the standards established by the Vibration Section of ISEE.

PART 3 EXECUTION

3.01 BLASTING HOURS

- A. Blast only between the hours of 9 a.m. and 4 p.m. during any weekday, Monday through Friday, unless special circumstances warrant another time or day and special approval is granted in writing by the Owner and the agency having jurisdiction. For any blasting within 1,200 feet of a residence or commercial structure, blast only between the hours of 9 a.m. and 4 p.m.
- B. At least 24 hours notice shall be provided of where and when the next days blasting will occur.

3.02 BLAST DESIGN

- A. Design of drilling and blasting patterns, explosive types, and quantities shall be the Contractor's choice. Use nonelectric initiation devices. Ensure the specified ground motion limitations are met with respect to explosives detonated per delay period. Use non-nitroglycerin explosive types in wet ground conditions, unless the dynamite is phlegmatized, i.e., PowerDitch 1000.
- B. Design each blast to avoid damage to existing facilities, adjacent property and completed work. Consider effects of blast-induced vibrations and air blast, and fly rock potential in design of each blast.
- C. Whenever peak particle velocity exceeds vibration limits, change design of subsequent blasts as necessary, to reduce peak particle velocity to within limits established by Contractor's Blast Control Specialist.
- D. Whenever air blast exceeds limits, change design of subsequent blasts or provide controls necessary to reduce air blast to within specified limits.

3.03 BLASTING OPERATIONS

- A. As production blasting operations progress, the drilling and blasting procedures shall be determined only by satisfactory results achieved. If a drilling and blasting program results in unacceptable results, devise and employ methods that will improve results. The revision may include special methods such as zone blasting, shorter holes, different delay patterns, reduction in size of individual blasts, smaller diameter blast holes, closer spacing of blast holes, or reduction of explosives as necessary to improve results.
- B. Only properly trained workers under the direct supervision of a state-licensed blaster shall do blasting. Blasting shall be done only when proper precautions are taken for the protection of persons, the work, and existing structures. Any damage done to persons, private property, the work, or existing structures shall be the responsibility of the Contractor.

3.04 FLY ROCK CONTAINMENT

- A. Control fly rock and debris to prevent damage to persons or structures. Use blasting mats in developed areas. Equipment used for drilling of holes shall have a positive means of dust control. Contain fly rock within the project rights-of-way so that it shall not represent a hazard to people, vehicles, existing improvements, or vegetation. Clean the blasting site of debris associated with the blasting operation at the end of each working day.
- B. Before the firing of any blast, the rock to be blasted shall be covered with approved blasting mats, soil, or other equally serviceable material, to prevent fly rock that may result in damage to life or property.
- C. The homeowners/renters determined to be in the design fly rock zone for a particular blast shall be notified 24 hours in advance of the pending blast, and at least two hours prior to the blast so that they may temporarily relocate during the blast. Signature along the roadway shall be used to supplement the notification process.
- D. Suggested methods of protecting structures and utilities from the effects of the blasting, blast induced fly rock, vibration, and air blast overpressure include, but are not limited to the following:
 - 1. New sisal rope blasting mats
 - 2. Wire rope or tire blasting mats
 - 3. Backfilling
 - 4. Stemming full depth
 - 5. Reduced explosive loads
 - 6. Use of millisecond delays
 - 7. Relocation of any or all existing utility lines
- E. The Contractor shall protect all overhead and underground utilities prior to blasting and immediately repair or replace any damaged by the blasting operations. If the Contractor wishes to temporarily relocate any utility lines that lie near a blast zone, he shall have written approval from the governing utilities and pay all relocation costs.
- F. If fly rock travels beyond the design fly rock zone limits, all blasting operations shall cease. The Contractor shall review the site and determine the cause and solution to the fly rock problem. Before any further blasting proceeds, a written report, prepared by the Contractor shall be submitted to the Engineer. In the event that the Contractor and the Engineer cannot reach an agreement on the cause and solution to the fly rock problem, progress payments shall be suspended until an agreement is achieved.
- G. If after review of the report, the Engineer determines that the design fly rock zone shall be re-established and additional residences notified, all new homeowners/renters shall be offered the same temporary relocation benefit of \$250.00 for each blast event.
- H. Failure to pay the temporary relocation benefits due or to resolve fly rock incidents in a timely manner, as indicated in the Specifications, will result in delay of progress payments.
- I. Delays caused by fly rock incidents do not constitute grounds for extension of Contract Time.
- J. If more than three fly rock incidents occur, at the option of the OWNER, the Contractor may be fined \$10,000 for each additional occurrence. A fly rock incident is defined as any fly rock that hits private property.

3.05 VIBRATION AND AIR BLAST MONITORING

- A. Monitor on, or at, structures or other facilities that are closest to point of blasting. Monitor more distant facilities that are expected to be sensitive to blast induced vibrations and air blast.
- B. The closest structure, as determined by the Engineer, shall be monitored at the wall and at 50 feet away. This procedure and locations may be modified by the Engineer/Owner's representative based on field conditions and blast location and if low pressure blasting is performed.
- C. The Contractor's Blast Control Specialist shall supervise establishment of monitoring programs and initial operation of equipment, review interpretation of records and recommended revisions of blast designs.

3.06 SAFETY PROCEDURES - WARNINGS AND SIGNALS

- A. The Contractor shall establish a method or warning all employees on the job site of an impending blast. The signal should consist of a five minute warning signal to notify all in the area that a blast shall be fired within a five minute period. A second warning signal shall be sounded one minute before the blast. After the blast is over, there shall be an "all clear" signal sounded so all in the area understand that all blasting operations are finished.
- B. Five minutes prior to the blast, five long signals on an air horn or siren shall be sounded. One minute prior to the blast, five short signals on an air horn or siren shall be sounded. The "all clear" shall be one long signal of at least 30 seconds in duration to indicate that all blasting has ceased.

3.07 BLASTING PROCEDURES

- A. Do not perform blasting closer than 5 feet to existing water, gas, sewer, or other buried utilities.
- B. Use controlled blasting techniques to keep the air blast overpressure, vibrations, and noise within the specified limits. Minimize overbreak or fracturing of rock beyond the designated excavation boundaries. Excessive blasting will not be permitted. Material outside the authorized cross-section, which may be shattered or loosened because of blasting, shall be removed at the Contractor's expense and the area repaired. Discontinue any method of blasting that leads to overshooting, is hazardous in any way to persons, or destructive to property or habitat.
- C. Regardless of the ground motion and air-overpressure limits set forth herein, controlled blasting shall be conducted in a manner which will produce relatively smooth and sound rock faces at the final excavation lines. The type, distribution and quantity of explosive detonated per delay period shall be such that existing rock fractures will neither be opened nor new fractures created outside of the minimum excavation limits. Whenever, in the opinion of the Owner's Representative or independent Inspector, further blasting is liable to reduce rock stability or damage pipelines or other structures, the Contractor shall cease blasting and continue to excavate the rock by approved mechanical means. Excessive blasting or "overshooting" will not be permitted, and any material outside the authorized cross-section which may be shattered or loosened by blasting shall be removed and replaced with acceptable materials at the Contractor's expense.
- D. Blasting shall be done only by properly trained workers under the direct supervision of a State-licensed Blasting Supervisor. Blasting shall be done only when proper precautions are taken for the protection of persons, the work, and existing structures. Any damage done to persons, private property, the work, or existing structures shall be the responsibility of the Contractor.
- E. Notify the Engineer/Owner at least seven workdays before blasting within 300 feet of a residence or commercial building.
- F. No cell phone, 2-way radio or remote communication devices shall be used within 300 feet of the blasting area.

- G. All traffic shall be stopped within 1,000 feet of the blasting area in all directions during the blast.
- H. Suspend blasting operations for any of the following reasons:
 - 1. Ground motion vibration levels exceed specified limits of particle velocity or frequency.
 - 2. Existing structural conditions are aggravated or adjacent improvements are damaged as a result of blasting.
 - 3. Blasting methods endanger the stability of intact rock outside the prescribed limits of excavation.
 - 4. Skilled operators and/or licensed foreman is not present.

Blasting operations shall not resume until modifications have been made to correct the conditions that resulted in the suspension. Repair or replace any damage caused by blasting. Repair or replace any damage resulting from possession or use of explosives for the work.

3.08 CHECK FOR MISFIRES

- A. The Contractor shall observe the entire blast area for a minimum of five minutes following a blast to guard against rock fall before commencing work in the cut. The five minute delay between blasting and allowing anyone but the Blast Control Specialist to enter the area is needed to make sure that no misfires have occurred.
- B. During the five minute delay, it is the Blast Control Specialist's responsibility to go into the shot area and check all holes to make sure that they have detonated. If any holes have not fired, the Blast Control Specialist shall handle these misfires before others enter the work area.
- C. The Engineer shall, at all times, have the authority to prohibit or halt the Contractor's blasting operations if it is apparent that through the methods being employed, the required slopes are not being obtained in a stable condition or the safety and convenience of the public is being jeopardized.

3.09 MISFIRE HANDLING PROCEDURES

- A. Should a visual inspection indicate that complete detonation of all charges did not take place, the following procedures shall be followed:
 - 1. If the system was energized and no charges fired for electric systems, the lead wire shall be tested for continuity prior to inspection of the remainder of the blast. For non-electric systems, the lead-in or tube shall be checked to make sure that detonation has entered the blast area.
 - 2. Should an inspection of the electrical trunk line or lead-in tubing line indicate that there is a break in the line or if the tubing did not fire, then the system shall be repaired and the blast re-fired. If the inspection indicates that the trunk line has fired, and misfired charges remain, the Blast Control Specialist shall perform the following:
 - a. The Blast Control Specialist shall exclude all employees except those necessary to rectify the problem
 - b. Traffic shall be closed if a premature explosion could be a hazard to nearby traffic
 - c. The Blasting Consultant shall correct the misfire in a safe manner. If the misfire poses a problem that cannot be safely corrected by the Blasting Consultant, then an explosive company representative skilled in the art of correcting misfires shall be called to rectify the problem.

3.10 BLASTING LIMITATIONS

- A. Do not use explosives as a means of transporting material outside the excavation prism.

- B. Holes for blasting shall be a nominal 3 inches or less in diameter and shall not be sprung or chambered.
- C. Design blast patterns such that the explosive energy is not directed into the sidewalls of the excavation but, instead, towards the developed free face.
- D. The quantity, quality, and use of explosives shall not open seams or otherwise damage rock outside the prescribed limits of excavation. Control the firing systems of general blast holes by the use of delay detonators. Explosives used for a single period of delay shall be the minimum required.
- E. Illumination levels for safe working conditions at the site shall be in accordance with the levels set forth in CFR, Title 29.
- F. When water is present in blast drill holes, use a non-nitroglycerin explosive product to prevent drill-hole-to-drill-hole propagation and to ensure that delay patterns are effective.

3.11 BLASTING RECORDS

- A. For each blast, document the following:
 - 1. Location of blast in relation to the coordinate system and elevations
 - 2. Date and time of loading and detonation of blast
 - 3. Number of blasts
 - 4. Name of person in responsible charge of loading and firing
 - 5. Plan view and section view of each blast with notes indicating free face, burden, spacing height of lift, hole diameter, stemming depth, hole angle, hole depth, subdrill depth
 - 6. Notes regarding conditions encountered in the drill holes, including soft or fractured zones, water table alignment problems
 - 7. Loading diagram indicating types and amounts of explosives, primers, initiators, stemming depth, powder factors, trade names, and sizes of explosives, primers and initiators
 - 8. Sequence plan of the shot, including surface delay times and initiator's delay times
 - 9. Comments by blaster-in-charge regarding damage to existing facilities, adjacent property, or completed work, misfires, fly rock occurrences, unusual results, or unusual effects

3.12 DAILY EXPLOSIVE MATERIAL CONSUMPTION AND LOSS

- A. The Contractor shall keep a daily record of transactions to be maintained at each storage magazine. Inventory records shall be updated at the close of every business day. The records shall show the class and quantities received and issued and total remaining on hand at the end of each day. Remaining explosive inventory shall be checked each day, and any discrepancies that would indicate a theft or loss of explosive material would be immediately reported.
- B. All holes drilled and loaded shall be set off and shot that day. No explosives shall be allowed to sit overnight once they are loaded into the hole.
- C. Should a loss or theft of explosives occur, all circumstances and details of the loss or theft shall be immediately reported to the nearest office of Alcohol, Tobacco & Firearms, local law enforcement authorities and the Engineer.

3.13 BLASTING SUPERVISORS

- A. Assign licensed blasting supervisors with experience in the use of explosives for underground excavation to the blasting operations and maintain on a full-time basis during the period of blasting.

The supervisors who hold blasting licenses shall be physically present to perform or direct and supervise blasting operations.

3.14 MAXIMUM PARTICLE VELOCITIES

- A. The maximum peak particle velocity at the nearest point to pipelines shall be 5.0 inches per second at a minimum frequency of 10 hertz. In the event neither of these limitations is met, perform excavations, repair as necessary, and backfill the excavations whether damage is discovered or it is determined no damage has been incurred.
- B. The maximum peak particle velocity at any other structure within 100 feet of the blast area shall be 1.0 inch per second at frequencies of 40 hertz or less. Where businesses, houses and structures do not encroach within 500 feet of the blast area, the allowable charge may be increased such that the peak ground particle velocity shall not exceed 2.0 inches per second at a distance of 100 feet from the blast.

3.15 AIR BLAST OVERPRESSURE

- A. Three air blast-monitoring systems shall be installed between the main blasting area and the nearest structures subject to blast damage or annoyance. The equipment used to make the air blast measurements shall be the type specifically manufactured for that purpose.
- B. Air overpressure at residential or other occupied structures shall not exceed 0.012 psi (133 dBL). Appropriate blast hole patterns, detonation systems, and stemming shall be used to prevent venting of blasts and to minimize air blast and noise levels produced by the blasting operations. The overpressure limit shall be lowered if it proves too high based on damage.
- C. A permanent signed and dated record of the peak overpressure measurements shall be furnished to the Engineer immediately after each shot.

3.16 SUSPENSION OF BLASTING

- A. If damage to existing facilities or adjacent property occurs due to blasting, immediately suspend blasting and report damage to the Blast Consultant, the Engineer, and the Project Manager.
- B. Before resuming blasting operations, adjust design of subsequent blasts, or take other appropriate measures to control effects of blasting and submit complete description of proposed changes for reducing potential for future damage to the Blast Consultant.
- C. Do not resume blasting until authorized by the Blast Consultant.

3.17 FIELD MEASUREMENT

- A. Measure PPV with a seismograph capable of producing a permanent record and capable of internal dynamic calibration. Record air blast overpressure with a peak impact-recording instrument having linear frequency response. Place a seismograph at the nearest structure to the blast area to monitor the ground motion particle velocity and frequency during each blast.

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SECTION 312310
EXCAVATION, BACKFILL, AND COMPACTION

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Excavate, backfill, compact and grade as required for the site underground utility and process piping systems, structure foundations and appurtenances as shown on the Drawings and specified herein.

1.02 GENERAL

- A. With reference to the terms and conditions of the construction standards for excavations set forth in the OSHA "Safety and Health Regulations for Construction", Chapter XVII of Title 29, CRF, Part 1926, the Contractor shall employ a competent person and, when necessary, a registered Professional Engineer, to act upon all pertinent matters of the Work of this section.
- B. The Contractor is, and the Owner and Engineer are not, responsible to review or assess the Contractor's safety precautions, programs or costs, or the means, methods, techniques or technique adequacy, reasonableness of cost, sequences or procedures of any safety precaution, program or cost, including but not limited to, compliance with any and all OSHA requirements. The Contractor is, and the Owner and Engineer are not, responsible to determine if any safety or safety related standards apply to the project.
- C. Classification of Excavation: Excavated material will not be classified with reference to type, and the terms "excavation" and "trenching" shall include all material encountered without regard to its physical properties, characteristics or composition.

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM):

D 698	Moisture-Density Relations of Soils Using 5.5 lb. (2.5 kg) Rammer and a 12 inch (304.8 mm) Drop.
D 1556	Density of Soil in Place by the Sand-Cone Method.
D 1557	Moisture-Density Relations of Soils Using 10 lb. (4.54 kg) Rammer and a 18 inch (457 mm) Drop.
D 2167	Density of Soil in Place by the Rubber Balloon Method.
D 448	Standard Sizes of Coarse Aggregate for Highway Construction.
D 2922	In Place by Nuclear Methods (Shallow Depth).

B. American Association of State Highway and Transportation Officials (AASHTO):

T 99	Moisture Density Relations of Soils, Using a 5.5 lb. (2.5 kg) Rammer and a 12 inch (305 mm) Drop.
T180	Moisture-Density Relations of Soils Using 10 lb. (4.54 kg) Rammer and a 18 inch (457 mm) Drop.

C. Colorado Department of Transportation:

2011 Edition	Standard Specifications for Road and Bridge Construction
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D. Military Standard (MIL-STD-619):

MIL-STD-619B

Unified Soil Classification System for Roads, Airfields, Embankments and Foundations.

E. Federal Register - Occupation and Safety Administration (OSHA):

29CFR Part 1926

Occupation Safety and Health Standards - Excavations.

1.04 SUBMITTALS

- A. General: Submit information and samples to the Engineer for review as specified herein in accordance with the entitled "Submittals".
- B. Bedding and Backfill Materials: Prior to any earthwork, the Contractor shall submit a sieve analysis and Proctor Curves for the existing soils to be used as backfill and the proposed bedding and backfill materials to Engineer for review and approval.
- C. Dewatering: The Contractor shall submit to the Engineer his proposed methods of handling ground water and the locations at which the water will be disposed of. Methods shall be acceptable to the Engineer before starting the excavation. The contractor shall obtain the necessary permits before starting and excavating.
- D. Sheet piling System: Drawings and design computations of any proposed sheet piling system shall be submitted to the Engineer; however, the review of these Drawings shall in no way relieve the Contractor of the responsibility to provide a safe and satisfactory sheet piling and shoring system. Sheet piling and shoring shall be designed by the Contractor, and the proposed design shall be sealed by a Professional Engineer registered in the State of Colorado. If the Engineer is of the opinion that at any point sufficient or proper supports have not been provided, he may order additional supports put in at the Contractor's expense.

1.05 QUALITY CONTROL

- A. Prior to the placement of any excavated or borrowed soils, each type of soil approved for backfill shall have a Standard Proctor Curve developed to indicate the moisture-density relationship required to obtain maximum density.
- B. A qualified soils engineer or geologist selected by the Contractor, approved by the Engineer and paid for by the Contractor shall be responsible for developing all required proctor curves and in-place density tests. The results shall be submitted to the Engineer for approval and used in determining the acceptability of the soils placed in accordance with the requirements of the section entitled "Earthwork". The Contractor shall coordinate and cooperate in the performance of the required testing. Do not place any footing reinforcing until the excavations have been tested for compaction.

1.06 SUBSURFACE INFORMATION

- A. The Contractor shall satisfy himself as to the character and amount of different soil materials, groundwater and the subsurface conditions to be encountered in the work to be performed. Information and data, when furnished, are for the Contractor's general information. However, it is expressly understood that any interpretation or conclusion drawn there from is totally the responsibility of the Contractor. Engineer and Owner assume no liability for the accurateness of the data reported or the materials used.

1.07 PROTECTION OF PROPERTY AND STRUCTURES

- A. The Contractor shall, at his own expense, sustain in place and protect from direct or indirect injury, all pipes, poles, conduits, walls, buildings, and all other structures, utilities, and property in the vicinity of his work. Such sustaining shall be done by the Contractor. The Contractor shall take all risks attending the

presence or proximity of pipes, poles, conduits, walls, buildings, and all other structures, utilities, and property in the vicinity of his work. He shall be responsible for all damage, and assume all expenses, for direct or indirect injury and damage, caused by his work, to any such pipe, structures, etc., or to any person or property, by reason of injury to them, whether or not such structures, etc., are shown on the Drawings.

- B. Barriers shall be placed at each end of all excavations and at such places as may be necessary along excavations to warn all pedestrian and vehicular traffic of such excavations. Barricades with flashing lights shall also be placed along excavation from sunset each day to sunrise of the next day until such excavation is entirely refilled, compacted, and paved. All excavations shall be barricaded where required to meet OSHA, local, and Federal Code requirements, in such a manner to prevent persons from falling or walking into any excavation.

PART 2 PRODUCTS

2.01 EXCAVATED MATERIALS

- A. Excavated Materials shall be as specified in the section entitled "Earthwork".

2.02 BEDDING MATERIALS

- A. CMP and CSP Storm Sewer Lines: Bedding material shall be crushed rock (3/4" Base Course) having the following characteristics:

Passing a 3/4 inch sieve	100%
Passing a No. 4 sieve	30-60%
Passing a No. 8 sieve	25-55%
Passing a No. 200 sieve	8-15%

- B. PVC and DIP Raw Water Pipeline: Bedding material shall be crushed rock (3/4" Base Course) having the following characteristics:

Passing a 3/4 inch sieve	100%
Passing a No. 4 sieve	30-60%
Passing a No. 8 sieve	25-55%
Passing a No. 200 sieve	8-15%

2.03 BACKFILL MATERIALS

- A. Backfill materials shall be furnished as required from on-site excavations or from acceptable off-site sources as required. Backfill material shall meet or exceed the requirements set forth in the section entitled "Earthwork". Broken Portland cement or asphaltic concrete will not be considered an acceptable fill material.
- B. Trench Backfill
 1. Backfill material for backfilling trenches for the first 1' above the top of the bedding material shall be approved selected material taken from the trench or other excavation, suitable for compaction and free of large clods or rocks over 3 inches in the largest dimension and free of debris.
 2. Backfill material for backfilling trenches for the remainder of the trench shall be approved selected material taken from the trench or other excavation, suitable for compaction and free of large clods or rocks over 24 inches in the largest dimension and free of debris.
 3. Flowable mortar fill material shall be as specified in Section 033000 "Cast in Place Concrete".

C. Building Backfill

1. Backfill within buildings shall be limited to materials classified as SC, ML and CL by MIL-STD-619 or Class 1 structure backfill material per CDOT having the following characteristics:

Passing a 2 inch sieve	100%
Passing a No. 4 sieve	30-100%
Passing a No. 50 sieve	10-60%
Passing a No. 200 sieve	5-20%

2.04 GRAVEL BASE

- A. Gravel base for all concrete structures shall be clean, crushed, nonporous rock as graded below:

1. Crushed, nonporous rock maximum particle size shall be crushed rock aggregate No. 6 per AASHTO M43 having the following characteristics:

Passing a 1 inch sieve	100%
Passing a 3/4 inch sieve	90-100%
Passing a 1/2 inch sieve	20-55%
Passing a 3/8 inch sieve	0-15%
Passing a No. 4 sieve	0-5%
Deleterious Substances, (max.)	5%.

2. Aggregates shall be washed, tested and conform to gradation as required by CDOT Standard Specification for State Road and Bridge Construction. Aggregates for Underdrain Installation, Type UD-1 (Section 703).

2.05 STABILIZING MATERIAL FOR TRENCH BOTTOMS AND STRUCTURE SUBGRADE

- A. Wet or unstable trench bottoms and structure subgrade shall be stabilized by excavating to additional depth as directed by the Engineer and replacing the unsatisfactory soil with crushed rock with angular shapes for high interlocking capability graded as follows:

1. 4-inch to 8-inch primary crusher run.
2. 3-inch to 4-inch crusher run.
3. 1 1/2-inch poorly graded.
4. 3/4-inch poorly graded.
5. Specification bedding material.

- B. Field conditions shall be the determining factor for individual or combined use of these materials. The upper 2-inches of any stabilized area shall consist of specification bedding material. In pipeline trenches, the minimum depth of bedding material shall be 4-inches under the pipe.

PART 3 EXECUTION

3.01 WETLAND BEST MANAGEMENT PRACTICES AND MITIGATION OF ADVERSE IMPACTS

- A. See the Section entitled "Temporary Environmental Controls" for these requirements.

3.02 TRENCH EXCAVATION

- A. The Contractor shall perform all excavation of every description and of whatever substance encountered,

to the dimensions, grades and depths shown on the Drawings, or as directed. All excavations shall be made by open cut. All existing utilities such as pipes, poles and structures shall be carefully located, supported and protected from injury; in case of damage, they shall be restored at the Contractor's expense.

- B. The width of the trench from the bottom to a point 12 inches above the top of the pipe shall be such that the clear space between the trench walls for 6-inch pipe and smaller shall maintain a minimum trench width of 12 inches and for 8-inch pipe and larger shall maintain a minimum trench width of 1-1/2 times the pipe diameter but not less than 18 inches. All pipe trenches shall be excavated to a level where suitable material is reached, a minimum of 4 inches below the pipeline that will allow for a minimum of 36" of covering unless otherwise indicated on the Drawings. Excavation depths in other types of materials and conditions shall be made as hereinafter specified.
- C. In areas where trench widths are not limited by right-of-way and/or easement widths, property line restrictions, existing adjacent improvements, including pavements, structures and other utilities, and maintenance of traffic, the trench sides may be sloped to a stable angle of repose of the excavated material but only from a point one foot above the crown of the pipe. A substantially and safely constructed movable shield, "box" or "mule" may be used in place of sheeting when the trench is opened immediately ahead of the shield and closed immediately behind the shield as pipe laying proceeds inside the shield.
- D. Ladders or steps shall be provided for and used by workmen to enter and leave trenches.
- E. Excavation for appurtenances shall be sufficient to provide a clearance between their outer surfaces and the face of the excavation or sheeting, if used, of not less than 12 inches.
- F. Excavated unsuitable material shall be removed from the site and disposed of by the Contractor. Materials removed from the trenches shall be stored in such a manner that will not interfere unduly with construction operations, traffic on public roadways and sidewalks and shall not be placed on private property. In congested areas, such materials as cannot be stored adjacent to the trench or used immediately as backfill shall be removed to other convenient places of storage acceptable to the Owner at the Contractor's expense.
- G. Stones shall be removed as necessary to avoid point bearing. Where rock excavation is required in trenches for pipe, the rock shall be excavated to a minimum overdepth of 6 inches below the trench depths indicated or specified and backfilled to the pipe bearing or bedding with the bedding material specified. Backfill material shall be thoroughly compacted to form a stable trench bottom.
- H. Where soil at designated elevations of pipelines is judged by the Engineer to be of an unstable character the Engineer may require that the trench be overexcavated as directed and backfilled to the pipe bearing or bedding with the bedding material specified. Backfill material shall be thoroughly compacted to form a stable trench bottom.

3.03 STRUCTURE EXCAVATION

- A. All excavation shall be made in such a manner, and to such widths, as will give ample room for properly constructing and inspecting the structures they are to contain. Excavation shall be made in accordance with the details shown on the Drawings, and as specified herein. Attention shall be given to the handling of storm water runoff.
- B. The entire area to be covered by the structures shall be excavated as shown by details on the drawings to elevations of the footings, foundations and floor slabs. Highly organic soils (peat or muck), weak silty materials, asphalt and concrete shall be removed from all foundation areas. In addition, all sandy silt zones shall be completely removed from mat foundation and footing areas.
- C. Footings, foundations and floor slabs shall be excavated to neat lines as shown on drawings, and shall be formed as required by site conditions. Excavations shall be carried outside slab or footing limits by one foot for each foot excavated below the bearing grade of the mat or footing.

- D. Sheet piling may be used in lieu of open cut. Unless specifically specified otherwise, if sheet piling is utilized, the piling must be removed as the backfill is replaced.

3.04 UNAUTHORIZED EXCAVATION

- A. Excavation Work carried outside of the Work limits required by the Contract Documents shall be at the Contractor's expense, and shall be backfilled by the Contractor at his own expense as directed by the Engineer. Where, in the judgment of the Engineer, such over-excavation requires use of lean concrete or crushed stone, the Contractor, at his expense shall furnish and place such materials.

3.05 SHEETING AND BRACING

- A. Trenches: The Contractor shall furnish, place and maintain sheeting and bracing to support sides of the excavation as necessary to provide safe working conditions in accordance with OSHA requirements, and to protect pipes, structures and other Work from possible damage.
 - 1. Where wood sheeting or certain designs of steel sheeting are used, the sheeting shall be cut off at a level of 2 feet above the top of the installed pipe and that portion below the level shall be left in place.
 - 2. If interlocking steel sheeting is used, it shall be removed providing removal can be accomplished without disturbing the bedding, pipe or alignment of the pipe.
 - 3. Any damage to the pipe bedding, pipe or alignment of the constructed utility caused by the removal of sheeting shall be cause for rejection of the affected portion of the work. The Owner may permit sheeting to be left in place at the request and expense of the Contractor.
- B. Structures: The walls of the excavation shall be sloped and, if required to protect the safety of workmen, the general public, this or other Work or structure, or excavation walls, the excavation shall be properly sheeted and braced for conditions encountered and OSHA requirements.
 - 1. Excavation for the structures shall be sufficient to provide a clearance between their outer surfaces and the face of the excavation, sheeting, or bracing, of not less than 2 feet.
 - 2. Materials encountered in the excavation which have a tendency to slough or flow into the excavation, undermine the bank, weaken the overlying strata, or are otherwise rendered unstable by the excavation operation shall be retained by sheeting, stabilization, grouting or other acceptable methods.
 - 3. Sheeting shall be removed provided its removal will not jeopardize existing or new pipes or structures. Sheeting left in place shall not interfere with new pipes or structures. Any sheeting left in place shall be cut-off 2 feet below finish grade, or as directed. The Contractor will not receive extra compensation for sheeting left in place or the cut off Work required.
- C. If the Engineer is of the opinion that at any point sufficient or proper supports have not be provided, he may order additional supports put in at the Contractor's expense. The Contractor shall be responsible for the adequacy of all sheeting used and for all damage resulting from sheeting and bracing failure or from placing, maintaining and removing it.

3.06 CONTROL OF WATER

- A. The utilities and structures have been designed to be constructed by open cut and constructed in a dry condition. All dewatering shall be provided at the Contractor's expense.
 - 1. Structures excavations below water table shall require a dewatering system to prepare the base of the excavation. The dewatering system shall remove water approximately two feet to three feet below the bottom of the excavation.
 - 2. If ground water is within twelve to twenty-four inches from the ground surface, it will be necessary to lower the ground water to permit effective compaction. The Contractor shall develop feasible procedures for dewatering.

3. Proof roll the exposed stripped and excavated surface area until a soil density of 95 percent of maximum modified Proctor Density (ASTM D-1557) has been achieved twenty-four inches below the exposed compacted surface. Test compaction as specified. Add water if necessary to bring up moisture to optimum levels. Replace all material if determined to be deleterious in areas that "yield" during the final rolling operation and replace with suitable fill material.
- B. Surface Water:
1. Surface water shall be diverted to prevent entry to trenches and excavations for structures.
 2. In the event surface water does accumulate in trenches and other excavations, the excavations shall be dewatered as necessary to permit the proper execution of the work.
- C. Ground Water: Where ground water is encountered, trenches and structure excavations shall be dewatered as necessary to permit the proper execution of the work.
1. The Contractor shall provide pumps, well points, and other appurtenant equipment necessary to remove and maintain water at such a level as to permit construction in a dry condition as specified except where authorized tremie concrete construction Work is shown or permitted. The groundwater level shall be controlled so as to permit the placing of pipelines and structure foundations, curing of concrete, and the maintenance of supporting foundations and adjacent Work and structures. The dewatering system and points of discharge shall be subject to permitting, reviews, and acceptance by the Engineer before installation. Disposal of water to any surface water body will require silt screens.
 2. The Contractor shall use dewatering systems that include automatic starting devices, and standby pumps that will ensure continuous dewatering in the event of an outage of one or more pumps. He shall be totally responsible for protecting structures from flotation until final acceptance of the Work. The Contractor shall also modify the dewatering system during the course of construction to satisfy faults, legitimate complaints, or legal requirements.
- D. Pipelines in place shall not be used for draining trenches.

3.07 TRENCH BACKFILL AND COMPACTION

- A. Backfill trenches only after pipelines, joints and bedding have been inspected and approved.
- B. All pipes shall be laid in bedding material compacted as specified for 95% Compaction. A bed of bedding material shall be placed at the bottom of the trench and up to the spring line of the pipe for VCP, DIP, RCP, CSP, CMP (plain and Smooth-Flo) and C 900/905 PVC pipes; up to the top of the pipe for Ultra-Flo CMP; and to one foot above the top of the pipe for SDR 35 and ASTM F679-PS46 PVC gravity sewer pipe as detailed on the Drawings. Bedding material shall be placed, sliced under the haunches of the pipe with a shovel or other suitable tool, and compacted to sufficient depth to provide uniform bearing for the bottom 180-degree arc of the pipe. Additional layers of selected material not exceeding six (6) inches in thickness shall be placed, thoroughly tamped and compacted until the pipe is covered to a depth of not less than two feet. Bedding material shall be installed uniformly on both sides of the pipe and compacted at the same time.
1. Aggregate material of the same gradation specified for bedding may be used in lieu of the selected material up to the one foot minimum cover over the top of the pipe.
- C. Compaction for the remainder of the backfill shall be as follows:
1. Under areas to be paved or aggregate surfaced and under curbs, backfill around structures, or as noted on the plans, compaction shall be Type "A" (mechanical tamped). After selected backfill and compaction to 12" over the pipe, the backfill shall be composed of selected excavated materials free from large clods, rocks, debris or junk and shall be deposited in six (6) inch loose layers at optimum moisture content ($\pm 2\%$) and compacted to a minimum of ninety five (95) percent of maximum density as determined in accordance with AASHTO T 180. The backfill material shall be properly "worked" to ensure the absence of shrinkage and swell potential for a stable subgrade.
 2. Backfill for the remaining areas and as noted on the Drawings shall be Type "AB" compaction.

After selected backfill and compaction to 12" over the pipe, the backfill shall be composed of selected excavated materials free from large clods, rocks, debris or junk and shall be deposited in six (6) inch loose layers at optimum moisture content ($\pm 2\%$) and compacted to a minimum of ninety five (95) percent of maximum density as determined in accordance with AASHTO T 180.

D. Flowable mortar fill material may be used for backfilling utility trenches in street or alley right-of-way and under pavement. This work shall consist of placing flowable mortar fill material in all trenches where the excavation occurs within two feet of an existing or future street, sidewalk, or alley.

1. Flowable mortar shall be discharged from the mixer by a reasonable means into the trench area to be filled. Filling operations shall proceed simultaneously on both sides of the pipe or conduit so that the two fills are kept at approximately the same elevation at all times. Flowable mortar shall be placed from the bottom of the trench to the bottom of the existing or future pavement.
2. Placement of flowable mortar fill shall be in accordance with the requirements of Section 033000 "Cast in Place Concrete".
3. The Contractor shall provide an external means of holding the pipe in place while placing and curing fill to resist the pipeline's tendency to "float" when placed in flowable mortar fill. Place pipe that is to be embedded in flowable mortar fill in proper position on temporary supports consisting of wood blocks or bricks with wood wedges. Anchor or weight the pipe to prevent floatation when the concrete is placed.
4. The flowable mortar fill shall be placed to the bottom of existing or future pavement with no embedment placed around the pipe or conduit, unless otherwise specified in the Contract Documents.

E. Additional Excavation And Backfill

1. Where organic material, such as roots, muck, or other vegetable matter, or other material which, in the opinion of the Engineer, will result in unsatisfactory foundation conditions, is encountered below the level of the proposed pipe bedding material, it shall be removed to a depth of two feet below the outside bottom of the pipe or to a greater depths as directed by the Engineer and removed from the site. Sheeting shall be installed if necessary to maintain pipe trenches within the limits identified by the Engineer. The resulting excavation shall be backfilled with suitable backfill material, placed in 12-inch layers, tamped and compacted up to the level of the bottom of the proposed pipe bedding material. Sufficient compaction of this material shall be performed to protect the proposed pipe against settlement. Construction shall then proceed in accordance with the provisions of Article 3.06 "Trench Backfill and Compaction..
2. Additional excavation (more than two feet below the pipe) as indicated on the trench detail shall be performed only when ordered by the Engineer. Where organic or other material is encountered in the excavation, the Contractor shall bring the condition to the attention of the Engineer and obtain his determination as to whether or not the material will require removal, prior to preparing the pipe bedding. The excavation of material up to a depth of two feet below the outside bottom of the pipe, incidental items of construction, and the Work shall be done at the Contractor's expense. Where ordered by the Engineer, the additional excavation, backfill and additional sheeting, if required, below two feet below the outside bottom of the pipe, shall be paid in accordance with the Change Order procedure specified in the General Conditions.

F. Trench Plugs

1. Impervious trench plugs shall be installed along every utility line. Trench plugs shall consist of dense clay material free of rocks and vegetation, native or imported material that has a permeability rate either the same or less than that of the native material. Bentonite may be added and thoroughly mixed with existing material to create an impervious plug. The trench plug shall be constructed by discontinuing the bedding material all around the utility line and installing approved trench plug material which shall be moisture conditioned and mechanically compacted to the same density as the adjoining backfill material.
2. Trench plugs are required on both sides of all stream, river, water body or wetland. In addition, trench plugs shall be installed at the following intervals:

- a. Pressure and utility lines - every 200 feet for trench slopes greater than 25%.

3.08 STRUCTURE BACKFILL AND COMPACTION

- A. General: Select structural fill material shall be used for all backfilling work. Fills under mats and footing shall be placed in the dry with loose lift thicknesses of 6-inches or less. Each lift of fill and all subgrades under structures shall be compacted to achieve a minimum of 95% Modified Proctor maximum dry density in accordance with ASTM D 1557. At least one in-place density test will be made in each lift of compacted soil for a minimum every 2,500 square feet of foundation area.
- B. Stabilization: Subgrades for concrete structures shall be firm, dense, and thoroughly compacted and consolidated and shall remain stable under the construction operation loads imposed by the workers, materials and equipment for that particular work. Subgrades shall be free of mud or muck and shall remain stable under the feet of the workers. Subgrades which are unstable or become mucky due to the proximity of the ground water or construction operations, shall be stabilized with crushed rock and/or gravel as specified. The stabilizing material shall be evenly spread and thoroughly compacted. Excess subgrade material shall be removed so that the elevation of the finished stabilized material shall be at the subgrade elevations indicated on the Drawings. A 4-inch, 3000 psi concrete mud mat as recommended by a geological engineer, may be used as an alternate to the stabilizing material with the Engineer's approval.
- C. Foundation Preparation (Filling, Backfilling and Excavation):
1. Structures: Level the bottom of excavation. Remove any unsuitable foundation materials and replace with gravel. Place clean gravel to thickness and extension beyond the foundation slab as indicated on plans. Compact gravel to form a stable working surface with hand held compactors.
 2. Buildings: After proof rolling of the stripped building area, place approved fill material within the building foundation lines plus a 6 foot margin in lifts of 6-inch maximum loose thickness. Compact each lift to a minimum of 95 percent Modified Proctor density 12 inches below the surface.
 3. Excavation for all building footings and structure foundations shall be made through precompacted soils/building pad to design elevations. Bottom of excavation shall be additionally compacted to 95% of Modified Proctor Density 12-inches below the surface. Test compaction as specified.
 4. Building Slab Backfill: Place fill inside the building foundation walls in lifts of 6-inches maximum loose thickness, each lift compacted with vibratory portable compactors and fill brought to bottom of the slab. Add necessary water to each lift to bring moisture content to optimum levels and compacting to achieve a minimum of 95% of Standard Proctor Density 6-inches below the surface. Fill shall be placed up to the bottom of the structural floor slabs, with allowance for capillary water barrier (gravel sub-base) and/or concrete mud mat as specified or shown on the drawings, to the elevations shown.
 5. Form monolithic slab beams by excavating from the compacted fill material to grades and lines indicated on the drawings.
 6. Place all backfill under the slabs, around utility trenches, mechanical and plumbing pipes, etc., in layers of six inches maximum loose thickness and compact with portable plate compactors to achieve a minimum of 95% of Standard Proctor density as per ASTM D-1557.
 7. Equipment Pads and Slabs on Grade: Cut, fill and compact subgrades for concrete slabs to required grade. Compact top 8-inches of concrete slab subgrade in cut sections and all fill material to a density of not less than 95 percent of its maximum density 12" below the surface as determined by ASTM D-1557.
 8. Test compaction of all structural fill as specified.
 9. Vibratory compaction shall never be done on dry sandy material or when water table is within eighteen inches of the surface. Before start of vibratory compaction, the soils should either have natural moisture or applied water to bring the soils to optimum moisture content.
- D. Capillary Water Barrier

1. Subgrade under floor slab shall be finished off smooth after the required density as specified above is achieved to the proper elevation.
 2. Capillary water barrier shall be placed directly on the subgrade and compacted with a minimum of two passes of a plate-type vibratory compactor.
 3. The minimum compacted thickness of the capillary water barrier shall be 4-inches unless noted otherwise in the Drawings.
- E. Backfill against Structures: Backfill against structures shall be placed and compacted to Type A compaction. Backfill against concrete or masonry structure shall not be performed until the Work has been reviewed and backfilling permitted. Backfill against walls shall also be deferred until the structural slab for floors above the top fill line have been placed and attained design strength or earlier at the discretion of the Engineer. Partial backfilling against adequately braced walls may be considered by the Engineer on an individual situation basis. Where walls are to be waterproofed all Work shall be completed and membrane materials dried or cured according to the manufacturer's instructions before backfilling.
- F. Final Grades: Final fill grades shall be within 0.1 foot of elevations shown. Where shown on the Drawings surfaces shall be sloped for drainage or other purposes.
- G. Well Pointed Areas: For fills being placed in confined areas within well pointed areas, the water table shall be lowered and maintained within practical limits in order that as much dry fill material may be placed and compacted as possible.

3.09 TESTING

- A. All soil testing and earthwork monitoring shall be done by the Contractor in conformance with the Contract Documents. Notify the appropriate testing company or personnel in time to be on hand to make the tests required by these specifications. The project superintendent shall be informed of the testing results and designated areas requiring corrective work.
- B. Optimum moisture content of fill material shall be by Modified Proctor Method (ASTM D-1557). Conduct field densities to verify compaction in accordance with ASTM D-1556, ASTM D-2167, or ASTM D-2922.
- C. Retest compaction tests that fail to pass after additional compaction until the specified minimum compaction density is achieved. Two additional tests shall be taken for each failed test. All retesting costs shall be paid for by the Contractor at no additional cost to the Owner.

END OF SECTION

SECTION 312317

ROCK REMOVAL

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Excavation, removal, transportation and disposal of rock encountered during excavation operations.

1.02 REFERENCES

- A. NFPA 495 – Code for the Manufacture, Transportation, Storage, and Use of Explosive Material.

1.03 QUALITY ASSURANCE

- A. Contractor shall provide evidence of sufficient experience, equipment and personnel to perform rock removal operations.

1.04 PAYMENT

- A. Rock excavation and removal is a pay item when specified in Section 012000. The quantity of rock excavation has been estimated.

PART 2 PRODUCTS

2.01 ROCK

- A. Definition: Solid mineral material consisting of Igneous, Metamorphic and Sedimentary Rock that cannot be removed from the trench by excavation equipment alone, and that requires the use of rock hammers, rippers or explosives for efficient removal shall be classified as rock.

PART 3 EXECUTION

3.01 INSPECTION

- A. Verify site conditions and note irregularities affecting work of this Section.
- B. Beginning work of this Section means acceptance of existing condition.

3.02 ROCK REMOVAL - MECHANICAL METHOD

- A. Excavate and remove rock by the mechanical method.
- B. Cut away rock at excavation bottom to form level bearing.
- C. Remove shaled layers to provide sound and unshattered base for footings, foundations, or pipeline bedding material as detailed.
- D. In utility trenches, excavate to 6 inches (150 mm) below bottom elevation of bedding.
- E. Remove from site and properly dispose of excavated material.

3.03 FIELD QUALITY CONTROL

- A. Provide for visual inspection of bearing surfaces and cavities formed by removed rock.

3.04 ROCK REMOVAL - EXPLOSIVES METHODS

- A. See section entitle "Blasting" for detailed information.

END OF SECTION

SECTION 313700

RIPRAP

PART 1 GENERAL

1.01 SUMMARY

- A. This section includes constructing a protective blanket of rock for embankments, ditches, stream banks, and at pipe discharges.

1.02 SUBMITTALS

- A. Submit gradation of the material to be used and soundness test, (not older than 2 years).
- B. Aggregate tickets showing type of material and amount delivered.
- C. Submit analysis from an independent laboratory showing specific gravity, absorption, and durability of stone.

1.03 QUALITY CONTROL

- A. Visual evaluation of the quarry, including examination of blast samples and diamond drill core samples and suitable tests and service records, may be used to determine the acceptability of the stone.
- B. Acceptance of quality and size of material will be made by visual inspection at the job site.
- C. The following tests may be required to determine the required quality, provide specific gravity, absorption, and durability tests of stone.

TEST	TEST METHOD	REQUIREMENT
Apparent Specific Gravity	AASHTO T85	2.50 minimum
Absorption	AASHTO T85	4.2% maximum
Durability	ASTM D3744	52 minimum

- D. Based on the formula below, absorption may exceed 4.2% if the durability absorption ratio (DAR) is greater than 10. Durability may be less than 52 if DAR is greater than 24, where:

$$\text{DAR} = \frac{\text{Coarse Durability Index}}{\% \text{ Absorption} + 1}$$

PART 2 PRODUCTS

2.01 NATURAL STONE

- A. Stone for riprap shall be quarry stone, well graded and angular. Stone shall be of such shape as to form a stable protection for the required section. Do not use flat or elongated shapes unless the thickness of the individual pieces is at least one-third the length. Material shall be clean and free from deleterious impurities including alkali, earth, clay, refuse, and adherent coatings with no more than 10 percent of soil, sand, shale or non-durable rock.
- B. The material shall contain a large percentage of pieces as large as the thickness of the blanket will permit, with enough smaller pieces of various sizes to fill the larger voids.
1. 6"-8" Crushed Limestone Riprap
 2. Riprap shall be clean rock, six to eight inches in the longest direction.

2.02 RUBBLE

- A. Rubble shall consist of broken concrete. Rebar protruding from the concrete shall not interfere with the placement of adjacent material to maintain a reasonably tight and uniform placement of the material.
- B. Rubble shall be of a graded mixture, with individual pieces weighing, in general, from 20 to 300 pounds each. Not over 25% of the total volume shall be composed of pieces weighing less than 50 pounds each, and at least 50% of the total volume shall be composed of pieces weighing 100 pounds or more.

PART 3 INSTALLATION

3.01 PLACEMENT

- A. Grade areas to a smooth surface. Place riprap on a filter blanket on the prepared slope in such a manner as to produce a well-graded mass with the minimum practical percentage of voids. Do not puncture or penetrate the geotextile liner if installed.
- B. Place the riprap to its full course thickness as shown on the Plans in one operation and in such a manner as to avoid displacing the underlying material and manipulated to eliminate large voids.
- C. Do not place rip rap over frozen or spongy subgrade surfaces.
- D. The finished surface of the blanket shall present an appearance free from segregation and with a proportionate quantity of the larger pieces showing. The rock shall be placed to the specified thickness, elevation and manipulated to eliminate large voids. The finished surface shall present a uniform appearance true to line, grade and section.

END OF SECTION

SECTION 323112

STEEL CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section includes materials and installation of galvanized steel chain link fence and gates, top rail and bottom tension wire, and anticlimb extension arms with barbed wire.

1.02 SUBMITTALS

- A. Submit shop drawings in accordance with the General Conditions and Section 013300.
- B. Submit manufacturer's descriptive literature and drawings of fence and gate installation.
- C. Submit manufacturer's certificate or original shipping tags showing compliance with cited U.S. Federal and ASTM specifications.

PART 2 PRODUCTS

2.01 GALVANIZED STEEL CHAIN LINK FABRIC

- A. Fabric height shall be 72 inches unless otherwise shown in the drawings.
- B. ASTM A392, Class 1; or U.S. Federal Specification RR-F-191/1D, Type I; 1.2 ounces per square foot zinc coating, hot-dip galvanized after weaving, 2-inch diamond mesh, 11-gauge steel wire for height 60 inches or less, 9 gauge for height over 60 inches.
- C. Top selvage knuckled, bottom selvage twisted and barbed.
- D. Tie wire shall be same material and gauge as the chain link fabric.

2.02 GALVANIZED POSTS AND BRACES

- A. Steel Pipe: ASTM F1083. Galvanize 1.8 ounces per square foot.
- B. Provide posts and braces in compliance with the over 6-foot classification of U.S. Federal Specification RR-F-191/3D, as follows:
 - 1. End, Corner, and Pull Posts: 2-1/2-inch steel pipe, 5.79 pounds per linear foot.
 - 2. Line Posts: 2-inch steel pipe, 3.65 pounds per linear foot.
 - 3. Gateposts for up to 6-Foot Leaf Width Gate: 2-1/2 inches, 5.79 pounds per linear foot.
 - 4. Gatepost for 6- to 13-Foot Leaf Width Gate: 3-1/2 inches, 9.1 pounds per linear foot.
- C. Alternatively, provide steel pipe, posts, and braces as follows:

Steel pipe shall conform to ASTM A1011 or A653, cold-formed, electric welded, minimum yield strength of 50,000 psi. Provide posts and braces with Type A galvanized coating in compliance with ASTM F1043 for heavy industrial fence, Group IA pipe or Group II rolled shapes as follows:

- 1. End, Corner, and Pull Posts: 2.875-inch (outside diameter) steel pipe, 4.64 pounds per linear foot.
- 2. Line Posts: 2.375-inch (outside diameter) steel pipe, 3.12 pounds per linear foot.

3. Gateposts for up to 6-Foot Leaf Width Gate: 2.875 inches (outside diameter), 4.64 pounds per linear foot.
 4. Gatepost for 6- to 13-Foot Leaf width Gate: 4 inches (outside diameter), 6.56 pounds per linear foot.
- D. Post Brace Assembly: At gateposts and end posts and at each side of corner and pull posts, place a horizontal compression brace to the next post at midheight of fabric. Truss the two posts together with a diagonal tension rod. Use 1-1/4-inch minimum pipe for the horizontal brace and 3/8-inch (nominal, 5/16-inch true) diameter adjustable diagonal truss rod.
 - E. Length of Posts into Footing: At line posts for fabric height of less than 72 inches, provide 24 inches. At line posts for fabric height of 72 inches and more, provide 30 inches. At end, corner, and pull posts, provide 6 inches more than at line posts. At gateposts, provide 12 inches more than at line posts. In solid rock, the portion of the depth of footing that is in solid rock may be reduced to one-half of the above lengths.

2.03 GALVANIZED HARDWARE

- A. Comply with U.S. Federal Specification RR-F-191/4D or ASTM F626 and the following:
- B. Caps: Weathertight caps on exposed ends of tubular members.
- C. Tension Wires: 7-gauge galvanized steel coil spring steel.
- D. Tension or Stretcher Bars: One piece, 2 inches less than fabric height, 3/16 inch by 3/4 inch. Provide one bar for each gatepost and end post and two for each corner and pull post.

2.04 GALVANIZED BARBED WIRE

- A. Barbed Wire: ASTM A121, Class 3,
- B. two twisted 12-1/2-gauge steel wires, 0.80-ounce-per-square-foot zinc coating, 4-point round-shape barbs 5 inches apart.
- C. Extension Arms: Post cap and anticlimb 45-degree galvanized steel single extension arm per ASTM F626 for three barbed wires. Top wire: 12 inches above fabric. Provide way for top rail.

2.05 GALVANIZED GATES

- A. Provide gates in accordance with ASTM F900, except as modified.
- B. Tubular Perimeter Members: Provide 2-inch pipe, 3.65 pounds per linear foot. Provide intermediate vertical member for width over 8 feet and intermediate horizontal member for width over 10 feet. Assemble frame by welding or with malleable or pressed steel corner fittings, riveted for rigid connection. Provide fabric and barbed wire as for fence. Use stretcher bars at vertical edges and optional at top and bottom edges. Diagonal cross bracing of 3/8-inch (nominal, 5/16-inch true) diameter adjustable truss rods. Form anticlimb extension by extending vertical members 12 inches above fabric. Provide hinged gates to swing through 90 degrees from closed to open.
- C. Gate Hardware:
 1. Hinges: Provide pressed or forged steel or malleable iron, nonlift-off type, one and one-half pairs for each leaf over 6 feet high.
 2. Latch: Provide forked type or plunger-bar type for operation from either side, with padlock eye as integral part.
 3. Cane Bolt: Provide one 24-inch-long cane bolt at each leaf more than 4 feet 0 inches wide.

2.06 FILLER STRIPS

- A. Fiberglass filler strips for diagonal installation into chain link fence shall be fabricated from large sheets of a durable, semirigid fiberglass-reinforced polyester resin, pigments, and acrylic modifier for protection against sunlight. Strips are to be 1.77 inches wide by 8 feet long, with a nominal thickness of 0.060 inch. Color to be dark green.

2.07 CONCRETE

- A. Five, 94-pound sacks of portland cement per cubic yard. Do not use accelerating admixtures.

PART 3 EXECUTION

3.01 PREPARATION FOR INSTALLATION

- A. Clear the line of the fence and dispose of resulting material. Grade between post centers, excavate high spots, and fill low spots so bottom of fabric will be between 1 and 2 inches above finished grade.

3.02 INSTALLATION

- A. Install in accordance with ASTM F567, except as modified herein.

3.03 SETTING POSTS

- A. Space line posts uniformly at maximum intervals of 10 feet between gateposts and corner posts.
- B. Excavate postholes so concrete will be 3 inches below and around metal posts, except that minimum diameter of concrete footing for end, corner, pull, and gateposts is 12 inches. In solid rock, diameters may be reduced to post outside diameter plus 3 inches.
- C. Set posts plumb to within 1/4 inch of the post vertical centerline.
- D. Fill postholes with concrete to 2 inches above finish grade and crown to slope away from post. In solid rock, emplace posts with a grout of one part portland cement to three parts sand, with sufficient water for workability.

3.04 INSTALLING FABRIC

- A. Place fabric on security side of fence. Place tension bands on side opposite fabric side and peen bolt ends or score threads.
- B. Tie fabric to line posts and clip tension bar to end, corner, pull, and gateposts at 15-inch intervals. Tie fabric to tension wires or weave tension wires through fabric at 24-inch intervals. Gauge of tie wire equal to gauge of fabric. Tie tension wires to line posts with 6-gauge wire. Twist tie wires two full turns and bend back edges to reduce hazard.
- C. Join rolls of fabric by weaving a single strand into ends of the rolls to form a continuous mesh.

3.05 INSTALLING FILLER STRIPS

- A. Starting at one end of a run of fence, insert strips into the "tunnel like" rows in the fence fabric. Continue until the entire height of a section of fence is completed.

END OF SECTION

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BARTLETT  **WEST**

SECTION 329219

SEEDING

PART 1 GENERAL

1.01 THE REQUIREMENTS

- A. Items specified in this Section include repairs to landscaped and grassed areas damaged by Contractor activities.

1.02 REFERENCES

- A. Federal Specifications:
 - O-F-241D Fertilizers; Mixed, Commercial.
- B. U.S. Department of Agriculture Federal Seed Act of August 9, 1939:
 - 53 Stat. 1275 Rules and Regulations

1.03 SUBMITTALS

- A. Grower's certification of purity and compliance with State and federal quarantine restrictions.
- B. Manufacturer's certification of fertilizer composition.

1.04 AREA

- A. All Contractor disturbed areas, fills and embankments shall be seeded and fertilized.

1.05 JOB CONDITIONS

- A. Existing Conditions: Perform seeding only after preceding work affecting ground surface is completed.
- B. Environmental Requirements:
 - 1. Plant seed on unfrozen soil.
 - 2. Do not perform seeding when wind exceeds 15 mph.
- C. Protection: Restrict foot and vehicular traffic from seeded areas after planting to end of the turf established period.

1.06 DELIVERY AND STORAGE

- A. During delivery seed shall be protected from contamination.
- B. Fertilizer shall be delivered to the site in the original, unopened containers bearing the manufacturer's guaranteed chemical analysis, name, trade name, trademark and conformance to State and Federal

laws. In lieu of containers, fertilizers may be furnished in bulk and a certificate indicating the above information shall accompany each delivery.

- C. Seed and fertilizer shall be kept in dry storage away from contaminants.
- D. Sod containing noxious weeds or excessive quantities of foreign grass will not be accepted.

PART 2 PRODUCTS

2.01 SEED MIXTURES, PROPORTIONS AND PURITY SHALL BE AS FOLLOWS:

- A. Native Seed Mix plus sterile cover crop for Ipomopsis polyantha habitat

Species	Common Name	% of Mix	PLS/1000 sq. ft.
Oryzopsis hymenoides	Indian Ricegrass var. Rimrock	18	0.102
Koeleria macrantha	Junegrass VNS	18	0.006
Bouteloua curtipendula	Side-oats Grama var Butte	15	0.063
Penstemon strictus	Rocky Mountain Penstemon VNS	12	0.014
Adenolinum lewisii	Blue Flax var Maple Grove	12	0.033
Tritosecale	Quickguard Sterile Hybrid	25	1.539
		100	1.756

2.02 REPLACEMENT TREES, GROUND COVER AND SHRUBS

- A. Replacement trees, ground cover and shrubs shall be of the same type and size and be sound, healthy and vigorous, well branched and densely foliated when in leaf. They shall have healthy, well developed root systems and shall be free of disease and insect pests, eggs or larvae.

2.03 FERTILIZER

- A. Fertilizer shall be commercial grade and shall bear the manufacturer's guaranteed statement of analysis. Analysis of fertilizer shall be approximately as follows:

Nitrogen	0%
Phosphoric Acid	66%
Potash	33%

2.04 MULCH

- A. Mulch shall be straw stalks from oats, wheat, rye, barley or rice that are free from noxious weeds, mold or other objectionable material. Straw shall be in an air-dry condition and suitable for placing with blower equipment.

2.05 EROSION CONTROL NET MATERIAL

- A. Erosion control net material shall be twisted jute mesh weighing 0.80 pounds per square yard with openings between strands 3/8 inch by 3/4 inch. Excelsior mat shall be dried excelsior covered with a fine paper net covering weighing 0.8 pounds per square yard with openings between strands 1/2 inch by 2 inches. Fiberglass mats shall be loosely woven glass fiber mat weighing 0.11 pounds per square yard with openings 3/8 inch square.

2.06 WATER

- A. Water shall be potable.

PART 3 PART 3 EXECUTION

3.01 INSPECTION

- A. Verify that soil preparation and related proceeding work have been completed.
- B. Do not start work until conditions are satisfactory.

3.02 TILLAGE

- A. After the areas required to be seeded have been brought to the grades specified on the plans, they shall be tilled to a depth of at least 3 inches by scarifying, disking, harrowing or other approved methods. The top 4 inches shall consist of good quality black top soil. All debris and stones larger than one inch in diameter remaining on the surface after tillage shall be removed.

3.03 TREES, GROUND COVER AND SHRUBS

- A. Excavation and Plant Holes: Plant hole excavations shall be roughly cylindrical in shape, with the side approximately vertical. Plants shall be centered in the hole. Bottoms of the holes shall be loosened at least six inches deeper than the required depth of excavation.
- B. Holes for balled and burlapped plants shall be large enough to allow at least eight inches of backfill around the earth ball. For root balls over 18 inches in diameter, this dimension shall be increased to 12 inches. Where excess material has been excavated from the plant hole, the excavated material shall be disposed of as and where directed by the Engineer.
- C. Setting of Plants: When lowered into the hole, the plant shall rest on a prepared hole bottom such that the roots are level with, or slightly above, the level of their previous growth and so oriented such

as to present the best appearance. The Contractor, when setting plants in holes, shall make allowances for any anticipated setting of plant.

- D. The backfill shall be made with a 50:50 topsoil/peat moss mixture and shall be firmly rodded and watered-in, so that no air pockets remain. The quantity of water applied immediately upon planting shall be sufficient to thoroughly moisten all of the backfilled earth. Plants shall be kept in a moistened condition for the duration of the Contract.
- E. Staking and Guying: Plants shall be staked in accordance with the following provisions:
1. Small Trees: For trees and shrubs of less than one-inch caliper, the size of stakes and the method of tying shall be such as to rigidly support the staked plant against damage caused by wind action or other effects. Trees larger than one inch and smaller than one and one-half inch caliper shall be staked with a two-inch stake, set at least 24 inches in the ground and extending to the crown of the plant. The plant shall be firmly fastened to the stake with two strands of 14 gauge soft wire, enclosed in rubber hose, or other approved covering. The wire shall then be nailed or stapled to the stake to prevent slippage.
 2. Medium Trees: All trees larger than one and one-half inch caliper and smaller than two and one-half inch caliper shall be staked with two or more, two-inch by two-inch stakes, eight feet long, set two feet in the ground. The tree shall be midway between the stakes and held firmly in place by two strands of 12-gauge wire, applied as specified above for single stakes. The wires shall be tightened and kept tight by twisting.
 3. Large Trees: All trees larger than two and one-half inch caliper, shall be guyed from at least three points with double strands of 12-gauge wire. Guy wires shall be anchored to two-inch by four-inch stakes, 24 inches long, driven into the ground at least two feet and sufficient that the top of the stake is at least three inches below the finished ground level. In firm rock soils, Number 4 steel reinforcing rods or one-half inch pipe may be used instead of stakes. Tie wires shall be securely fastened to the tree by means of a collar of rubber hose, or other approved material. Guy wires shall be tightened and kept tight by twisting.
 4. Pruning: All broken or damaged roots shall be cut off smoothly, and the tops of all trees shall be pruned in a manner complying with standard horticultural practice. At the time pruning is completed, all remaining wood shall be alive. All cut surfaces of one inch or more in diameter, above the ground, shall be treated with an approved commercial tree paint.
 5. Maintenance: Maintenance shall begin immediately after each plant is planted and shall continue until all work under this Contract has been completed and accepted by the Owner. Plants shall be watered, mulched, weeded, pruned, sprayed, fertilized, cultivated and otherwise maintained and protected. Settled plants shall be reset to proper grade position, planting saucer restored and dead material removed. Guys shall be tightened and repaired.
 6. Defective work shall be corrected as soon as possible after it becomes apparent. Upon completion of planting, the Contractor shall remove excess soil and debris, and repair any damage to structures, etc., resulting from planting operations.

3.04 ESTABLISHMENT OF TURF

- A. Seeding and fertilizing should be done only during the periods between March 1 and May 30 or between August 10 and September 30. Seed and fertilize improvements upon completion of each relocation.

3.05 SOWING SEED

- A. Seed shall be sowed by drilling, broadcasting, or other approved method that will evenly distribute the seed over the area to be planted. If drilling is used, drills shall be not more than 4 inches apart and successive passes shall overlap.
- B. The seed shall be covered by an average depth of 1/4 inch by means of brush harrow, cultipacker or other approved device.
- C. Contractor shall reseed turfed areas with seed mixture that matched existing turf or grassed areas.

3.06 APPLICATION OF FERTILIZER

- A. Fertilizer shall be applied at the rate of 1 pound of actual nitrogen per 1,000 square feet as recommended by manufacturer on areas to be seeded. Fertilizer shall be incorporated into the soil to a depth of at least 3 inches and may be incorporated as part of the tillage operation hereinbefore specified. Immediately before seeding or sodding, the soil shall be restored to an even condition.

3.07 MULCH

- A. shall be evenly spread over all seeded areas. The mulch shall be anchored by either a mulch tiller, twine or netting.

3.08 WATERING

- A. Watering shall be started immediately after seed bed has been mulched. Water shall be applied to the seeded areas at a rate sufficient to insure moisture saturation of the soil to a depth of at least 3 inches. Watering operations shall be supervised to prevent run off. The Contractor shall supply all hoses, pipelines and sprinkling equipment. All areas damaged by the Contractor's watering operations shall be repaired at no cost to the Owner.

3.09 TURF ESTABLISHMENT PERIOD

- A. The Contractor shall be responsible for the establishment and care of a stand of turf over the entire seeded areas.
- B. Maintenance shall be performed on the seeded areas for a period of three months after placing or until the turf has been mowed three times whichever comes first. The Contractor shall provide the following maintenance: watering, fertilizing, reseeding and any other operations necessary to ensure the growth of the grass.

- C. If the area becomes gullied or otherwise damaged or if the grass does not survive within the one year correction period, the area shall be reseeded as specified herein.

3.10 LAWN SPRINKLER SYSTEMS

- A. Sprinkler systems damaged or disturbed during performance of the Work shall be repaired to the satisfaction of the owner thereof at no additional cost to the Owner.
- B. Prior to beginning of construction activities the Contractor shall verify the location of sprinkler system piping and individual sprinkler heads.
- C. The Contractor shall coordinate with the individual property owners to assure that each of the sprinkler systems damaged in the course of construction of this project is functioning properly to the satisfaction of the Engineer and property owner.

3.11 CLEANUP

- A. Remove trash and excess materials from project site.

3.12 ACCEPTANCE

- A. Final inspection and acceptance will be at the end of the correction period as specified herein. Prior to the final acceptance, the Contractor shall apply fertilizer to the newly turfed area at the rate of 1 pound of actual nitrogen per 1000 sq. ft. as recommended by the manufacturer.

END OF SECTION

SECTION 330522
DIRECTIONAL BORING OF PIPE

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section includes materials and installation of restrained-joint PVC pipe by the directional boring method.

1.02 SUBMITTALS

- A. Submit shop drawings in accordance with the General Conditions and Section 013300.
- B. Submit list and description of materials and equipment to be used.
- C. Submit drawings showing proposed method of construction including location of receiving and sending pits. Submit proposed sequence of construction.
- D. Submit proposed pressure testing location for pipe before directional boring.
- E. Submit an accurate record of the crossing location in plan view and profile depth. Record all changes on the contract drawings as work progresses.
- F. Calculations signed and sealed by a professional engineer licensed in the state of Colorado demonstrating a factor of safety of 1.5 against buckling of the pipe considering the materials and equipment to be used.

PART 2 PRODUCTS

2.01 BOLTS AND NUTS FOR FLANGED CONNECTIONS

- A. See Section 400500.

2.02 DRILLING FLUID

- A. Drilling fluid shall be bentonite and water or a combination of bentonite and polymers and water formulated to move cuttings to the surface and lubricate the pipe during pullback.

2.03 DRILL PIPE

- A. Drill pipe shall be steel with sufficient strength to withstand the maximum rated pullback and pushing load of the drilling equipment. Drill pipe joints shall be flush and capable of transmitting maximum rated torque of the drilling equipment.

2.04 DRILLING EQUIPMENT

- A. Drilling equipment shall have a maximum sound power level of 72 dBA (as defined in ANSI S1.4) at 10 feet when operating within 100 feet of a residential unit. Measure sound power level in accordance with ISO 3740 and 3744.
- B. Mixing, pumping, and holding/separation tanks shall be capable of delivering mixed drilling fluid to the cutting head. Drilling fluids circulating equipment shall be designed to minimize spillage.

2.05 DOWNHOLE TOOLS

- A. Cutting heads, backreamers, and hole openers shall be suitable for the soil and rock conditions anticipated by the Contractor.
- B. Grips, pulling heads, and swivels shall be compatible with the pipe material. Design to transmit without distortion the maximum rated pullback force of the equipment used. Grips, pulling heads, and swivels shall be specifically engineered for directional drilling applications.
- C. Tracking equipment shall be capable of determining the location of the cutting head at depth within ± 1 foot.

PART 3 EXECUTION

3.01 INSTALLATION

- A. The pipe shall follow the line and grade shown in the drawings and shall exit the ground within five (5) feet of the design location.
- B. Install the pipe in a manner that does not cause upheaval, settlement, cracking, movement, or distortion of the surface material including bridge walls, retaining walls, and channel bottom.
- C. Locate the entrance and exit pits to be within the Owner's right-of-way.

3.02 TRENCHING AND EARTHWORK

- A. Accomplish trenching and earthwork in accordance with Section 312316.

3.03 PIPE JOINING

- A. Where the staging area permits, join entire length of pipe to be pulled through bore prior to commencement of pullback operation. If not feasible because of the length of the bore and the size of the staging area, each pipe section may be fused or welded to the previous section before the pull back. Support weight of joined pipe suspended on rollers to minimize pulling forces.

3.04 PRE-BORE AND POST-BORE PRESSURE TESTING

- A. Prior to pulling the pipe through the directional bore hole, the pipe shall be pressure tested at in accordance with Section 400515. Perform pressure testing again after final installation of the pipe and before final acceptance by the Owner.
- B. At the Contractor's option, pipe need not be pressure tested before pulling the pipe through the bore hole. In such case, if the pipe does not pass the pressure test after installation, then remove the entire pipe from the bore hole, repair the pipe, and perform pressure testing prior to reinstalling the pipe and again after reinstallation.
- C. The Resident Project Representative will witness the pressure tests and shall be informed 48 hours in advance of pressure tests.

3.05 PILOT BORE

- A. Construct a pilot bore at the centerline alignment and grade as shown in the drawings. Circulate drilling fluids to maintain an open bore at all times. If the path of the pilot bore is successfully completed, then proceed with the reaming procedure, and pull the pipe from the receiving location (exit pit) to the sending location (entry pit). If the pilot bore could not be successfully completed, then do not proceed with the reaming procedure until the Owner, Owner's Representative, Engineer, and Contractor have met to

discuss alternative options for the pipeline crossing. The pilot bore and reaming procedure shall be controlled by a magnetic survey system including accelerometers, magnetometers, connector wire, and survey probe. The guidance system shall be capable of measuring depth, location, pitch, and roll of the bore and shall be able to indicate depth up to 30 feet.

3.06 DRILLING FLUIDS

- A. Contain and dispose of the drilling mud in accordance with state and federal regulations and permit conditions. Install erosion and sedimentation control measures including straw bales to prevent drilling mud from inadvertently spilling out of the entrance/exit pit. Monitor drilling fluids at the surface to avoid excessive downhole pressures which may buckle the surface or the pipe during installation.

3.07 BACKREAMING BORE AND PIPE INSTALLATION

- A. Upon completing the pilot bore, pull the drill pipe back through the bore using an oversized backreamer larger than the proposed pipe to be pulled back through the bore hole. Repeat backreaming as necessary to enlarge the bore to provide sufficient clearance for the pipe. Attach pulling head and swivel and pull pipe through with closed end. Pull pipe back in one continuous pull to avoid closure of the bore hole.

END OF SECTION

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SECTION 331219
FIRE HYDRANTS

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section includes materials, testing, and installation of dry barrel fire hydrants.

1.02 SUBMITTALS

- A. Submit shop drawings in accordance with the General Conditions and Section 013300.
- B. Submit certificate of compliance with AWWA C502.
- C. Submit manufacturer's catalog data and descriptive literature. Show materials of construction. Submit dimensional drawings. Show coatings.

PART 2 PRODUCTS

2.01 FIRE HYDRANT SELECTION

- A. Provide fire hydrants of the dry barrel design.

2.02 TYPE 492: DRY BARREL FIRE HYDRANT DESIGN

- A. Fire hydrants shall comply with AWWA C502. Provide frangible section near the ground line designed to break on impact.
- B. Provide two 2-1/2-inch NFPA 1963 threaded nozzles and one 4-1/2-inch STORZ-style nozzle. Provide cap with chain on each nozzle.
- C. Inlet Connection of Bury: Mechanical joint.
- D. Manufacturers and Models: Mueller Super Centurian.

2.03 BRONZE COMPONENTS IN CONTACT WITH WATER

- A. Bronze shall have the following chemical characteristics:

Constituent	Content
Zinc	7% maximum
Aluminum	2% maximum
Lead	8% maximum
Copper + Nickel + Silicon	83% minimum

2.04 WRENCHES

- A. Provide one wrench to operate the hydrant for each hydrant in the project.

PART 3 EXECUTION

3.01 PAINTING AND COATING

- A. Coat hydrant top section and the exposed portion of the bury section per Manufacturer's standard coating system. Apply all coats at factory. **Color of finish coat shall be Black.** Apply touch up's and repairs to coating system in field.
- B. If cement-mortar coated bury sections are used, hold back the mortar coating so it does not extend more than 2 inches above grade.

3.02 SIGN

- A. Erect a sign near the hydrant with the following lettering:

"NON-POTABLE WATER - HYDRANT WILL NOT RECEIVE WATER WHEN SYSTEM NOT IN OPERATION"

3.03 FACTORY TESTING

- A. Test per AWWA C502, Section 5.

3.04 INSTALLATION

- A. Install with the face of the bottom flange of the barrel 4 to 6 inches above the adjacent ground or paving.
- B. Provide thrust block on bury elbow as detailed in the drawings.

END OF SECTION

SECTION 352104
CYLINDRICAL WATER INTAKE SCREENS

PART 1 GENERAL

A. Description

1. This section covers the furnishing and installation of the Intake Screens and appurtenances as shown on the drawings and specified herein.

B. Submittals

1. Submit:
 - a. Drawing(s) showing screen diameter, screen length, assembly length, interface dimensions for outlet and air backwash dimensions, materials of construction and assembly weight.
 - b. Weld Certifications. All welders shall be certified to ASME Section IX.
 - c. Provide supporting flow distribution data where calculation methods are verified by physical flow distribution tests.
 - d. Detailed layout drawings
 - e. Supporting flow distribution data via a CFD (Computational Fluid Dynamics) analysis.
 - f. Evidence of a recognized ongoing quality assurance program.
 - g. Evidence of a statistical control program.
 - h. Detailed component specifications and catalog cuts of all components.
 - i. Detailed list of all variations from the original design, referencing appropriate sections of the specifications and locations on the drawings.
 - j. Full installation and maintenance recommendations.
 - k. Strength and buckling calculations verifying compliance with criteria specified herein.
2. Include in the intake screen submittals all associated air-cleaning equipment catalog information, system sizing criteria and drawings. All dimensional and operational information will be provided. All interconnecting wiring and piping information will be included.
3. The entire intake screen system shall be furnished by a single manufacturer who shall maintain an ongoing quality assurance program, including ISO-9000 certification. Submit proof of same.

PART 2 PRODUCTS

A. General

1. All system components and equipment utilized in the intake screen system, including the system described in Section 1.01 shall be furnished as a complete integrated system by one manufacturer; Johnson Screen, New Brighton, MN, model T-36HCE or equal.

B. Intake Screens – Contract 2

1. Capacity
 - a. The intake assembly capacity shall be 10,000 GPM at a maximum through-slot velocity, as a result of water withdrawal, of 0.5 feet per second. The corresponding average through-slot velocity shall be 80% of the maximum velocity. At this flow rate the pressure drop through the clean screen surface shall be approximately .0035 psi. Pressure drop through the entire intake assembly shall be approximately .345 psi at the rated flow.
 - b. Demonstrate the intake assembly capacity and flow distribution by a Computational Fluid Dynamic (CFD) analysis. Verify the CFD Analysis by actual physical testing.

2. Strength
 - a. The intake assembly shall be designed to withstand a differential hydrostatic collapse pressure of 47.69 psi (110 feet of water).
 - b. Design stress used for determining strength of the assembly shall be no more than 90% of the specified minimum yield strength of the material used.
3. Slot Opening Size
 - a. The screen slot size shall be 0.125 inches. The open area for this slot opening shall be 63.78%.
 - b. Slot size shall be controlled and continuously monitored during manufacture.
 - c. The mean slot size shall be within +/- 0.003 inches with a standard deviation no greater than 0.003 inches throughout the entire assembly.
4. Air Burst Connections
 - a. Screen shall include provisions connection to existing air burst piping. Connections shall be flanged and shall direct compressed air to location appropriate for screen cleaning as determined by Manufacturer.
5. Materials
 - a. All materials shall be a copper-nickel based alloy designed to demonstrate successful zebra mussel protection. Product: Johnson Screen's Z-Alloy or equal.
 - b. The intake screen surface wire shall be V-shaped wire made from a copper-nickel based alloy to deter zebra mussels. Product: Johnson Screen's Vee-Wire® number 69 (0.071" wide and 0.179" in height) or equal.
 - c. The surface wire, support beam and stiffener structure shall be an all-welded matrix designed to provide the specific strength with minimal interference with the through screen flow pattern.
 - d. End plates and tee body shall be a minimum of 0.105 inches thick. All structural butt welds shall be full penetration fillet welds and shall be the thickness of the thinner component.
 - e. The main outlet flange shall mate with a 36-inch flange matching AWWA C-207, Table 2, Class D.
 - f. Air backwash connection(s) (see Drawings) shall be 6-inch nominal pipe size.
 - g. The intake screen material shall be manufactured of Z-Alloy material.
 - h. If material is not Z-Alloy, any alternate copper-based materials must demonstrate a minimum of five (5) years' experience showing prevention of attachment of zebra mussels.

C. Air Burst System - Contract 1

1. Compressor
 - a. Simplex, sized to refill receiver within 30 minutes following air burst sequence, 30 hp max.
 - b. See Specification Section 221519
2. Receiver
 - a. Color by owner, blend with landscape.
 - b. Sized to complete a single burst cycle without compressor run prior to completion, 12' dia max.
 - c. Automatic drain, heat-traced.
3. Valves and Piping
 - a. Piping and valves to conform to Division 22. Air Burst Manifold shall be designed to integrate with compressor and receiver as a package system and will be shop-fabricated and assembled except for final connection to air-burst delivery piping at site.

- b. Valved, quick-connect pneumatic tool connections with drip-leg to be provided in piping at both compressor and receiver locations.
- 4. Control System
 - a. The air-burst control system shall be a self-contained panel that provides both control and power distribution to the air burst system using either PLC or relay control. Automatic air burst sequences shall be activated by either remote signal or elapsed time control. Control panel shall be constructed in compliance with applicable Division 40 specifications. Alternately, function provided by individual selectors and pilots may be provided by a touchscreen control.
 - b. Control panel shall provide automatic control of air-burst sequences, along with the following:
 - (1) Receiver drain Hand-Off-Auto selector and pilots.
 - (2) Heat Trace Hand-Off-Auto selector and pilots.
 - (3) Individual control valve Hand-Off-Auto selectors and pilots.
 - (4) Compressor Hand-Off-Auto selector and pilots.
 - (5) System Ready, Air Burst in-progress and System Fault pilots.
 - (6) Receive/forward to SCADA: remote initiate (each screen), high/low pressure signals, compressor run, compressor fault, system fault, HOA status.

PART 3 EXECUTION

NOT USED

END OF SECTION

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SECTION 355353
UNDERWATER STRUCTURES CONSTRUCTION

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Bidders shall be expected to conduct underwater service operations to a maximum depth of 110 feet of fresh water at site elevation of approximately 6,900 feet above mean sea level, using approved commercial diving practices, procedures, equipment, and trained and experienced diving personnel who shall have completed a recognized course of commercial diving, in order to perform the following underwater activities:
1. Install Upper Screen at depth of approximately 40 feet below water surface, including:
 - a. Demolition and removal of existing bar screen or plastic end flange.
 - b. Installation of new screen as defined in Section 352104, including connection of main screen flange and associated air cleaning piping.
 2. Install Lower Screen at depth of approximately 110 feet below water surface, including:
 - a. Demolition and removal of existing bar screen or plastic end flange.
 - b. Installation of new screen as defined in Section 352104, including connection of main screen flange and associated air cleaning piping.
- B. Underwater operations shall be conducted in accordance with all local, state, and federal regulations, as applicable to the area of jurisdiction. As a minimum, these shall be considered to be:
1. 29 CFR § 1910.T
 2. Association of Diving Contractors International "Consensus Standards for Commercial Diving and Underwater Operations" – 6th Edition or latest.
- C. In no circumstances shall diving operations be conducted with less than a three man diving team, comprised of a Diving Supervisor, Diver, and Standby Diver/Entry Level Tender/Diver, nor shall any member of a diving team remain at the dive station for a period longer than twelve hours per day. Personnel shall be afforded a minimum of eight hours rest between shifts and be provided with at least two hot meals during any twenty-four hour period. The diving team members must:
1. Be formally trained in Commercial Diving either through:
 - a. Having completed a formal course of instruction at a public or private accredited school (including a military school) commercial diving school or;
 - b. Have a minimum of five years of documented on-the-job experience in the conduct of commercial diving activities
 2. Possess an ADCI Commercial Diver Certification Card at a level appropriate to their competency evaluated by their employer.
- D. Diving operations must be supervised as required by the appropriate governing regulation. The designated Person-In-Charge/Diving Supervisor shall be appointed in writing as that individual who is in charge of planning and execution of the diving operation including the responsibility for the safety and health of the dive team. He or she shall insure that before commencing any diving operation that the dive team members are briefed on:
1. The tasks to be undertaken.
 2. Any unusual hazards or environmental conditions likely to affect the safety of the diving operation.
 3. Any modifications to operating procedures necessitated by the specific diving operation.

- E. The Designated Person-In-Charge/Diving Supervisor is that individual properly appointed in writing who shall at all times be able to meet the responsibilities of that position. The Designated Person-In-Charge/Diving Supervisor shall not serve in a dual capacity as a dive tender, diver or in any other functional position that would interfere with his or her ability to remain in charge and take action as appropriate.
- F. No diving operation will be conducted by personnel who have not had a minimum of eight hours rest prior to Commencement of any operation.
- G. The following waterborne environmental hazards are expected to be present at the site of diving operations:
 - 1. Water temperatures less than 50°F will likely be present.
- H. The dive site is currently closed to recreational use. Movement of marine craft or other interference will not be present in the area of diving operations while diving operations are planned.

1.02 DEFINITIONS

- A. Services provided under this Specification are intended to be furnished by a subcontractor that meets the requirements specified herein. That subcontractor will be referred to as the Dive Contractor.

1.03 SUBMITTALS

- A. Dive Contractor shall be required to submit one copy of their company Safe Practices or Operations Manual for review. That documentation must include a copy of the applicable National regulation(s) and shall be present at the dive station throughout any operation conducted. This document shall include as a minimum:
 - 1. Safety procedures and checklists for each diving mode used.
 - 2. Diving checklists: pre- and post-dive.
 - 3. Dive team assignments and responsibilities.
 - 4. Equipment procedures and checklists for each diving mode used.
 - 5. Emergency procedures for:
 - a. Fire
 - b. Equipment failure
 - c. Adverse environmental conditions including but not limited to weather and sea state.
 - d. Medical illness and treatment of injury.
- B. Insurance documentation shall be furnished as required by the General Conditions. In addition to those required by the General Conditions, Proof of Marine Employers Liability shall be provided which demonstrate applicable policies are in effect for each and every person intended to be utilized on the job and with the appropriate classification indicated.
- C. If a decompression chamber is not required at the job site, the Dive Contractor shall include a statement to the effect: "I certify that a decompression facility is located at _____; that available hospitals and physicians have been identified and their contact telephone numbers are on record; that these persons have been advised that diving operations are planned over a period between _____ and _____, and have stated that the decompression chamber will be available in response to a diving emergency."

D. Each Dive Contractor shall furnish a statement that:

1. Semi-Annual air quality samples have been taken on breathing air systems intended for use on the job.
2. Annual inspection of diving umbilicals have been completed and each diving umbilical is marked in ten-foot increments as per regulations.
3. All gauges have been calibrated within the last six months.
4. Diver helmets have been maintained and inspected in accordance with manufacturers' recommended procedures and a record of same available either from the diving company or the Divers Log book.
5. Each dive member has a valid CPR Certification document (annual) and current first aid certificate (renewed every three years).
6. Each dive team member has a current diving physical report on file in the company offices.

PART 2 PRODUCTS

2.01 EQUIPMENT ON SITE

- A. Minimum diving emergency equipment shall be available at the site of diving operations and consist of:
1. a physician-approved first aid kit and manual.
 2. a bag-type manual resuscitator with transparent mask and tubing.
- B. Each dive team member has:
1. A Divers Log Book.
 2. ADCI Commercial Diver Certification Card.
 3. One additional form of state or federal photo identification.

2.02 VIDEO RECORD OF WORK

- A. Contractor shall provide video documentation of all underwater construction activities similar in content and format to Audio-Visual Preconstruction Record as identified in Section 013300.

PART 3 EXECUTION

NOT USED

END OF SECTION

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SECTION 400513
PIPING, GENERAL

PART 1 GENERAL

1.01 WORK INCLUDED

- A. All piping systems shall be furnished and installed as indicated on the Drawings and as specified. Each system shall be complete with all necessary fittings, hangers, supports, anchors, expansion joints, flexible connectors, valves, accessories, lining and coating, testing, disinfection, excavation, and backfill, to provide a functional installation.

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Commercial Standards:

ANSI/AWS D1.1	Structural Welding Code
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class125
ANSI B16.5	Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and other Special Alloys
ASTM A307	Specification for Carbon Steel Externally Threaded Standard Fasteners.
ASTM A325	Specification for High Strength Bolts for Structural Steel Joints.
ASTM D792	Test Methods for Specific Gravity and Density of Plastics by Displacement
AWWA C900/C905	Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings for Water Transmission and Distribution

1.03 CONTRACTOR SUBMITTALS

- A. Complete shop drawings and certificates, test reports, affidavits of compliance, of all piping systems shall be submitted in accordance with the requirements in the Submittals Section, and as specified in the individual piping sections.
- B. O&M Manuals: The Contractor shall furnish complete Operations and Maintenance Manuals for all equipment specified in the various sections and on the Drawings, together with all piping, valves, and controls for review by the Engineer and use by the Owner in accordance with Section entitled "Operation and Maintenance Data."
- C. Each shop drawing submittal shall be completed in all aspects incorporating all information and data listed herein and all additional information required to evaluate the proposed piping material's compliance with the Contract Documents. Partial or incomplete submissions will be returned to the Contractor without review.
- D. Data to be submitted shall include, but not be limited to:
1. Catalog Data consisting of specifications, illustrations and a parts schedule that identifies the materials to be used for the various piping components and accessories. The illustrations shall be in sufficient detail to serve as a guide for assembly and disassembly.
 2. Complete layout and installation drawings with clearly marked dimensions and elevations. Piece numbers which are coordinated with the tabulated pipe layout schedule shall be clearly marked. Piping layout drawings shall indicate the following additional information; pipe supports, location, support type, hanger rod size, insert type and the load on the hanger in pounds.
 3. Weight of all component parts.

4. Design calculations above specified.
 5. Tabulated pipe layout schedule which shall include the following information for all pipe and fittings, service, pipe size, working pressure, wall thickness and piece number.
- E. Certifications: Prior to installation, the Contractor shall furnish an Affidavit of Compliance certified by the pipe manufacturer that the pipe, fittings and specials furnished under this Contract comply with all applicable provisions of AWWA and these specifications. No pipe or fittings will be accepted for use in the Work on this project until the affidavits have been submitted and accepted in accordance with the Section entitled "Shop Drawings, Project Data and Samples."
- F. All expenses incurred in making samples for certification of tests shall be borne by the Contractor.
- G. Coordination of Work: All work shall be fully coordinated with other work and shop drawings must be checked with each of the various trades. Conflicts in the sequence of the work shall be coordinated through consultation with the Engineer.

1.04 QUALITY ASSURANCE

- A. Tests: Except where otherwise specified, all materials used in the manufacture of the pipe shall be tested in accordance with the applicable Specifications and Standards.
- B. Welding Requirements: All welding procedures used to fabricate pipe shall be prequalified under the provisions of ANSI/AWS D1.1. Welding procedures shall be required for, but not necessarily limited to, longitudinal and girth or spiral welds for pipe cylinders, spigot and bell ring attachments, reinforcing plates and ring flange welds, and plates for lug connections.
- C. Welder Qualifications: All welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used. Welders shall be qualified under the provisions of ANSI/AWS D1.1 by an independent local, acceptable testing agency not more than 12 months prior to commencing work. Machines and electrodes similar to those used in the Work shall be used in qualification tests. The CONTRACTOR shall furnish all material and bear the expense of qualifying welders.

1.05 MANUFACTURER'S SERVICE REPRESENTATIVE

- A. Where the assistance of a manufacturer's service representative is advisable, in order to obtain correct pipe joints, supports, or special connections, the Contractor shall furnish such assistance at no additional cost to the Owner.

1.06 MATERIAL DELIVERY, STORAGE, AND PROTECTION

- A. All piping materials, fittings, valves, and accessories shall be delivered in a clean and undamaged condition and stored off the ground to provide protection against oxidation caused by ground contact. All defective or damaged materials shall be replaced with new materials.

1.07 CLEANUP

- A. After completion of the work, all remaining pipe cuttings, joining and wrapping materials, and other scattered debris, shall be removed from the site. The entire piping system shall be handed over in a clean and functional condition.

PART 2 PRODUCTS

2.01 GENERAL

- A. All products shall be new and unused except as may be requested for testing and shall be the product of a reputable manufacturer regularly engaged in the manufacture of the product. Where two or more units of the same class are required, these units shall be products of a single manufacturer; however, the component parts of equipment need not be the products of the same manufacturer.
- B. All pipes, fittings, and appurtenances shall be installed in accordance with the requirements of the applicable Sections of Division 40 and furnished as specified herein.
- C. Pipe Supports: All pipes shall be adequately supported in accordance with the requirements of the "Pipe Supports" Section, and as shown.
- D. Lining: All requirements pertaining to thickness, application, and curing of pipe lining, shall be in accordance with the requirements of the applicable Sections of Division 40, unless otherwise specified.
- E. Coating: All requirements pertaining to thickness, application, and curing of pipe coatings, are in accordance with the requirements of the applicable Sections of Division 40, unless otherwise specified. Pipes above ground or in structures shall be field-painted in accordance with the Section entitled "Painting."

2.02 PIPE FLANGES

- A. Flanges: Where the design pressure is 125 psi or less, flanges shall conform to either ANSI/AWWA C115/A21.15 Class D or ANSI B16.1 125-lb class, unless otherwise specified in the applicable piping sections. Where the design pressure is greater than 150 psi, up to a maximum of 250 psi, flanges shall conform to either ANSI/AWWA C115/21.15 Class 125 or ANSI B.16.1 250-lb class, unless otherwise specified in the applicable piping sections. Flanges shall have flat faces and shall be attached with bolt holes straddling the vertical axis of the pipe unless otherwise shown. Attachment of the flanges to the pipe shall conform to the applicable requirements of ANSI/AWWA C115/A21.15. Flanges for miscellaneous small pipes shall be in accordance with the standards specified for these pipes.
- B. Blind Flanges: Blind flanges shall be in accordance with ANSI/AWWA C 207, or with the standards for miscellaneous small pipes. All blind flanges for pipe sizes 12-inches and over shall be provided with lifting eyes in the form of welded or threaded eye bolts.
- C. Flange Coating: All machined faces of metal blind flanges and pipe flanges shall be coated with a temporary rust-inhibitive coating to protect the metal until the installation is completed.
- D. Flange Bolts: If studs are required, they shall be in accordance with ASTM A 307, Grade B, with heavy hex nuts. Machine bolts, nuts, washers used on all flanged connections exposed to wastewater shall be AISI Type 304 stainless steel and shall conform to the requirements of ASTM F593 and F594, respectively. All other flange bolts and nuts shall be plain carbon steel and shall conform to ASTM A307. Nuts shall be hexagonal, heavy semi finished pattern in accordance with ANSI/ASME B18.2.2. Flange bolts and studs shall extend through the nuts a minimum of 1/4-inch.
- E. Flange Gaskets: Gaskets for flanged joints shall be of materials as specified in applicable piping sections. Blind flanges shall have gaskets covering the entire inside face of the blind flange and shall be cemented to the blind flange. Ring gaskets shall not be permitted.

2.03 GROOVED COUPLINGS

- A. Grooved couplings shall be provided where shown. Couplings shall be furnished with carbon steel bolts and nuts. Couplings shall be ductile iron or carbon steel with a fusion bonded epoxy coating, inside and out.

B. Suppliers for Steel Pipe Couplings, or equal:

1. Victualic Style 41 or 44 (banded).
2. Victualic Style 77 or 07 (grooved).
3. Gustin-Bacon (banded or grooved).
4. Depend-O-Lok (banded).
5. Note: Steel pipe couplings shall be furnished with Grade E rubber gaskets.

C. Suppliers for Ductile Iron Pipe Couplings, or equal:

1. Victualic Style 31.
2. Gustin-Bacon.
3. Depend-O-Lok Heavy Duty.
4. Note: Ductile iron pipe couplings shall be furnished with grade M flush seal gaskets.

D. Suppliers for PVC Pipe Couplings, or equal:

1. Victualic Style 775.
2. Gustin-Bacon
3. Note: PVC pipe couplings shall be furnished with grade E gaskets and radius cut or standard roll grooved pipe ends.

2.04 DISMANTLING JOINTS

- A. Dismantling joints shall be provided at the locations shown on the drawings. Dismantling joint flange shall conform to C207 with ANSI 150 bolt pattern and shall have a rated working pressure for pressures equal to or greater than that of the adjacent piping.
- B. Steel used in the manufacture of the dismantling joints for diameters greater than 12 inches shall conform to the requirements of ASTM A283 Grade C and ASTM A53. Ductile iron conforming to ASTM A56 Grade 65-45-12 shall be used for the flange adapter for pipe diameters 12 inches and smaller.
- C. The dismantling joint shall be restrained using 304 stainless steel tie rods extending from flange to flange. Use of point-load restraining bolts placed circumferentially around the flange adapter end of the joint shall not be permitted.
- D. The dismantling joint shall be shop coated with fusion bonded epoxy in accordance with AWWA C213-01 and NSF 61.
- E. Gaskets used with dismantling joints shall be nitrile (Buna-N) gaskets.
- F. Dismantling joints shall be manufactured by Romac Industries, Inc., or approved equal.

2.05 FLANGE ADAPTERS

- A. Flange adapters shall be made of ductile iron conforming to ASTM A536 and have flange bolt circles that are compatible with ANSI/AWWA C110/A21.10 (125#/Class 150 Bolt Pattern).
- B. Restraint for flange adapter shall consist of a plurality of individual actuated gripping wedges to maximize restraint capability. Torque limiting actuating screws shall be used to insure proper initial set of gripping wedges.
- C. The flange adapters shall be capable of deflection during assembly or permit lengths of pipe to be field

cut to allow a minimum 0.6 inch gap between the end of the pipe and the mating flange without affecting the integrity of the seal.

- D. All internal surfaces of the gasket ring (wetted parts) shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213. Sealing gaskets shall be constructed of EPDM. The coating and gaskets shall meet ANSI/NSF-61. Exterior surfaces of the gasket ring shall be coated with a minimum of 6 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C116/A21.16.
- E. For PVC pipe, the flange adapter will have a pressure rating equal to the pipe.
- F. For ductile iron pipe, the flange adapter shall have a safety factor of 2:1 minimum.
- G. The flange adapter shall be the Series 2100 MEGAFLANGE® Restrained Flange Adapter as produced by EBAA Iron, Inc. or approved equal.

2.06 SLEEVE-TYPE COUPLINGS

- A. Construction: Sleeve-type couplings shall be provided where shown, without a pipe stop, and shall be of sizes to fit the pipe, and fittings shown. The middle ring shall be not less than 1/4-inch in thickness and shall be either 5 or 7-inches long for standard steel couplings, and 16-inches long for long-sleeve couplings. The followers shall be single-piece contoured mill section welded and cold-expanded as required for the middle rings. They shall be of sufficient strength to accommodate the number of bolts necessary to obtain adequate gasket pressures without excessive rolling. The shape of the follower shall be of such design as to provide positive confinement of the gasket. Bolts and nuts shall conform to the requirements of Section entitled "Metal Fabrications".
- B. Pipe Preparation: The ends of the pipe, where specified or shown, shall be prepared for sleeve-type couplings. Plain ends for use with couplings shall be smooth and round for a distance of 12-inches from the ends of the pipe, with outside diameter not more than 1/64-inch smaller than the nominal outside diameter of the pipe. The middle ring shall be tested by cold-expanding a minimum of one percent beyond the yield point, to proof-test the weld to the strength of the parent metal. The weld of the middle ring shall be subjected to an air test porosity by the manufacturer.
- C. Gaskets: Gaskets for sleeve-type couplings shall be Buna-N.
- D. The gaskets shall be immune to attack and degradation by the material which is being transported. All gaskets shall meet the requirements of ASTM D2000, AA709Z, meeting Suffix B13 Grade 3, except as noted above.
- E. Insulating Couplings: Where insulating couplings are required, both ends of the coupling shall have a wedge-shaped gasket which assembles over a rubber sleeve or an insulating compound in order to obtain insulation of all coupling metal parts from the pipe.
- F. Restrained Joints: Where harnesses are required for sleeve-type couplings, they shall be in accordance with the requirements of the appropriate reference standard, or as shown. Harnesses/Restrained Joints shall have a minimum pressure rating of the pipe/joint pressure rating.
- G. Supplier, or equal:
 - 1. Rockwell (Smith-Blair), Style 411.
 - 2. Dresser, Style 38.
 - 3. Ford Meter Box Co., Inc. Style FC1 or FC3.
 - 4. Depend-O-Lok, Type FXF.

2.07 INSULATING CONNECTIONS

- A. Insulating connections shall be made using clearflow dielectric pipe nipples unless otherwise specified or shown.
- B. General: Insulating bushings, unions, or couplings, as appropriate, may be used, if approved by the Engineer, for joining threaded pipes of dissimilar metals and for piping systems or connections where corrosion control and cathodic protection are involved.
- C. Materials: Insulating connections shall be of nylon, Teflon, poly-carbonate, polyethylene, or other nonconductive materials, and shall have ratings and properties to suit the service and loading conditions.

2.08 REINFORCED FLEXIBLE PIPE COUPLING

- A. Reinforced flexible piping couplings shall be as manufactured by Mercer Rubber Company, General Rubber Co., Metraflex or equal.
- B. The coupling shall be rated for a minimum working pressure of 150 psig or higher as required for the individual piping system and shall be constructed of Kevlar reinforcing and natural rubber elastomer rates for a maximum temperature of 180 degrees F. A hypalon coating shall be applied to the exterior of the elastomer.
- C. All couplings shall have integrally molded flanges with split and beveled galvanized steel retaining rings. Galvanized steel washers shall be provided at the point where the rings are split. Bolt holes and bolt circle patterns shall conform to the mating flange patterns as specified in the piping paragraphs. Coupling lengths shall be as shown on the Drawings.
- D. Control units shall be 316 stainless steel and shall be provided and installed with all flexible pipe couplings. The control unit shall be supplied by the coupling manufacturer.

2.09 PIPE INSULATION

- A. Hot and cold liquid piping, flues and engine exhaust piping shall be insulated as shown on the Drawings. No unprotected hot piping shall be within reach of operating personnel or others.

2.10 UNIONS

- A. Ground joint type – materials and pressure class to match the respective piping system.
- B. Dielectric type – provide between piping systems of dissimilar metals or between piping and equipment of dissimilar metals. Where the use of dielectric unions are shown on the Drawings, the use of insulated bushings or couplings are not acceptable.

2.11 SERVICE SADDLES

- A. Service pipe saddle shall fit to the maximum O.D. of the saddle's range, and extend a minimum of 160 degrees around the pipe. When the saddle is used on pipe to the minimum pipe size of the range, the saddle shall extend 180 degrees around the pipe. Service saddles shall have a minimum pressure rating of 300 psi. Straps shall have ends chamfered and be provided with Class 2 fit, National Coarse Threads. Saddle casting shall be ductile iron, double strap and shall have epoxy or "Rilsan" coating. Straps shall be stainless steel. Valve gaskets shall be self-sealing neoprene or BUNA-N except for chlorine lines which shall be viton.
- B. Suppliers for Service Saddles less than 4", or equal:
 - 1. Smith-Blair #317.

2. Mueller series #DR2S.
 3. Romac Style 101NS.
- C. Suppliers for Service Saddles 4" or larger, or equal:
1. Smith-Blair #317.
 2. Mueller series #DR2S.
 3. Romac Style 202NS.

2.12 BELL X MALE THREAD ADAPTERS

- A. General: All adapters shall be manufactured of Ductile Iron conforming to ASTM A536-72, minimum grade 65-45-12. Fittings meet all requirement of AWWA C153. Fittings are of the all-bell rubber ring connecting type joints.
- B. Gaskets: Gaskets to meet requirements of AWWA C111 for Push-on Joint gaskets.
- C. Coating: Coated with Asphalt coating in accordance with AWWA C-153 standard.
- D. Suppliers for Adapters, or equal:
1. Harco

2.13 MODULAR ANNULAR SEALING DEVICES

- A. Modular annular sealing devices shall be of the modular mechanical type, utilizing interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe sleeve and the passing pipe. Rubber links shall be EPDM rubber per ASTM D2000 M3 BA510. Assemble links with Type 316 stainless-steel bolts to form a continuous rubber belt around the pipe, with a glass reinforced nylon pressure plate under each bolthead and nut. Devices shall be Link-Seal or equal.
- B. The size of the wall sleeve needed to accommodate the passing pipe shall be as recommended by the modular annular seal manufacturer.
- C. Wall sleeves for modular annular sealing devices shall be galvanized in accordance with ASTM A 123 or molded high density polyethylene Model CS as manufactured by Link-Seal.

PART 3 EXECUTION

3.01 GENERAL

- A. The Contractor shall furnish all labor, tools, materials, and equipment necessary for installation and jointing of the pipe. All piping shall be installed in accordance with the Drawings in a neat workmanlike manner and shall be set for accurate line and elevation. All piping shall be thoroughly cleaned before installation, and care shall be taken to keep the piping clean throughout the installation.
- B. The Contractor shall investigate all conditions affecting his work, arrange the work accordingly, and have such fittings and accessories as required on hand to meet the condition and provide a complete installation. The pipelines shall be laid to the elevations shown on the plans and shall have a minimum depth of cover of 3'-0". The pipelines shall be installed by qualified and competent workmen in strict accordance with the manufacturer's instructions and recommendations. The pipe manufacturer shall provide the services of a field representative to instruct the Contractor on proper handling and installation of the pipelines.
- C. Before setting wall sleeves, pipes, castings and pipes to be cast in place, the Contractor shall check the Drawings and equipment manufacturer's drawings which may have a direct bearing on the pipe locations.

The Contractor shall be responsible for the proper location of the pipes and appurtenances during the construction of and renovation of all tanks and structures.

- D. Piping shall be attached to pumps, valves and equipment, in accordance with the respective manufacturers' recommendations.
- E. For piping assembled with threaded, solvent welded, welded or soldered joints, liberal use of unions shall be made. Unions shall be provided close to main pieces of equipment and in branch lines to permit ready dismantling of piping without disturbing main pipe lines or adjacent branch lines. A minimum of one union per straight run of pipe between fitting and/or valves with multiple lengths of pipe shall be used.
- F. All changes in directions or elevations shall be made with fittings.
- G. The Contractor shall plan his job to minimize the necessity for cutting. Cutting that absolutely must be done shall be by use of approved mechanical or roller chain cutters. The work shall be done by workmen experienced in pipe cutting and shall be accomplished in such a manner as not to damage the lining or coating of the pipe.
- H. All changes in direction or elevation shall be made with fittings except for Flexible Process Tubing or as noted in the piping paragraphs.

3.02 SHIPPING, HANDLING AND STORAGE

- A. Special care in handling shall be exercised during delivery, distribution and storage of pipe to avoid damage and setting up stresses. Damaged pipe will be rejected and shall be replaced at the Contractor's expense. Pipe and specials stored prior to use shall be stored in such a manner as to keep the interior free from dirt and foreign matter.
- B. No pipe shall be dropped from cars or trucks to the ground. All pipe shall be carefully lowered to the ground by mechanical means. In shipping, pipe and fittings shall be blocked in such manner as to prevent damage to castings or lining. Any broken or chipped lining shall be grounds for rejection of the pipe for installation. The Engineer will be the final judge as to the acceptability of any material on the project.
- C. All mechanical joint pipe shall be laid with 1/8-inch space between the spigot and shoulder of pocket.

3.03 LAYING PIPE

- A. Proper and suitable tools and appliances for the safe convenient handling and laying of pipe shall be used and shall, in general, agree with manufacturer's recommendation. At the time of laying, the pipe shall be examined carefully for defects, and should any pipe be discovered to be defective after being laid, it shall be removed and replaced with sound pipe by the Contractor at his expense.
- B. All piping shall be laid with the bells facing up slope for all slopes greater than 20%.
- C. All earthwork including excavation, backfill, bedding, compaction, sheeting, shoring and bracing, dewatering and grading shall be performed in accordance with the applicable Sections of Division 310000.
- D. Upon satisfactory excavation of the pipe trench and completion of the pipe bedding, a continuous trough for the pipe barrel and recesses for the pipe bells, or couplings, shall be excavated by hand digging. When the pipe is laid in the prepared trench, true to line and grade, the pipe barrel shall receive continuous, uniform support and no pressure shall be exerted on the pipe joints from the trench bottom.
- E. All piping 3-inches and larger shall be provided with two 4-foot-lengths of pipe for the first two joints outside a building or tank wall unless a greater number of joints is shown on the Drawings.
- F. Pipe shall be installed by qualified and competent workmen in strict accordance with the manufacturer's

recommendation. Pipe shall not be laid in a wet or unstabilized trench. Before being lowered into the trench, the pipes and accessories shall be carefully examined and the interior of the pipes shall be thoroughly cleaned of all foreign matter and other acceptable methods. At the close of each work day and during suspension of work for any reason at any time, a suitable stopper shall be placed in the end of the pipe last laid to prevent mud, water or other foreign material from entering the pipe.

- G. Lines shall be laid straight and depth of cover shall be maintained uniform with respect to finish grade, whether grading is completed or proposed at time of pipe installation. Where a grade or slope is shown on the Drawings, the Contractor shall use laser based surveying instruments to maintain alignment and grade. At least one elevation shot shall be taken on each length of pipe and recorded. No abrupt changes in direction or grade will be allowed.
- H. Aligning Pipe: Pipe runs intended to be straight shall be laid straight. When horizontal or vertical deflections are required, the angular divergence of the axis of any two adjacent lengths of pipe shall not exceed three-fourths of the manufacturer's recommended allowable deflection.
- I. All underground piping shall be properly blocked at all fittings, where the pipeline changes direction, changes size, or ends, using cast in place concrete thrust blocks. All concrete blockings shall be at the locations shown and as indicated on the plans. In all cases, the concrete shall be placed directly against the wall of the trench opposing the thrust of the pipeline. The trench wall that is to act as a form for the concrete shall be vertical and shall be finished by hand to a smooth, firm surface. If necessary for stabilization, the trench wall shall be given a plaster coat of cement mortar. No concrete shall be placed until the Engineer has approved the excavation. Should over-excavation occur either below the base of anchor block or in the trench wall, the over-excavated areas shall be filled with concrete. All clamps, rods, bolts and other structural shapes used in anchors and blocks and not encased in concrete shall be Type 304/316 stainless steel, unless otherwise specified. Concrete for thrust blocks shall be Class B (3,000 psi) as specified in the Cast In Place Concrete Section. No concrete blocking shall be placed within 3-inches of the jointing area to allow for future maintenance work. All blocks shall have neat lines. All underground restrained joint piping and fittings shall be provided with concrete thrust blocks unless otherwise accepted by the Engineer.
- J. Conflicting Utilities: The trench shall be excavated a distance of 150 feet in advance of the completed pipe laying operation to allow the Engineer sufficient time to check the grades and the owner(s) of the utilities sufficient time to relocate them should it be necessary. The owner(s) shall be given ample notice in order to permit the required removal to be accomplished without delaying construction of the project. Any delay in construction resulting from the relocation of utility lines or their appurtenances will not be grounds for additional payment to the Contractor.

3.04 FLANGED JOINTS

- A. Flanged joints shall be made up with full face gaskets as specified in the piping paragraphs. Flange faces shall have a uniform bearing on the gaskets. Flanges shall be drawn together uniformly until the joint is tight. The length of the bolts shall be uniform and in accordance with the requirements specified herein. The bolt's maximum projection beyond the end of the nut shall be ½-inch maximum and ¼-inch minimum

3.05 WELDED JOINTS

- A. Welded joints shall be shop fabricated in accordance with the standards and specifications contained herein.
- B. Field welding will be permitted for black carbon steel pipe where it can be demonstrated that the interior of the pipe can be satisfactorily lined and inspected. Welding in the field shall be performed only when requested on the shop drawings and accepted by the Owner and Engineer in writing as specified herein.
- C. All welding shall be performed in accordance with ANSI B31.1 and AWWA C206 except as modified or supplemented herein. All welders shall be AWS certified in accordance with AWWA C206, and ANSI B31 requirements.

- D. Pipe and fittings with wall thicknesses of 3/16-inch and larger shall have ends beveled for welding. Bevels shall be 30 degrees with a maximum of 37½ degrees. The abutting pipe ends shall be separated before welding to permit complete fusion to the inside wall of the pipe without overlapping. Welding shall be continuous around the joint and shall be completed without interruption. Welds shall be of the single vee butt type, of sound weld metal thoroughly fused into the ends of the pipe and into the bottom of the vee. Welds shall be free from cold spots, pin holes, oxide inclusions, burrs, snags, rough projections or other defects.
- E. Filler metal for welding shall be of the same composition as the base metal. All welding of steel pipe flanges shall be in accordance with requirements of AWWA C207 and ANSI B31.1.
- F. Field repairs of cement mortar lining at welded joints shall be made in accordance with AWWA C205 Appendix A or AWWA C602.
- G. Field welds shall be "fixed position" type.
- H. All field welds shall be radiographically inspected by the Contractor if so ordered by the Engineer.

3.06 THREADED JOINTS

- A. All threads shall be clean, machine cut and all pipe shall be reamed before erection. Taps and dies shall be cleaned, sharpened and in good condition. All threaded joints shall be made tight with Teflon tape or Teflon thread sealer.
- B. After having been set thus, a joint shall not be backed off unless the joint is broken, the threads cleaned and new tape is applied.

3.07 SOLVENT WELDED JOINTS

- A. Joints shall be made up in accordance with ASTM D 2855 and the manufacturers' recommendations. The Contractor shall handle the solvent cements in accordance with ASTM F 402.

3.08 GROOVED COUPLINGS

- A. Grooved couplings shall be installed so that the coupling is firmly and completely seated against the seating faces of the grooves. Expansion of the grooved coupling when subjected to pressure shall not be permitted. The responsibility of repairing any damage caused by the expansion of the grooved coupling shall be born by the Contactor.

3.09 THRUST RESTRAINT

- A. Where the distance between adjacent flanges is in excess of ten feet or where a harness cannot be used, the pipe supports adjacent to the coupling shall restrain the piping preventing any linear or angular movement resulting in the pipe separating from the coupling or misalignment in the joint.
- B. All buried tie rods and associated hardware shall be AISI 316 stainless steel.
- C. In general, all valves and fittings shall be restrained in an acceptable manner such that the unbalanced force developed at them shall be supported independent of the piping system.
- D. On all piping, where sleeve-type couplings and flanged adaptors are located near fittings or valves, tie rods shall span across the coupling as specified herein to restrain movements of the pipe along its axial direction. Such restraints can be deleted if both ends of the pipe are anchored in a concrete structure with no fitting or valve occurring within the span length, in the suction piping to a pump where the coupling is between the pump and valve, or when the water pressure measured at the crown of the pipe is less than five feet.

- E. All sleeve-type couplings shall be harnessed except where noted specifically on the Drawings or as specified herein.
- F. Where expansion joints are used, control units shall be provided. All tie rods and control units shall be installed in accordance with the manufacturer's recommended procedures.
- G. Harnesses for ductile iron pipe shall be as shown on the Drawings.
- H. The following abbreviations are used in the project:

1. Material

304 SS	304 Stainless Steel (nonwelded joints) or 304L Stainless Steel - low carbon (welded joints)
316 SS	316 Stainless Steel (nonwelded joints) or 316L Stainless Steel - low carbon (welded joints)
AL	Aluminum
CPVC	Chlorinated Polyvinylchloride
DI	Ductile Iron
PVC	Polyvinyl Chloride

2. Wall Thickness

CL	Class
SCH	Schedule
SDR	Standard Dimension Ratio

3. Joint Type

CID	Cast Iron Drainage Fitting
FLG-	Flanged
MJ	Mechanical Joint
PO	Push on Joint
RJ	Restrained Joint

4. Fitting Type

304 SS	304 Stainless Steel (nonwelded joints) or 304L Stainless Steel - low carbon (welded joints)
316 SS	316 Stainless Steel (nonwelded joints) or 316L Stainless Steel - low carbon (welded joints)
AI	Aluminum
CPVC	Chlorinated polyvinylchloride
DI	Ductile Iron
PVC	Polyvinylchloride

5. Interior Surface Protection

CL	Cement Lined
EC	Epoxy Coated
PEL	Polyethylene Lined
PVC	PVC Liner

6. Exterior Surface Protective Coating

AC	Asphalt Coated
P	Painted

END OF SECTION

PIPING SCHEDULE

Service	Nominal Pipe Diameter (Inches)	Material	Schedule	Working Press PSIG	Type of Joints	Type of Fittings	Protective Coating	
							Interior	Exterior
All unless otherwise noted								
Above Ground	All	DI	--	--	FLG	DI	CL (PW) PEL/EC (FM)	P
*Below Ground	All	DI	--	--	MJ/RJ	DI	CL (PW) PEL/EC (FM)	AC
Potable Water (PW)	All	C-900	DR 14	305	MJ/RJ	DI	CL	AC
Drain: Below Ground	ALL	PVC	SCH 80	--	SW	PVC	--	
*Refer to specifications for type of restrained joint.								

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BARTLETT —  **WEST**

SECTION 400514
DUCTILE IRON PIPE

PART 1 GENERAL

1.01 WORK INCLUDED

- A. The Contractor shall furnish and install ductile iron pipe and all appurtenant work, complete in place, all in accordance with the requirements of the Contract Documents.

1.02 SUBMITTALS

- A. Shop Drawings: The Contractor shall submit Shop Drawings of pipe and fittings in accordance with the requirements in the General Conditions.

PART 2 PRODUCTS

2.01 GENERAL

- A. All ductile-iron pipe shall conform to the requirements of ANSI/AWWA C151/A21.51. The wall thickness and outside diameter of the pipe shall conform to Tables 51.4 and 51.5 of AWWA C151. All ductile iron pipe shall be Pressure Class 350, except as noted otherwise.
- B. The thickness classes indicated herein are the minimum permitted unless otherwise specified. Each pipe shall be cast with the year of manufacture, the class and the letters "DI" for ductile iron.
- C. All gaskets shall be Buna-N for wastewater service and EPDM for water service.

2.02 FITTINGS

- A. Fittings for use with the ductile iron pipe specified herein, shall be ductile iron. Cast ductile-iron fittings shall be pressure rated for at least 350 psi. All fittings with mechanical joints, flange joints and push-on joints shall conform to ANSI/AWWA C110/A21.10 or C153/A21.53. In addition, fittings with mechanical joints and push-on joints shall conform to ANSI/AWWA C111/A21.11, except that Buna-N gaskets shall be used for the joint for wastewater service. The fitting manufacturer shall furnish the proper gaskets, nuts, bolts, glands, for each type of joint. All fittings shall be American made with uniform flange/gland thickness.

2.03 JOINTS

- A. All ductile iron pipe and fittings intended for interior use and for use above grade shall be flanged as shown or specified. All pressurized ductile iron pipe and fittings for use below grade shall have thrust restrained joints and/or thrust blocks as shown or specified.

2.04 GASKETS

- A. Gaskets for flanges shall be full face, 1/8 inch thick, Buna-N.

- B. Push on, mechanical joint and thrust restraint joints shall be Buna-N.
- C. Gaskets for air service shall be suitable for 250° F air.

2.05 FLANGED PIPE

- A. Flanges shall be ductile iron conforming to ANSI/AWWA C115/A21.15, flat faced. The use of hollowback or cavitated flanges will not be acceptable. Joint gaskets shall be full face gaskets. Flange bolts and nuts are covered in Section entitled "Piping, General."

2.06 MECHANICAL JOINT PIPE

- A. All mechanical joint pipe and fittings shall be furnished with Type 304-316 stainless steel tee head bolts and hex nuts with teflon coated nuts. All other external nuts and bolts for buried service shall be Type 304-316 stainless steel. Bolt and nut composition, dimensions and threading in accordance with ANSI/AWWA C111/A21.11. Segmented glands will not be acceptable. Bolt holes for mechanical joints shall be equally spaced, and shall straddle the vertical centerline.

2.07 THRUST RESTRAINED JOINTS

- A. Thrust restrained joints for ductile iron pipe and fittings shall be Flex-Ring, as manufactured by the American Cast Iron Pipe Co., mechanical joint with retainer glands or MJ close coupled for buried installation, and flanged for exposed or above ground installation. The restraining components, when not cast integrally with the pipe and fittings, shall be ductile iron or a high strength corrosion-resistant alloy steel. Tee head bolts and hexagonal nuts for all restrained joints in pipe and fittings shall be Type 304-316 stainless steel with teflon coated nuts and composition, dimensions and threading as specified in ANSI/AWWA C111/A21.11, except that the length of the bolts shall meet the requirements for the restrained joint design. All restrained joints shall be per the pipe manufacturer's supplied systems or by specific written acceptance by the pipe manufacturer of other systems designed for this particular project.
- B. For cut grooved retainers, the thickness of barrel left after grooving shall not be less than the nominal wall thickness of equal sized nonrestraining pipe as specified hereinabove for the centrifugally cast ductile iron pipe. The gasket and joint accessories shall be shipped in suitable protective containers. Completed grooved joints shall be rigid and shall not allow angular deflection or longitudinal movement.
- C. Each restrained joint and the pipe and fitting of which it is a part, shall be designed to withstand the axial thrust neither from an internal pipeline pressure of at least 250 psi at bulkhead conditions without reduction because of its position in the pipeline nor from support by external thrust blocks. Unless otherwise specified, restrained joint pipe and fittings other than flanged joints or grooved end joints shall be capable of being deflected after assembly. Completed grooved joints shall be rigid and shall not allow angular deflection or longitudinal movement.
- D. Restrained Mechanical Joint Pipe: Restrained mechanical joint pipe shall only be used where specifically delineated on the Drawings.

- E. Mechanical joints with retainer glands for ductile iron pipe and fittings shall utilize a restraining follower gland which, when actuated, imparts multiple wedging action against the pipe, increasing its resistance as the pressure increases. Glands shall be a single piece, manufactured of ductile iron, conforming to ASTM A536. Restraining devices shall be of ductile iron heat treated to a minimum hardness of 370 BHN. Dimensions shall be such that the gland can be used with the standardized mechanical joint bell and tee head bolts. Twist off nuts, sized same as tee head bolts, shall be used to insure proper actuating of restraining devices. The mechanical joint shall have a working pressure of at least 350 psi for 4-16" and 250 psi for 18-48" with a minimum safety factor of 2:1 and shall be MEGALUG Series 1100 as manufactured by EBAA Iron, Inc., or equal.
- F. Restrained flanged coupling adapters shall be series 2100 Megaflange as manufactured by EBAA Iron, Inc. or RFCA as manufactured by Romac Industries, Inc. Adapter shall have a fusion bonded epoxy coating and stainless steel bolts and nuts.

2.08 INTERIOR COATING

- A. Inside coatings of all ductile iron pipe and fittings for water service shall be cement lined in accordance with AWWA C104/ANSI A21.4. Special attention shall be given to the lining of fittings. Lining shall be applied to bare metal. All lining shall extend to the faces of flanges, to the end of spigots, or to the shoulder of hubs, as the case may be.

2.09 EXTERIOR COATING

- A. An asphaltic coating shall be applied to the exterior of all ductile iron pipe and fittings intended for buried service and shall conform to ANSI/AWWA C151/A21.51. The exterior of all piping in the pump stations shall be coated with Tnemec 46-413 as specified in the Painting Section. All ductile iron pipe and fittings intended for interior use and for use above grade shall receive a prime coat of universal primer as specified in the Painting Section that is compatible with the specified coating system.

2.10 WALL PIPE

- A. Ductile iron wall pipes shall be installed at locations where piping passes through walls or floors and shall have intermediate flanges for anchorage in the concrete. Wall pipe shall have the same joints as pipe installed or as otherwise shown on the drawings.

2.11 PIPE SUPPORTS AND BRACKETS

- A. General: Pipe supports shall be constructed as indicated on the drawings. Fabrication of brackets and supports shall conform to applicable requirements of Section "Metal Fabrication".

2.12 CORROSION PROTECTION

- A. The exterior of all buried ductile iron piping, fittings, and valves shall be protected from corrosion by a seamless linear low-density polyethylene (LLDPE) tube conforming to ANSI/AWWA C105/A21.5 with a minimum thickness of 8 mils.

- B. The tube shall have markings placed at two-foot intervals and include the manufacturer's name and/or trade mark, the year of manufacture, the standard designation ANSI/AWWA C105/A21.5, the minimum film thickness and material type, the application range of pipe nominal diameters for the film, and a warning notice: "Warning - Corrosion Protection – Repair any Damage."
- C. Certification shall be in accordance with Section 5.1.
- D. Corrosion protection supplied in 48-inch wide flat sheets shall be used to cover irregular shaped valves, fittings and appurtenances not protected by the tube form of polyethylene wrap.
- E. Securing tape shall be 2-inch wide by ten (10) mil thickness and supplied by the pipe manufacturers.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Unless otherwise directed, ductile iron pipe shall be laid with the bell ends facing upstream in the normal direction of flow and in the direction of laying.
- B. Restrained joints shall be made in accordance with the manufacturer's standards except as otherwise specified herein. Joints between mechanical joint pipe and/or fittings shall be made in accordance with the manufacturers recommendations, except that deflection at joints shall not exceed three/fourths of the manufacturer's recommended allowable deflection. Grooved joints shall be fully "extended" to eliminate expansion and pipe movement.
- C. Before laying restrained joint pipe and fittings, all lumps, blisters and excess bituminous coating shall be removed from the bell and spigot ends. The outside of each spigot and the inside of each bell shall be wire brushed, and wiped clean and dry. The entire gasket groove area shall be free of bumps or any foreign matter which might displace the gasket. The cleaned spigot and gasket shall not be allowed to touch the trench walls or trench bottom at any time. Vegetable soap lubricant shall be applied in accordance with the pipe manufacturer's recommendations, to aid in making the joint. The workmen shall exercise caution to prevent damage to the gasket or the adherence of grease or particles of sand or dirt. Deflections shall only be made after the joint has been assembled.
- D. Prior to making up flanged joints in ductile iron pipe and fittings, the back of each flange under the bolt heads and the face of each flange shall have all lumps, blisters and excess bituminous coating removed and shall be wire brushed and wiped clean and dry. Flange faces shall be kept clean and dry when making up the joint, and the workmen shall exercise caution to prevent damage to the gasket or the adherence of grease or particles of sand or dirt. Bolts and nuts shall be tightened by opposites in order to keep flange faces square with each other, and to insure that bolt stresses are evenly distributed.
- E. Bolts and nuts in thrust restrained, mechanical and flanged joints shall be tightened in accordance with the recommendations for the pipe manufacturer for a leak-free joint. The mechanics shall exercise caution to prevent overstress. Torque wrenches shall be used until, in the opinion of the Engineer, the mechanics have become accustomed to the proper amount of pressure to apply on standard wrenches.
- F. Cutting of the ductile iron pipe for inserting valves, and fittings shall be done by the Contractor in a neat and workmanlike manner without damage to the pipe, the lining, or the coating. Pipe 16 inches and

larger in diameter shall be cut with a mechanical pipe saw. After cutting the pipe, the plain end shall be beveled with a file or grinder to remove all sharp edges.

- G. Areas of loose or damaged lining associated with field cutting shall be replaced as recommended by the pipe manufacturer and required by the Engineer. Repair methods shall be as recommended by the manufacturer and shall be submitted to the Engineer for approval.
- H. Any work within the pipe shall be performed with care to prevent damage to the lining. NO cable, lifting arms or other devices shall be inserted into the pipe. All lifting, pulling or pushing mechanisms shall be applied to the exterior of the pipe barrel.
- I. Assembly of the pipe joints shall be accomplished by the use of a hydraulic or mechanical pulling device, unless otherwise accepted by the Engineer. No pipe shall be driven or struck in order to seat it home.
- J. Protective coating for DIP pipe, fittings, and valves shall be provided by the use of 8 mil polyethylene loose fitting tubing. The tubing shall be bunched up at each end to provide for overlap to adjoining pipe by 1 foot. The wrapping on the adjacent pipe is pulled over the bell and secured with three circumferential turns of polyethylene adhesive tape. The resulting loose wrap on the barrel of the pipe shall be pulled snugly around the barrel and taped at 3 foot intervals. The Contractor shall use care in backfilling as to avoid tearing and shall repair all holes in the wrapping.
- K. Cleaning methods shall be acceptable to the Engineer, and must be sufficient to remove silt, rocks, or other debris which may have entered the pipeline during its installation and shall also follow the requirements of Section entitled "Pipeline Testing".
- L. Taps shall be made using service saddles as specified in the "Piping, General" section. Direct tapping of ductile iron pipe walls will not be acceptable unless specifically delineated on the Drawings.

END OF SECTION

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SECTION 400517
PVC PRESSURE PIPE

PART 1 PART 1 GENERAL

1.01 WORK INCLUDED

- A. The Contractor shall furnish and install polyvinyl chloride (PVC) pressure pipeline, complete in place, all in accordance with the requirements of the Contract Documents.

1.02 CONTRACTOR SUBMITTALS

- A. Shop Drawings. The Contractor shall submit shop drawings of pipe, fittings, and appurtenances in accordance with the requirements in Section entitled "Submittals".
- B. Certifications. The Contractor shall furnish a certified affidavit of compliance for all pipe and other products or materials furnished under this Section of the Specifications, as specified in the referenced standards and the following supplemental requirements:
 - 1. Hydrostatic proof test reports.
 - 2. Sustained pressure test reports.
 - 3. Burst strength test reports.
- C. All expenses incurred in making samples for certification of tests shall be borne by the Contractor.

1.03 QUALITY ASSURANCE

- A. Tests. Except as modified herein, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of this Section of the Specifications, as specified in the referenced standards, as applicable.
- B. In addition to those tests specifically required, the Engineer may request additional samples of any material for testing by the Owner. The additional samples shall be furnished at no additional cost to the Owner.

PART 2 PRODUCTS

2.01 GENERAL

- A. PVC pressure pipe shall conform to the applicable requirements of ANSI/AWWA C900 and C905 or ASTM D 2241, per Drawings. Pressure rating and dimension ratio shall be as specified or noted in the Drawings.
- B. PVC pipe shall be blue in color for water.

2.02 ASTM PVC PRESSURE PIPE

- A. Materials shall conform to ASTM D1784 (Cell Classification 12454-B) PVC 1120.
- B. Pipe shall be PVC plastic conforming to ASTM D 2241, Class 200, SDR 21. Pipe shall be Iron Pipe Size.

- C. Restrained pipe shall be by Class 250, shall use a gasketed, spline inter-lock system, and shall be as manufacture by CertainTeed "Yellowmine", Victaulic "Aquamine" or equal.
- D. Pipe joints should be single gasketed with integral bell joints in conformance with ASTM D3139. Gasket material shall be per ASTM F477.
- E. Fittings. All fittings shall be push joint or mechanical joint ductile iron fittings meeting AWWA C110 or C153.
- F. Restrained PVC pipe joints and fittings. For mechanical joint applications the restraint device shall use wedge feature, not set screws. EBAA Iron Series 2000, Ford Series 1500, or equal. For push joint applications the restraint device shall use a serrated ring. EBAA Iron Series 6500, Ford Series 1390, or equal.

2.03 AWWA PVC PRESSURE PIPE, 4-INCHES AND LARGER

- A. The pipe shall be of the diameter and pressure class specified or shown, shall be furnished complete with rubber gaskets, and all specials and fittings. The dimensions and pressure classes for Dimension Ratios for PVC pressure pipe with Cast-Iron Pipe Equivalent O.D.'s shall conform to the requirements of AWWA C900 and C905.
- B. Joints: All joints for the buried PVC pipe shall be an integral bell manufactured on the pipe. The bell shall be the same thickness as of the pipe barrel, or greater thickness. The gasket shall be snugly seated in deep grooves to prevent gasket roll-out during assembly.
- C. Joint Deflection. Deflection at the joint shall not exceed 1.5 degrees or three-fourths the maximum deflection recommended by the manufacturer, whichever is less. No deflection of the joint shall be allowed for joints which are overbelled or not belled to the stop mark.
- D. FITTINGS
 - 1. Fittings shall be mechanical joint ductile iron conforming to ANSI AWWA C110/A21.10 or C153/A21.53, and shall be rated for a working pressure of 350 psi.
 - 2. Each fitting shall be clearly labeled to identify its size and pressure class.
- E. Restrained joint PVC pipe shall be restrained either mechanically through the use of external restraints using grip wedges or serrations; spline restrained grooved pipe end and coupling; or fusible pipe joints. Restrained piping systems shall be as follows:
 - 1. Series 1900 restraint harness as manufactured by EBAA Iron, Inc., or approved equal.
 - 2. Certa-Lok C900/RJ as manufactured by CertainTeed, or Eagle Loc 900 as manufactured by JM Eagle.

2.04 PVC (POLYVINYL CHLORIDE) PRESSURE PIPE, 3½-INCHES IN DIAMETER AND SMALLER

- A. Solvent Welded: PVC pipe in sizes 1-¼ to 3½-inches in diameter shall be made from all new rigid unplasticized polyvinyl chloride and shall be CELL CLASSIFICATION 12454-B, Schedule 80, and shall conform to ASTM D 1785. Fittings shall comply with ASTM D 2464 and shall be made of the same material and have the same pressure rating of the pipe. Solvent cement shall conform to ASTM D 2564 and the primer shall conform to ASTM F 656.
- B. Gasketed PVC pipe in sizes 1-½ to 3½-inches in diameter shall be made from all new rigid unplasticized polyvinyl chloride and shall be CELL CLASSIFICATION 12454-B 26 (160 psi), and shall conform to ASTM

D 2241. Fittings shall comply with ASTM D 3139 and shall be made of the same material and have the same pressure rating of the pipe. Gaskets shall conform to ASTM F 477.

- C. Unless otherwise shown, joint design for above ground PVC pipe shall be solvent welded and gasketed for buried installations.

2.05 THRUST RESTRAINT

A. Thrust Restraint:

1. Thrust restraint shall be provided at all horizontal and vertical bends as shown on the Drawings. Thrust restraint shall be provided using restrained joints on either side of the restrained fitting or piping component. The use of concrete thrust blocks as a means of joint restraint shall not be allowed unless specifically indicated on the Drawings. All restrained joints shall be per the pipe manufacturer's supplied systems or by specific written acceptance by the pipe manufacturer of other systems designed for this particular project.
2. Because required restraint lengths vary by pipe and manufacture, the restraint lengths shown on the Drawings are given for the purpose of identifying the locations where thrust restraint is required and may not reflect the actual required length of restraint. The Contractor shall submit the pipe manufacturers calculated restraint lengths at each bend location to the Engineer for review and acceptance. Acceptance of shorter restrained lengths is at the sole discretion of the Engineer and non-acceptance shall not be justification for an increase in cost. The lengths of restraint required at each bend location shall be calculated in accordance with Section 7.5 of AWWA Manual M-41 using the following criteria.
 - a. The thrust restraint design pressure shall be 250 psi.
 - b. Type 4 design trench: pipe is bedded to top of pipe in compacted granular material, 4-inches minimum under pipe. Approximately 90% Standard Proctor, AASHTO T-99, Bedding angle of 150°.
 - c. Soil designation: clay, medium to low plasticity, LL = 50, less than 25% coarse particles (CL and CL-ML), soil friction angle: 0°, soil cohesion: 300 psf.
 - d. Density of backfilled soil: 90 pcf.
 - e. Factor of safety: 1.5
 - f. Pipe coefficient of friction shall be determined by the pipe manufacturer and included in the submitted calculations.
 - g. Depth(s) of fittings and restrained piping lengths shall be determined by the pipe manufacturer and included in the submitted calculations.

- B. Calculated restrained lengths based upon the above criteria shall be increased to the next nominal 20' full pipe length.

- C. The following three sub-sections delineate the mechanically restrained systems acceptable for 3-inch through 24-inch PVC Pipe. See these individual sub-parts for the particular requirements and allowable sizes for each system.

2.06 GRIP WEDGE TYPE MECHANICALLY RESTRAINED PVC PIPE.

- A. PVC pipe shall be mechanically restrained only where specifically delineated on the drawings. Restraint devices for nominal pipe sizes 3 inch through 36 inch shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C110/A21.10.

- B. The devices shall have a working pressure rating equal to that of the pipe on which it is used. Ratings are for water pressure and must include a minimum safety factor of 2:1 in all sizes.
- C. Gland body, wedges and wedge actuating components shall be cast from grade 65-45-12 ductile iron material in accordance with ASTM A536.
- D. Ductile iron gripping wedges shall be heat treated within a range of 370 to 470 BHN.
- E. Three (3) test bars shall be incrementally poured per production shift as per Underwriter's Laboratory (U.L.) specifications and ASTM A536. Testing for tensile, yield and elongation shall be done in accordance with ASTM E8.
- F. Chemical and nodularity tests shall be performed as recommended by the Ductile Iron Society, on a per ladle basis.
- G. An identification number consisting of year, day, plant and shift (YYDDD) (plant designation) (Shift number), shall be cast into each gland body.
- H. All physical and chemical test results shall be recorded such that they can be accessed via the identification number on the casting. These Material Traceability Records (MTR's) are to be made available, in hard copy, to the purchaser that requests such documentation and submits his gland body identification number.
- I. Production pieces that are too small to accommodate individual numbering, such as fasteners and wedges, shall be controlled in segregate inventory until such time as all quality control tests are passed. These component parts may then be released to a general inventory for final assembly and packaging.
- J. All components shall be manufactured and assembled in the United States. The purchaser shall, with reasonable notice, have the right to plant visitation at his/her expense.
- K. Coating for restraint devices shall consist of the following:
 - 1. All wedge assemblies and related parts shall be processed through a phosphate wash, rinse and drying operation prior to coating application. The coating shall consist of a minimum of two coats of liquid Xylan® fluoropolymer coating with heat cure to follow each coat.
 - 2. All casting bodies shall be surface pretreated with a phosphate wash, rinse and sealer before drying. The coating shall be electrostatically applied and heat cured. The coating shall be a polyester based powder to provide corrosion, impact and UV resistance.
 - 3. The coating system shall be MEGA-BOND by EBAA Iron, Inc. or approved equal. Requests for approved equal must submit coating material and process details for review prior to bid.
- L. Approvals:
 - 1. Mechanical Joint Restraints shall be Listed by Underwriters Laboratories in the 4 inch through 12 inch sizes.
 - 2. Mechanical Joint Restraints shall be Factory Mutual Approved in the 4 inch through 12 inch sizes.
 - 3. Mechanical Joint Restraints, 4 inch through 24 inch, shall meet or exceed the requirements of ASTM F1674.
 - 4. Mechanical joint restraint shall be Series 1900/19MJ00 produced by EBAA Iron Inc. or approved equal.

2.07 UNDERGROUND PIPE TRACER WIRE

- A. Tracer wire shall be installed on all PVC pressure pipe and service lines. The wire shall be installed in such a manner as to be able to properly trace all pipelines without loss or deterioration of signal and without the transmitted signal migrating off the tracer wire.
- B. Tracer wire shall be THHN/THWN, ten gauge (10 AWG), single strand, insulated copper wire.
- C. All spliced or repaired wire connections in the tracer wire system shall be made using a Wing Nut® Model Number 454, Catalogue Number 30-454, wire connector, or approved equal. The connector shall be made waterproof using an approved buried service wire closure. The buried service wire closure shall be either a Klik-it II Number C8816 Buried Service Wire Closure or a Raychem GHFC-2-90 H-Frame Gel Closure or approved equal.
- D. Pipeline marker/terminal post shall be a TriView Terminal Post with external terminals as manufactured by Rhino or approved equal. Color shall conform to industry standard color coding for the liquid/material being conveyed.
- E. Pipeline marker/terminal posts may be field located slightly off the pipeline alignment next to a fence post or similar item to keep it out of a mowed, farmed or traveled way. The exact location shall be determined by the Engineer based upon actual field conditions.

2.08 CORROSION PROTECTION

- A. The exterior of all buried ductile iron fittings, restrained joints and valves shall be protected from corrosion by a seamless linear low-density polyethylene (LLDPE) tube conforming to ANSI/AWWA C105/A21.5 with a minimum thickness of 8 mils.
- B. The tube shall have markings placed at two-foot intervals and include the manufacturer's name and/or trade mark, the year of manufacture, the standard designation ANSI/AWWA C105/A21.5, the minimum film thickness and material type, the application range of pipe nominal diameters for the film, and a warning notice: "Warning - Corrosion Protection – Repair any Damage."
- C. Corrosion protection supplied in 48-inch wide flat sheets shall be used to cover irregular shaped valves, fittings and appurtenances not protected by the tube form of polyethylene wrap.
- D. Securing tape shall be 2-inch wide by ten (10) mil thickness and supplied by the pipe manufacturers.

PART 3 EXECUTION

3.01 GENERAL

- A. All laying, jointing, testing for defects and for leakage shall be performed in the presence of the Engineer, and shall be subject to acceptance by the Engineer. All material found during the progress to have defects will be rejected and the Contractor shall promptly remove such defective materials from the site of the work.
- B. Installation shall conform to the requirements of AWWA M23, AWWA C-605, instructions furnished by the pipe manufacturer, and to the supplementary requirements or modifications specified herein. Wherever the provisions of this Section and the aforementioned requirements are in conflict, the more stringent provision shall apply.

3.02 SHIPPING, HANDLING AND STORAGE

- A. Special care in handling shall be exercised during delivery, distribution and storage of pipe to avoid damage. Damaged pipe will be rejected and shall be replaced at the Contractor's expense. Pipe stored prior to use shall be stored in such a manner as to keep the interior free from dirt and foreign matter.
- B. The pipe manufacturer's recommendation for handling, storing, unloading and cutting pipe shall be followed. Individual pipes shall not be allowed to drop from the truck when unloading. Pipe units shall not be handled with chains or single cables. Pipe shall not be stored more than two units high. Care shall be taken in handling and laying pipe and fittings to avoid damaging the pipe or scratching or marring machined or finished surfaces.

3.03 THRUST BLOCKING

- A. The Contractor shall place reaction thrust blocking at the backs of all fittings, including elbows, tees, tapping sleeves, valves and other fittings as shown on the Drawings and/or as directed by the Engineer. Blocking shall be cast in place against undisturbed earth. The concrete for thrust blocking shall be as specified in the Cast-in-Place Concrete Section.
- B. The cost for thrust blocking shall be included in the linear foot price of the force main or individual fitting, as delineated in the Measurement and Payment Section.

3.04 INSTALLATION

- A. Unless otherwise directed, PVC pipe shall be laid with the bell ends facing upstream in the normal direction of flow and in the direction of laying.
- B. Proper and suitable tools and appliances for the safe convenient handling and laying of pipe shall be used and shall, in general, agree with manufacturer's recommendation. At the time of laying, the pipe shall be examined carefully for defects, and should any pipe be discovered to be defective after being laid, it shall be removed and replaced with sound pipe by the Contractor at his expense.
- C. The Contractor shall perform all earthwork including excavation, backfill, bedding, compaction, sheeting, shoring and bracing, dewatering and grading in accordance with the specifications.
- D. Upon satisfactory excavation of the pipe trench and completion of the pipe bedding, a continuous trough for the pipe barrel and recesses for the pipe bells, or couplings, shall be excavated by hand digging. When the pipe is laid in the prepared trench, true to line and grade, the pipe barrel shall receive continuous, uniform support and no pressure shall be exerted on the pipe joints from the trench bottom.
- E. Pipe and fitting shall be laid accurately to the lines and grades indicated on the Drawings or required. Care shall be taken to ensure a good alignment both horizontally and vertically.
- F. Each length of pipe shall have a firm bearing along its entire length. Embedment requirements are shown on the Drawings.
- G. The bell and spigot of the pipe shall be thoroughly cleaned prior to assembly. Only lubricants made by the pipe manufacturer may be used on the spigot.
- H. Homing the pipe shall be accomplished by the use of a hydraulic or mechanical pulling device, unless otherwise accepted by the Engineer. No pipe shall be driven or struck in order to seat it home.
- I. Pipe shall be cut by means of saws, power driven abrasive wheels or pipe cutters, which will produce a square cut. No wedge-type roller cutters will be permitted.

- J. Cut ends to be used with push-on joints shall be carefully chamfered and the reference mark located in accordance with the manufacturer's recommendation to prevent cutting the gasket when the pipe is laid or installed.

3.05 UNDERGROUND PIPE TRACER WIRE

- A. Tracer wire shall be laid flat and securely affixed to the pipe at 10' intervals. The wire shall be protected from damage during the execution of the work. No breaks or cuts in the tracer wire or tracer wire insulation shall be permitted. The tracer wire shall not be allowed to be placed between the saddle and the sewer main at service locations.
- B. Install pipeline test markers on 1,000' maximum intervals in conjunction with using the air release valves and low point drain valves as connection points.
- C. Contractor shall test the entire tracer wire system in the presence of the Engineer to verify continuity in the system and to ensure no damage was incurred during installation. Any tracer wire segments found to be damaged shall be corrected at the Contractors expense.

3.06 FIELD TESTING

- A. Field testing shall conform to the requirements of the Section entitled "Pipeline Testing."
- B. Cleaning methods shall be acceptable to the Engineer, and must be sufficient to remove silt, rocks, or other debris which may have entered the pipeline during its installation and shall also follow the requirements of Section entitled "Pipeline Testing".

END OF SECTION

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SECTION 400521
PROCESS PIPING SUPPORTS AND HANGERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. The Contractor shall provide all tools, supplies, materials, equipment, and all labor necessary for the furnishing, construction, and installation of all pipe supports, hangers, guides, and anchors shown, specified, and/or required for a complete and operable piping system, in accordance with the requirements of the Contract Documents.
- B. Pipe and equipment hangers and supports.
- C. Equipment bases and supports.
- D. Sleeves and seals.
- E. Flashing and sealing equipment and pipe stacks.

1.02 REFERENCES

- A. ASME B31.2 - Fuel Gas Piping
- B. ASME B31.5 - Refrigeration Piping
- C. ASME B31.9 - Building Services Piping
- D. ASTM A123 – Specifications for zinc (hot-galvanized) coatings on products fabricated from rolled, pressed, and forged steel shapes, plates, bars, and strip.
- E. ASTM F708 - Design and Installation of Rigid Pipe Hangers.
- F. MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
- G. MSS SP69 - Pipe Hangers and Supports - Selection and Application.
- H. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

1.03 SUBMITTALS

- A. Submit complete shop drawings of all pipe supports, hangers, anchors, and guides as well as calculations for special supports and anchors in accordance with the Submittals section.
- B. Provide line drawings of each piping system to the scale shown in the drawings, locating each support or hanger with detail of trapeze hangers. Identify each type of hanger or support by the manufacturer's catalog number or figure.

- C. Provide installation drawings and manufacturer's catalog information including load capacity on each type of hanger and support used. Clearly indicate the actual pipe outside diameter (not just nominal pipe size) that is used for the hangers and supports.

1.04 REGULATORY REQUIREMENTS

- A. Conform to applicable code for support of plumbing and hydronic piping.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Code Compliance. All piping systems and pipe connections to equipment shall be properly supported, to prevent undue deflection, vibration, and stresses on piping, equipment, and structures. All supports and parts thereof shall conform to the requirements of ANSI/MSS SP-58 and 69, except as supplemented or modified by these Specifications. Supports for plumbing piping shall be in accordance with the latest edition of the applicable plumbing code, or local administration requirements.
- B. Not all pipe supports or hangers required are shown in the Drawings. Provide pipe supports for every piping system installed. Support piping by pipe support where it connects to pumps or other mechanical equipment.
- C. Pipe support and hanger components shall withstand the dead loads imposed by the weight of the pipes, fittings, and valves (all filled with water), plus valve actuators and any insulation, and shall have a minimum safety factor of five based on material ultimate strength.
- D. Structural Members. Wherever possible, pipes shall be attached to structural members. Where it is necessary to frame structural members between existing members, such supplementary members shall be provided by the Contractor at no additional cost to the Owner. All supplementary members shall be in accordance with the requirements of the building code and the American Institute of Steel Construction.
- E. Support Spacing. Supports for piping with the longitudinal axis in approximately a horizontal position shall be spaced to prevent excessive sag, bending and shear stresses in the piping, with special consideration given where components, such as flanges and valves, impose concentrated loads. Spacing of supports shall be as specified herein and/or indicated on the Drawings.
- F. Pipe Hangers. Pipe hangers shall be capable of supporting the pipe in all conditions of operation. They shall allow for free expansion and contraction of the piping, and shall prevent excessive stress on equipment. All hangers shall have a means of vertical adjustment after erection. Hangers shall be designed so that they cannot become disengaged by any movement of the supported pipe. Hangers subject to shock, or thrust imposed by the actuation of safety valves, shall include hydraulic shock suppressors. All hanger rods shall be subject to tensile loading, only.
- G. Hangers Subject to Horizontal Movements. At hanger locations where lateral or axial movement is anticipated, suitable linkage shall be provided to permit such movement. Where horizontal pipe movement is greater than ½-inch, or where the hanger rod deflection from the vertical is greater than

4 degrees from the cold to the hot position of the pipe, the hanger rod and structural attachment shall be offset in such a manner that the rod is vertical in the hot position.

- H. **Spring-Type Hangers.** Spring-type pipe hangers shall be provided for piping subject to vibration or vertical expansion and contraction, such as engine exhausts and similar piping. All spring-type hangers shall be sized to the manufacturer's printed recommendations and the loading conditions encountered. Variable spring support shall be provided with means to limit misalignment, buckling, eccentric loading, or to prevent overstressing of the spring, and with means to indicate at all times the compression of the spring. The support shall be designed for a maximum variation in supporting effort of 25 percent for the total travel resulting from thermal movement.
- I. **Thermal Expansion.** Wherever expansion and contraction of piping is expected, a sufficient number of expansion loops or joints shall be provided, together with the necessary rolling or sliding supports, anchors, guides, pivots, and restraints. They shall permit the piping to expand and contract freely in directions away from the anchored points and shall be structurally suitable to withstand all loads imposed.
- J. **Heat Transmission.** Supports, hangers, anchors, and guides shall be so designed and insulated that excessive heat will not be transmitted to the structure or to other equipment.
- K. **Riser Supports.** Where practical, risers shall be supported on each floor with riser clamps and lugs, independent of the connected horizontal piping.
- L. **Freestanding Piping.** Freestanding pipe connections to equipment, like chemical feeders, pumps, etc., shall be firmly attached to fabricated steel frames made of angles, channels, or I-beams anchored to the structure. Exterior, freestanding overhead piping shall be supported on fabricated pipe stands, consisting of pipe columns anchored to concrete footings, with horizontal, welded steel angles and U-bolts or clamps, securing the pipes.
- M. **Submerged Supports:** All submerged piping shall be supported with Tangers, brackets, clips, or fabricated supports and anchors of Type 316 stainless steel, unless otherwise shown.
- N. **Point Loads.** Any meters, valves, heavy equipment, and other point loads on PVC, fiberglass, and other plastic pipes, shall be supported on both sides, according to manufacturer's recommendations to avoid undue pipe stresses and failures. To avoid point loads, all supports on plastic and fiberglass piping shall be equipped with extra wide pipe saddles or galvanized steel shields.
- O. **Noise Reduction.** To reduce transmission of noise in piping systems, all copper tubes in buildings and structures shall be wrapped with a 2-inch wide strip of rubber fabric or similar, suitable material, at each pipe support, bracket, clip, or hanger.

2.02 PIPE HANGERS AND SUPPORTS

- A. **Stock Parts:** Where not specifically shown or detailed, designs, generally accepted as exemplifying good engineering practice, using stock or production parts, shall be utilized wherever possible. Such parts shall be locally available, new, of best commercial quality, designed and rated for the intended purpose.
- B. **Manufacturers:**

1. ITT Grinnel.
 2. Other acceptable manufacturers offering equivalent products.
 - a. Basic Engineers.
 - b. B-Line.
 - c. NPS Industries.
 - d. Bergen-Paterson Corp.
 - e. Approved Equal.
- C. Plumbing Piping - DWV, Domestic and Plant Water, Hydronic Piping and Refrigerant Piping:
1. Conform to ASME B31.9/ASTM. F708/MSS SP58.
 2. Hangers are to be galvanized or cadmium plated for use with ferrous or PVC piping systems, or copper coated for use with copper piping system. Non-metallic hangers may be used with either piping.
 3. Hangers for uninsulated pipe, 1/2 to 1½ inches: adjustable swivel ring, Grinnell Fig. 69 (Plated) or Fig CT-69 (copper).
 4. Hangers for insulated pipe, 1/2 to 1½ inches: adjustable clevis, Grinnell Fig. 260 (galvanized), Grinnell Fig. CT-65 (copper).
 5. Hangers for pipe size 2-inches and larger, insulated or un-insulated, adjustable clevis, Grinnell Fig. 260 (galvanized) or Fig. CT-65 (copper), B-Line BFP3104 (non-metallic).
 6. Multiple or Trapeze Hangers: Strut per Part 2.1.D
 7. Wall Support for Pipe up to 3 Inches: Strut per Part 2.1.D
 8. Wall Support for Pipe 4 Inches and Larger: Fabricated supports as shown on drawings and per Metal Fabrications Section.
 9. Floor Supports: Cast Iron Adjustable Pipe Saddle, Grinnel Figure 264, or equal, concrete pier, or fabricated steel support.
 10. Pipe Rollers: Single pipe roller, cast iron roll and stand, Grinnell Fig. 271 or Fig. 171, or Strut-Tech Part No. ANR Series (non-metallic).
 11. Threaded Rods - Grinnel Figure 140, 146 (galvanized), or equal. Use copper coated rod, or non-metallic with copper coated hangers.
- D. Process Piping
1. Adjustable Cast Iron Pipe Saddle - Grinnel Figure 264, or equal.
 2. Double Bolt Pipe Clamp - Grinnel Figure 295 (galvanized), or equal.
 3. Medium Pipe Clamp - Grinnel Figure 212 (galvanized, or equal.
 4. Single Pipe Roller - Grinnel Figure 171, or equal

5. Threaded Rods - Grinnel Figure 140, 146 (galvanized), or equal.
6. Weldless Eye Nut - Grinnel Figure 290, or equal.
7. Turnbuckle - Grinnel Figure 230 (galvanized), or equal.
8. Clevis - Grinnel Figure 299 (galvanized), or equal.
9. Structural Welding Lug - Grinnel Figure 55 (galvanized), or equal.
10. Welded Beam Attachment - Grinnel Figure 66 (galvanized), or equal.
11. Fabricated Supports shall be as shown on drawings and per the Metal Fabrications Section.

E. Steel Strut Pipe Supports

1. Channels shall be U-shaped 1-5/8 inches wide by 1-5/8 or 3-1/4 inches deep by 12-gauge metal thickness, unless otherwise shown in the drawings. One side of the channel shall have a continuous open slot with inturned clamping ridges. Maximum allowable stress under any combination of applied uniformly distributed loads and concentrated loads shall not exceed those recommended in the AISC or AISI. Deflection shall not exceed 1/240 of span. Use multiple back-to-back channels to achieve this criteria if a single channel is not sufficient. Products: Unistrut P1000 or P5000 Series, B-Line B11 or B22 Series, or equal.
2. Strut shall be fabricated of galvanized steel, 316 stainless steel, or fiberglass reinforced PVC (FRP), unless otherwise noted on the Drawings. Accessories such as nuts, clamps, post braces, brackets, etc. shall be of same material as strut. If non-metallic accessory items are not available, use 316 stainless steel. See schedule in Part 3 of this specification for locations of use for different types of strut.
3. Steel channels shall be hot-dipped galvanized per ASTM A153.
4. Nuts shall be machined and case hardened. Provide rectangular nuts with the ends shaped to permit a quarter turn crosswise in the framing channel. Provide two serrated grooves in the nut to engage the inturned edges of the channel.
5. Hanger rods for trapezes shall be carbon steel (ASTM A36, A575, or A576) unless stainless steel is indicated in the drawings. Stainless steel hanger rod material shall comply with ASTM A276, Type 304.
6. Coat ends of cut FRP strut with manufacturers recommended sealing resin. Coat ends of cut galvanized strut with galvanized touch-up product per Painting Section.
7. Hanger Rods: Steel (ASTM A36, A575, or A576) galvanized, unless stainless steel or FRP is indicated on the Drawings. Stainless steel hanger material shall comply with ASTM A276 Type 304 stainless steel; threaded both ends, threaded one end, or continuous threaded, unless otherwise noted on the Drawings. Match strut type.

F. Accessory fittings and brackets shall be the same material as the channel or trapeze. Provide coating on carbon steel fittings and brackets as specified for the channels and frames.

1. Flat Plate Fittings: Unistrut P1065, P1066, P1925; Superstrut AB-206, AB-207; or equal.

2. Post Bases: Unistrut P2072A, Superstrut AP-232, or equal.
3. 90-Degree Brackets: Unistrut P1326, P1346; Superstrut AB-203; or equal.
4. Rounded-End Flat Plate Fittings: Unistrut P2325, Superstrut X-240, or equal.

G. Multiple Horizontal PVC Piping Support (Cable Tray)

1. Manufacturers:
 - a. B-line
 - b. P-W Industries
 - c. Approved Equal
2. Cable tray is to be galvanized or reinforced fiberglass. Trough drop-out type. Provide trough drop-out bushings to protect piping from wear. Locations where galvanized and FRP can be used is the same as strut. See Part 3.
3. Cable tray to be Class 8B. Support 8 feet on center maximum. The working load to be 75 lbs./linear foot.
4. The side height of the cable tray to be 4". The width of the tray to be determined by the number and the size of the chemical feed piping to be supported.
5. The fittings and accessories are to match the cable tray material.

H. Galvanizing. Unless otherwise shown or specified, all fabricated pipe supports, other than stainless steel or non-ferrous supports, shall be blast-cleaned after fabrication and hot-dip galvanized in accordance with ASTM A 123. Stainless steel supports may be provided as an alternate for the galvanized supports specified herein.

I. Other Coatings. Other than the supports mentioned in paragraph 2.02G, all supports shall receive protective coatings in accordance Painting section.

2.03 FLASHING

- A. Metal Flashing: 26 gage galvanized steel.
- B. Metal Counter-flashing: 22 gage galvanized steel.
- C. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing, coordinate with roofing Contractor.
- D. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.04 EQUIPMENT CURBS

- A. Where possible provide curbs with equipment. (as part of equipment supplied).
- B. Curbs should be minimum of 18" in height, unless indicated otherwise.

2.05 SLEEVES

- A. Manufacturers: By Contractor.
- B. Wall sleeves for process piping (DIP, steel, or PVC) 4-inches and larger, see the Piping General Section and the Drawings.
- C. Sleeves for Pipes through Non-fire Rated Floors: 18 gage galvanized steel.
- D. Sleeves for Pipes through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage galvanized steel.
- E. Sleeves for Pipes through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.
- F. Sleeves for Round Ductwork: Aluminum.
- G. Sleeves for Rectangular Ductwork: Aluminum.
- H. Firestopping Insulation: Glass fiber type, non-combustible.
- I. Sealant: Acrylic.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General. All pipe supports, hangers, brackets, anchors, guides, and inserts shall be fabricated and installed in accordance with the manufacturer's printed instructions and ANSI/MSS SP-58 and 69. All concrete inserts for pipe hangers and supports shall be coordinated with the formwork.
- B. Appearance. Pipe supports and hangers shall be positioned in such a way as to produce an orderly, neat piping system. All hanger rods shall be vertical, without offsets. Hangers shall be adjusted to line up groups of pipes at the proper grade for drainage and venting, as close to ceilings or roofs as possible, without interference with other work.
- C. Pipe Support Spacing. The distance between supports for each size of pipe shall not exceed those listed in the attached schedule. However, if the pipe size to be supported is not listed in the schedule, the next smaller nominal pipe size spacing shall be used. In all cases, there shall be a minimum of one support per laying length of pipe on interrupted horizontal runs. This support shall be placed within one foot of the joint. If the pipe manufacturer recommends a smaller spacing interval than specified herein, then the manufacturer's spacing shall be used.
- D. Install in accordance with manufacturer's instructions.

3.02 PIPE HANGERS AND SUPPORTS

- A. Support horizontal piping as scheduled.

- B. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
- C. Place hangers within 12 inches of each horizontal elbow.
- D. Use hangers with 1-1/2 inch minimum vertical adjustment.
- E. Provide separate hangers or supports at each valve. Provide one hanger or support around each end of the valve body or on the adjacent connecting pipe within one pipe diameter of the valve end. Provide additional hangers or supports to relieve eccentric loadings imposed by offset valve actuators.
- F. Provide separate hangers or supports at each pipe elbow, tee, or fitting. Provide separate hangers or supports on both sides of each nonrigid joint or flexible pipe coupling.
- G. Support horizontal cast iron soil pipe adjacent to each hub or coupling, with 5 feet maximum spacing between hangers.
- H. Support vertical piping at every floor level. Support vertical cast iron soil pipe at each floor at hub or coupling.
- I. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers, or use cable tray with PVC pipes.
- J. Support riser piping independently of connected horizontal piping.
- K. Provide copper plated hangers and supports for copper piping.
- L. Design hangers for pipe movement without disengagement of supported pipe.
- M. Provide insulating sleeves between pipe supports and pipes of dissimilar materials.
- N. Strut pipe and cable tray support material shall be 316SST unless otherwise noted.
- O. Adjust pipe hangers per MSS SP-89, paragraph 10.6.
- P. Install leveling bolts beneath support baseplates. Provide 3/4-inch (minimum) thick grout pad beneath each base.
- Q. Install piping without springing, forcing, or stressing the pipe or any connecting valves, pumps, and other equipment to which the pipe is connected.

3.03 EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 4 inches thick and extending 4 inches beyond supported equipment. Refer to the Section entitled "Cast in Place Concrete".
- B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment, coordinate with shop drawings of equipment.

- C. Construct supports of steel members. Steel pipe and fittings. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.04 FABRICATION

- A. Quality Control. Pipe hangers and supports shall be fabricated and installed by experienced welders and fitters, using the best welding procedures available. Fabricated supports shall be neat in appearance without sharp corners, burrs, and edges.

3.05 PAINTING AND COATING

- A. Grind welds of fabricated steel pipe supports smooth, prepare surface by sandblasting, and apply coating system.
- B. Coat exposed cast iron and steel hangers and supports per appropriate Painting section System. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed. Copper plated, stainless steel, and FRP hangers and supports do not need to be coated. If the adjacent wall is not painted, paint the hangers and supports to match color code of the largest pipe on the support.
- C. Coat all submerged cast iron, steel, and galvanized steel hangers and supports per appropriate Painting section System.

3.06 FLASHING

- A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate wet/damp locations, weather or waterproofed walls, floors, and roofs.
- B. Flash vent and soil pipes projecting 24 inches minimum above finished roof surface with lead worked one inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counterflash, and seal. Where vent pipes and other pipes penetrate single ply roofing coordinate flashing with roof contractor.
- C. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.
- D. Seal floor, shower and mop sink drains watertight to adjacent materials.
- E. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.
- F. Provide curbs for mechanical roof installations 24 inches minimum high above roofing surface. Flash and counterflash with sheet metal; seal watertight. Attach counterflashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints.

- G. Adjust storm collars tight to pipe with bolts; calk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.07 SLEEVES

- A. Set sleeves in position in formwork. Provide reinforcing around sleeves.
- B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- C. Extend sleeves through floors one inch above finished floor level. Calk sleeves.
- D. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with fire stopping insulation and calk. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- E. Install chrome plated steel escutcheons at finished surfaces and at all sink/lavatory drain lines into wall.

3.08 PIPE SUPPORT AND HANGER SCHEDULES

- A. The distance between supports and minimum hanger rod diameters listed below shall not be exceeded unless otherwise specifically noted.

B. PIPE SUPPORT SCHEDULE

Type of Pipe	Pipe Support Max Spacing (ft)	Max Run Without Expansion Joint, Loop, or Bend (ft) (Note 1)	Expansion Joint Max Spacing (ft) (Note 2)	Type of Expansion Joint
Cast & ductile iron:				
2" to 3"	6	80	80	Mech. Cplgs.
4" and Larger	10	80	80	Mech. Cplgs.
CI & DI, glass-lined	12	80	80	Mech. Cplgs.
Steel for hot water heating:				
1¼" & Smaller	7	30	100	Note 3
1½ To 4 Inch"	10	30	100	Note 3

Type of Pipe	Pipe Support Max Spacing (ft)	Max Run Without Expansion Joint, Loop, or Bend (ft) (Note 1)	Expansion Joint Max Spacing (ft) (Note 2)	Type of Expansion Joint
Over 4"	15	30	100	Note 3
Steel for services other than hot water				
1 ¼ " & Smaller	7	30	100	Note 3
1 ½ To 4 Inch	10	30	100	Note 3
Over 4 Inch	15	80	80	Mech. Cplgs.
Copper for hot water:				
1 Inch And Smaller	5	20	100	Note 3
Over 1 Inch	7	20	100	Note 3
Copper for other services				
1" And Smaller	5	--	--	None Req.
Over 1 Inch	7	50	100	Note 3
PVC, Schedule 80:				
1/8 And ¼ Inch	Continuous Support	20	60	Note 3
½ Inch	4	20	60	Note 3
¾ Inch	4 ½	20	60	Note 3
1 And 1 ¼ Inch	5	20	60	Note 3
1 ½ And 2 Inch	5 ½	20	60	Note 3
2 ½ Inch	6	20	60	Note 3
3 Inch	7	20	60	Note 3

Type of Pipe	Pipe Support Max Spacing (ft)	Max Run Without Expansion Joint, Loop, or Bend (ft) (Note 1)	Expansion Joint Max Spacing (ft) (Note 2)	Type of Expansion Joint
4 Inch	7 ½	20	60	Note 3
6 Inch	8 ½	20	60	Note 3
PVC, Schedule 40:				
1/8 And ¼ Inch	Continuous Support	20	60	Note 3
½ Inch	3 ½	20	60	Note 3
¾ And 1 Inch	4	20	60	Note 3
1 ¼ And 1 ½ Inch	4 ½	20	60	Note 3
2 Inch	5	20	60	Note 3
2 ½ Inch	5 ½	20	60	Note 3
3 Inch	6	20	60	Note 3
4 Inch	6 ½	20	60	Note 3
6 Inch	7 ½	20	60	Note 3
C. I. Soil pipe (bell & spigot or no-hub and at joints)	5	--	--	None Req.

Notes:

1. Unless otherwise permitted, an expansion joint shall be provided in each straight run of pipe having an overall length between loops or bends exceeding the maximum run specified herein.
2. Unless otherwise permitted, the spacing between expansion joints in any straight pipe run shall not exceed the maximum spacing specified herein.
3. Expansion joint fittings as specified in the General piping section.

C. HANGER ROD DIAMETERS

PIPE SIZE (inches)	HANGER ROD DIAMETER (inches)
1/2 to 1-1/4	3/8
1-1/2 to 2	3/8
2-1/2 to 3	1/2
4 to 6	5/8
8 to 12	7/8
14 and Over	1
PVC (3" and Less)	3/8
PVC (4" and Larger)	1/2
C.I. Bell and Spigot(or No-Hub) and at Joints	3/8
Process Piping (6-inch and larger)	As shown on Drawings

END OF SECTION

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BARTLETT & WEST

SECTION 400522
PIPELINE TESTING

PART 1 GENERAL

1.01 REQUIREMENTS

- A. The Contractor shall perform flushing, testing, disinfection and bacteriological testing of all pipelines and appurtenant piping, complete, including conveyance of test water from the source to point of use and all disposal thereof, all in accordance with the requirements of the Contract Documents and local regulations.
- B. The Contractor shall provide all necessary piping, connections between the pipeline and nearest available source of supply, test pumping equipment, temporary fittings and valves, water measuring equipment, sampling points, pressure gauges and other equipment, materials and facilities necessary for performing the specified test.
- C. The Owner shall provide the water required for two complete pressure tests. The water required for subsequent retests shall be at the Contractor's expense.

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. ANSI/AWWA C 600, Pressure Testing
- B. AWWA C605, Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
- C. ANSI/AWWA C 651, Disinfecting Water Mains
- D. CDPHE – Regulations, Policies, and Guidance

1.03 SUBMITTALS

- A. A testing schedule, including proposed plans for water conveyance, control and disposal as required, shall be submitted in writing for approval a minimum of one week before testing is to start.
- B. Disinfection report shall be an accurate record of:
 - 1. Type and form of disinfectant used.
 - 2. Date and time of disinfectant injection start and time of completion.
 - 3. Test locations.
 - 4. Initial and 24 hour disinfectant residuals (quantity in treated water) in ppm for each outlet tested.
 - 5. Date and time of flushing start and completion.
 - 6. Disinfectant residual after flushing in ppm for each outlet tested.
- C. Bacteriological Test Report.

1.04 PROJECT CONSIDERATIONS

- A. All new water lines shall be individually disinfected and a bacteriological test performed on each.
- B. The highly chlorinated disinfection water shall be properly disposed of or neutralized and discharged into the storm sewer.

PART 2 PRODUCTS

2.01 MATERIALS REQUIREMENTS

- A. All test equipment, temporary valves or bulkheads, or other water control equipment and materials shall be determined and furnished by the Contractor subject to the Engineer's review. No materials shall be used which would be injurious to the construction or its future function.

2.02 CHLORINE FOR DISINFECTION

- A. Comply with ANSI/AWWA C651.

2.03 CHLORINE RESIDUAL TEST KIT

- A. For high range (10-200 mg/l as total chlorine) chlorine levels, use a drop count titration method. HACH Model CN-21P or equal.
- B. For mid-range (1-20 mg/l as total chlorine) chlorine levels, use a drop count titration method. HACH Model CN-65 or equal.
- C. All reagents used in chlorine residual tests shall be within the expiration date limit and be properly packaged and stored to maintain integrity.

PART 3 EXECUTION

3.01 GENERAL

- A. Unless otherwise provided herein, water for testing pipelines will be furnished by the Contractor. The Contractor shall make all necessary provisions for conveying the water from the source to the points of use.
- B. All pressure pipelines shall be tested. All testing operations shall be performed in the presence of the Engineer.
- C. Only pipelines that have been installed, anchored and/or blocked as required for testing or as specified or shown on the Drawings, in strict accordance with the Contract Documents shall be hydrostatically tested.

3.02 HYDROSTATIC TESTING OF PIPELINES

- A. Prior to hydrostatic testing, all pipelines shall be flushed or blown out as appropriate to remove all soil, backfill materials or construction debris. The Contractor shall test all pipelines either in sections or as a unit. No section of the pipeline shall be tested until all field-placed concrete or mortar has attained an age of 14 days. The test shall be made by closing valves when available, or by placing temporary bulkheads in the pipe and filling the line slowly with water. The Contractor shall be responsible for ascertaining that all test bulkheads are suitably restrained to resist the thrust of the test pressure without damage to, or movement of, the adjacent pipe. Care shall be taken to see that all air vents are open during filling.
- B. The pipeline shall be filled at a rate which will not cause any surges or exceed the rate at which the air can be released through the air valves at a reasonable velocity and all the air within the pipeline shall be properly purged. After the pipeline or section thereof has been filled, it shall be allowed to stand under a slight pressure for at least 24 hours to allow the escape of air from any air pockets. During this period, bulkheads, valves, and connections shall be examined for leaks. If leaks are found, corrective measures satisfactory to the Engineer shall be taken.
- C. The hydrostatic test shall consist of holding the test pressure on the pipeline for a period of 4 hours. The test pressure shall be 1.5 times the working pressure or 50 psi, whichever is greater, up to a maximum of 250 psi. All joints shall be exposed during the test. All visible leaks shall be repaired in a manner acceptable to the Engineer.
- D. The allowable water loss shall conform to the requirements of AWWA C600 or AWWA C605, whichever is applicable. Table 1 shows the allowable leakage for typical test pressures and pipe diameters. Allowable leakage for lengths greater than or less than 1,000 feet can be calculated by multiplying the leakage indicated in the table by the length factor or by using the equation below. The length factor is the actual pipeline length divided by 1,000.

For PVC or DIP pipe,

$$L = \frac{SD\sqrt{P}}{148,000}$$

where,

L = allowable leakage, in gallons per hour

S = length of pipe tested, in feet

D = nominal diameter of the pipe, in inches

P = average test pressure during the leakage test, in pounds per square inch

- E. The above equation is based on a leakage rate of 10.5 gallons per day per mile per inch of nominal diameter pipe.

- F. In the case of pipelines that fail to pass the prescribed leakage test, the Contractor shall determine the cause of the leakage, shall take corrective measures necessary to repair the leaks, and shall again test the pipelines.
- G. All leaks shall be repaired by tightening of mechanical joints where possible or by removal of pipe or fittings where the pipe joint material is found to be defective or damaged during the installation. Repairs shall be made using new pipe, fittings and gaskets as necessary. Pipe closures made where the pipe is cut for repair of leaking joints shall be made by use of mechanical joint long sleeves with internal pipe spacers as required with no additional cost to the Owner. It is the intent of this specification that all joints and piping shall be watertight, and that all joints which are found either by observation or by test to leak shall be made watertight by removal and replacement of the defective pipe joint or gasket by the Contractor. External bell clamps are not an acceptable method of repair of faulty pipe joints. Any and all leaks in buried lines, which shall appear within the correction period after the date of substantial completion of the entire project, shall be located and repaired by the Contractor at no additional cost to the Owner. Tests shall then be repeated until all defects have been repaired to the satisfaction of the Engineer. After approval of all replacement and repair, the pressure shall again be set and maintained for a period of four hours, during which time the joints shall be visually inspected for leakage. The previous steps shall be repeated until the pipeline section has successfully passed the leakage test requirements.
- H. Any and all leaks in buried lines, as evidenced by undue saturation of the soil at any point on the line, which shall appear within the warranty period after the date of substantial completion of the entire project, shall be located and repaired by and at the expense of the Contractor.
- I. After testing is complete, the Contractor is to remove the temporary corporation stops and replace them with brass pipe plugs.

3.03 PREPARATION FOR PIPELINE DISINFECTION

- A. Verify that piping system has been cleaned, inspected and pressure tested.
- B. Perform disinfection and coordination with flushing, startup and related work.

3.04 PIPELINE DISINFECTION

- A. Provide and attach equipment required to execute the work of this Section.
- B. Disinfect the pipeline and appurtenances in accordance with ANSI/AWWA C651, Section 5.2 Continuous-Feed Method with the following modifications:
 - 1. Delete paragraph 5.2.1 - Placing of calcium hypochlorite granules.
- C. The new pipeline shall receive a dose of chlorine fed at a constant rate such that the water entering the beginning of the line will have not less than 25 mg/l free chlorine.
- D. Chlorine application shall not cease until the entire pipeline is filled with heavily chlorinated water.

- E. The chlorinated water shall be retained in the pipeline for at least 24 hours, during which time all valves and hydrants in the treated section shall be operated to assure disinfection of the appurtenances.
- F. At the end of 24-hour period, the treated water in all portions of the line shall have a measurable residual of not less than 10 mg/l free chlorine.
- G. If the chlorine residual cannot be maintained above 10 mg/l free chlorine after 24 hours, flush out the line and repeat the disinfection procedure.
- H. After the disinfection has been achieved, flush the pipeline with potable water. Comply with state health department requirements and ANSI/AWWA C651, Section 6.2 Disposing of Heavily Chlorinated Water. If dechlorination is required, refer to AWWA C651, Appendix B for neutralizing chemicals.
- I. Replace permanent system devices removed for disinfection.
- J. After the 24 hour period, the new water main shall be flushed of the heavily chlorinated water, leaving chlorine content equal to system chlorine, but not less than 1 ppm.

3.05 CONNECTIONS TO EXISTING SYSTEM

- A. Where connections are to be made to an existing potable water system, the interior surfaces of all pipe and fittings used in making the connections shall be swabbed or sprayed with a 500 mg/l chlorine solution before they are installed. Thorough flushing shall be started as soon as the connection is completed and shall be continued until discolored water is eliminated.

TABLE 1
ALLOWABLE LEAKAGE PER 1000 FT (305 M) OF PIPELINE* - GPH

Average Test Pressure psi	Nominal Pipe Diameter - in.															
	3	4	6	8	10	12	14	16	18	20	24	30	36	42	48	54
50	0.14	0.19	0.29	0.38	0.48	0.57	0.67	0.76	0.86	0.96	1.15	1.43	1.72	2.01	2.29	2.58
75	0.18	0.23	0.35	0.47	0.59	0.70	0.82	0.94	1.05	1.17	1.40	1.76	2.11	2.46	2.81	3.16
100	0.2	0.27	0.41	0.54	0.68	0.81	0.95	1.08	1.22	1.35	1.62	2.03	2.43	2.84	3.24	3.65
125	0.23	0.3	0.45	0.60	0.76	0.91	1.06	1.21	1.36	1.51	1.81	2.27	2.72	3.17	3.63	4.08
150	0.25	0.33	0.50	0.66	0.83	0.99	1.16	1.32	1.49	1.66	1.99	2.48	2.98	3.48	3.97	4.47
175	0.27	0.36	0.54	0.72	0.89	1.07	1.25	1.43	1.61	1.79	2.15	2.68	3.22	3.75	4.29	4.83
200	0.29	0.38	0.57	0.76	0.96	1.15	1.34	1.53	1.72	1.91	2.29	2.87	3.44	4.01	4.59	5.16
225	0.3	0.41	0.61	0.81	1.01	1.22	1.42	1.62	1.82	2.03	2.43	3.04	3.65	4.26	4.86	5.47
250	0.32	0.43	0.64	0.85	1.07	1.28	1.50	1.71	1.92	2.14	2.56	3.21	3.85	4.49	5.13	5.77
275	0.34	0.45	0.67	0.90	1.12	1.34	1.57	1.79	2.02	2.24	2.69	3.36	4.03	4.71	5.38	6.05
300	0.35	0.47	0.70	0.94	1.17	1.40	1.64	1.87	2.11	2.34	2.81	3.51	4.21	4.92	5.62	6.32
350	0.38	0.51	0.76	1.01	1.26	1.52	1.77	2.02	2.28	2.53	3.03	3.79	4.55	5.31	6.07	6.83
400	0.41	0.54	0.81	1.08	1.35	1.62	1.89	2.16	2.43	2.70	3.24	4.05	4.86	5.68	6.49	7.30
450	0.43	0.57	0.86	1.15	1.43	1.72	2.01	2.29	2.58	2.87	3.44	4.30	5.16	6.02	6.88	7.74

END OF SECTION

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BARTLETT & WEST

SECTION 400524
VALVES, GENERAL

PART 1 GENERAL

1.01 WORK INCLUDED

- A. The Contractor shall provide all tools, supplies, materials, equipment, and labor necessary for furnishing, epoxy coating, installing, adjusting, and testing of all valves and appurtenant work, complete and operable, in accordance with the requirements of the Contract Documents. Where buried valves are shown, the Contractor shall furnish and install valve boxes to grade, with covers, extensions, and position indicators.
- B. The provisions of this Section shall apply to all valves and valve operators specified in the various Sections of these Specifications except where otherwise specified in the Contract Documents. Valves and operators in particular locations may require a combination of units, sensors, limit switches, and controls specified in other sections of these Specifications.

1.02 CONTRACTOR SUBMITTALS

- A. Shop Drawing. Shop drawings of all valves and operators including associated wiring diagrams and electrical data, shall be furnished as specified in Section entitled "Shop Drawings, Project Data and Samples".
- B. Valve Labeling. The Contractor shall submit a schedule of valves to be labeled indicating in each case the valve location and the proposed wording for the label.

1.03 QUALITY ASSURANCE.

- A. Valve Testing. Unless otherwise specified, each valve body shall be tested under a test pressure equal to twice its design water-working pressure.
- B. Bronze Parts. Unless otherwise specified, all interior bronze parts of valves shall conform to the requirements of ASTM B 62, or, where not subject to dezincification, to ASTM B 584.

PART 2 PRODUCTS

2.01 VALVES

- A. General: The Contractor shall furnish all valves, gates, valve-operating units, stem extensions, and other accessories as shown or specified. All valves and gates shall be new and of current manufacture.
- B. Shut-off valves mounted higher than 6-feet above working level shall be provided with chain operators. All valves shall have a minimum design pressure rating of 250 psi and capable of a test pressure of 300 psi. For service applications with pressures in excess of 150 psi, valves shall have a minimum pressure rating in excess of the service application working pressure.
- C. Cast iron parts of valves shall meet the requirements of ASTM A 126. Flanged ends shall be flat-faced and have bolt circle and bolt patterns conforming to ANSI/ASME B16.1, Class 125, unless otherwise specified hereinafter.
- D. All castings shall be clean and sound, without defects of any kind and no plugging, welding or repairing of defects will be permitted. All bolt heads and nuts shall be hexagonal conforming to ANSI B18.2. Gaskets shall be full face and made of natural or synthetic elastomers in conformance with ANSI B16.21 suitable for the service characteristics, especially chemical compatibility and temperature. Nonferrous

alloys of various types shall be used for parts of valves as specified. Where no definite specification is given, the material shall be the recognized acceptable standard for that particular application.

- E. All buried valves shall be provided with cast-iron valve boxes unless otherwise indicated. The boxes shall be asphalt varnished, or enameled cast iron, adjustable to grade, and installed perpendicularly, centered around and covering the upper portions of the valve or valve operator, or the pipe. The top of each valve box shall be placed flush with finish grade unless otherwise indicated on the Drawings. Valve boxes shall be as specified elsewhere in this section.
- F. All buried valves and other valves located below the concrete operating deck or level, specified or noted to be key operated, shall have an operator to finish grade or deck level, a 2-inch square AWWA operating nut, and cover or box and cover, as may be required.
- G. Protective Coating: Except where otherwise specified, ferrous surface except stainless steel in the interior passages of all valves 4-inch and larger, as well as the exterior surfaces of all submerged valves, shall receive a fusion-bonded epoxy coating in accordance with AWWA C550. Flange faces of valves shall not be epoxy coated. The Contractor, through the valve manufacturer, shall certify in writing that such coating has been applied and tested in the manufacturing plant prior to shipment, in accordance with these Specifications.
- H. Valve Operators: Where shown, certain valves shall be furnished with operators, provided by the valve or gate manufacturer. All operators of a given type shall be furnished by the same manufacturer. All valve operators, regardless of type, shall be installed, adjusted, and tested by the valve manufacturer at the manufacturing plant.
- I. All operators, unless otherwise specified, shall turn counter-clockwise to open. Operators shall have the open direction clearly and permanently marked. All valve operators, manual, motor and pneumatic, shall be provided with the valve by the valve manufacturer. The Contractor, through the valve manufacturer, shall be solely responsible for the selection of the proper operator to meet the operating conditions specified herein. Field calibration and testing of the operators and valves to ensure a proper installation and an operating system shall be the responsibility of the Contractor.
- J. Unless otherwise specified, all manual operators shall have levers or handwheels. Where buried, the valves shall have extensions with square nuts or floor stands. Tee wrenches for buried valves and hydrants shall be provided at a rate of one (1) per five (5) valves/hydrants. Valves mounted higher than 7'6" above floor or operating level shall have chain operators. Unless otherwise shown or specified, valves of sizes 4-inch and larger shall have gear-assisted operators.
- K. Operation of valves shall be designed so that the effort required to operate the handwheel, lever or chain shall not exceed 40 pounds applied at the extremity of the wheel or lever. The handwheels on valves 14 inches and smaller shall not be less than 8 inches in diameter, and on valves larger than 14 inches, the handwheel shall not be less than 12 inches in diameter.
- L. Chainwheel operator shall be fabricated of malleable iron and pocketed type chainwheels with chain guards and guides. Chainwheel operators shall be marked with an arrow and the word "open" indicating direction to open. The operators shall have galvanized smooth welded link type chain. Chain that is crimped or has links with exposed ends shall not be acceptable.
- M. Floor Stands: Floor stands shall be cast iron, non-rising stem type with lockable hand wheel operator, valve position indicator and steel extension stem. Hand wheel shall be lockable in the full closed position. The floor stand shall be furnished with an armored padlock and six keys. Lock shall be as manufactured by Master, Schlage or equal. Floor stand shall be standard pattern type as manufactured by Clow Corporation, or equal.
- N. Valve Labeling: A label shall be provided on all shut-off valves. The label shall be of 1/16-inch plastic or stainless steel, minimum 2 inches by 4 inches in size, and shall be permanently attached to the valve or on the wall adjacent to the valve or as indicated by the Engineer.
- O. Position Indicators: All shut-off valves, 6-inch and larger, shall have operators with position indicators.

Where buried, these valves shall be provided with valve boxes and covers containing position indicators, and valve extensions, as required. The valve indicator shall be hermetically sealed for installation inside a cast iron valve box and shall show valve disc position, direction of rotation and number of turns from fully opened to full closed. Position indicator, complete, shall be Diviner Ground Level Position Indicator as manufactured by Henry Pratt Company, GPI-S Series as manufactured by DynaTorque, Inc, or Valve Position Indicator as manufactured by Trumbull Industries, Inc.

- P. Extension Stems: Extension stems and stem guides shall be furnished and installed where specified, indicated on the drawings, or otherwise required for proper valve operation. Extension stems shall be of solid steel and shall be not smaller in diameter than the stem of the valve actuator shaft. Extension stems shall be connected to the valve actuator by means of a Lovejoy "Type D" single universal joint with grease-filled protective rubber boot and S.S. fasteners. All stem connections shall be pinned.
- Q. At least two stem guides shall be furnished with each valve requiring stem guides. Stem guides shall be of cast iron construction, bronze bushed and adjustable in two directions. Stem guide spacing shall not exceed 100 times the stem diameter or 10 feet, whichever is smaller. The top stem guide shall be designed to carry the weight of the extension stem. The extension stem shall have a collar; the collar shall be pinned to the stem and shall bear against the stem thrust guide.
- R. Extension stems shall be provided for all buried valves when the valve actuator is greater than 4 feet below finished grade and/or as required for position indicators. Each extension stem for a buried valve shall extend to within 6 inches of the ground surface, shall be provided with spacers which will center the stem in the valve box, and shall be equipped with a wrench nut.

2.02 VALVE BOXES

- A. Each valve buried to a depth of 4 feet or less shall be provided with a slide type valve box. Valve boxes shall be cast iron, extension sleeve type, suitable for the depth of cover required by the drawings. Not more than one extension will be allowed with each slide type valve box. Valve boxes shall be not less than 5 inches in inside diameter, shall have a minimum thickness at any point of 3/16 inch, and shall be provided with suitable cast iron bases and covers.
- B. Each valve buried to a depth greater than 4 feet shall be provided with a valve box consisting of a cast iron cover and a 6 inch cast iron pipe section. The cover shall be a Clay & Bailey "No. 2193" or Tyler "Series 6890-A". The pipe shaft shall be sized to extend from the valve to 5 inches inside the valve box cover. Covers shall have cast thereon designation of the service for which the valve is used.
- C. All parts of valve boxes, bases, and covers shall be shop coated by dipping in asphalt varnish.
- D. Top sections and covers for valve boxes which are to be provided with position indicators shall be designed for proper installation of the position indicator and accessories.
- E. Valves and valve boxes shall be set plumb. Each valve box shall be placed directly over the valve it serves, with the top of the box brought flush with the finished grade. After being placed in proper position, earth shall be filled in around each valve box and thoroughly tamped on each side of the box.
- F. The covers shall be marked "WATER", "SEWER", "GAS", depending on service.

PART 3 EXECUTION

3.01 VALVE INSTALLATION

- A. General: All valves, operating units, stem extensions, valve boxes, and accessories shall be installed in accordance with the manufacturer's written instructions and as shown and specified. All gates shall be adequately braced to prevent warpage and bending under the intended use. Valves shall be firmly supported to avoid undue stresses on the pipe.

- B. Access: All valves shall be installed to provide easy access for operation, removal, and maintenance and to avoid conflicts between valve operators and structural members or handrails.
- C. Valve Accessories: Where combinations of valves, sensors, switches, and controls are specified, it shall be the responsibility of the Contractor to properly assemble and install these various items so that all systems are compatible and operating properly. The relationship between interrelated items shall be clearly noted on shop drawing submittals.

END OF SECTION

SECTION 400525
BUTTERFLY VALVES

PART 1 GENERAL

1.01 WORK INCLUDED

- A. The Contractor shall furnish and install Butterfly Valves, complete and operable, as shown and specified herein, including manual, operators, protective coating, and appurtenant work, all in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Valves, General
- B. Valve Operators

PART 2 PRODUCTS

2.01 GENERAL

- A. All butterfly valves, unless otherwise specified, shall be the product of one manufacturer and shall meet the full requirements of AWWA C504 except as modified or supplemented herein.
- B. Butterfly valves shall be class 150 B for all valves.
- C. Butterfly valves shall be flanged short body design for interior and exposed piping and mechanical joint body design for buried service. Buried valves greater than 48 inches in diameter shall be flanged joint. Bolt hole and bolt circle patterns shall conform to ANSI B16.1 Class 125.
- D. Actual port diameter shall not be less than 1-inch smaller than the nominal pipe size to which it is attached.
- E. Valves shall be equipped with adjustable mechanical stop limiting devices in the operator to prevent over travel of the valve disc in the open and closed position. Disc position stops located in the valve body are not acceptable.
- F. Valve bodies shall be constructed of ASTM A126 Class B cast iron and shall have two integrally cast trunnions for shaft bearings.

2.02 VALVE SEATS

- A. Valve seats shall be field adjustable around the full circumference of the valve body without interruption for valves with NPS 24-inches and larger. Valve seats may be incorporated in the valve body or the valve disc.
- B. Valve seats shall be replaceable without dismantling operator, disc or shaft and without removing the valve from the line. Manufacturer shall certify that the valve seat is field replaceable as specified for valves with NPS twenty-four 24-inches and larger.
- C. Valve seats shall be EPDM for air service, which will operate satisfactorily at temperature of 250 degrees F, and shall be Buna-N for all other services.
- D. Valve seats shall have the bond with the valve body tested with a 75 pound pull in accordance with test procedures ASTM D429, method B for valves with NPS 20-inches and smaller. For valves larger than 20-inches, seats shall be retained in the body by mechanical means without retaining rings, segments,

screws or hardware of any kind in the flow streams.

2.03 BEARINGS

- A. Valve bearings shall be sleeve type bearings, and shall be 100% nylon or Teflon for valves with NPS 20-inches and smaller.
- B. Valve bearings shall be Teflon lining with fiberglass backing for valves with NPS 24-inches and larger. Valve bearings shall be self lubricating and bearings load shall not exceed 1/5 of the compressible strength of the bearing or shaft material.

2.04 VALVE DISCS

- A. Valve discs shall operate through a 90 - ¼ degree angle from full closed to full open position.
- B. Valve discs shall be for NPS 20-inches and smaller alloy cast iron ASTM A436 Type 1, or ASTM A48 or ASTM A126 cast iron and shall be for NPS 24-inches and larger ASTM A48 cast iron or ASTM A536 ductile cast iron.
- C. Valve discs shall also be provided with a type 316 stainless steel seating edge for ASTM A48, A126 or A536 cast iron discs, and shall not have any hollow chambers which can entrap water.

2.05 SHAFTS

- A. Valve shafts shall be type 304 stainless steel for air service, and shall be type 316 stainless steel for all other services. Shaft diameter shall meet minimum requirements established by AWWA Standard C504 for Class 150B.
- B. Valve shafts shall be one piece for valves with NPS 20-inches and smaller and two piece for valves with NPS 24-inches and larger.

2.06 SHAFT SEALS

- A. Valve shaft seals shall be self compensating split V-type, and shall be adjustable and replaceable without removing the operator and/or the shaft, except for buried valves.
- B. Valve shaft seals shall be the same elastomer as specified for the valve seats for the intended service.

2.07 BURIED SERVICE

- A. For buried service, valves shall be totally enclosed, fully gasketed, grease packed and shall be designed to operate indefinitely when submerged under 20 feet of water. Buried service operators shall be provided with a valve extension stem, AWWA Standard operating nut and valve box unless shown with an operator on the Contract Drawings. The extension stem for buried service shall be sufficiently long to extend to within 12 inches of the ground surface. Where required, valves shall be furnished with extension bonnets.

2.08 SUPPLIERS, OR EQUAL

- A. Henry Pratt Co.
- B. Clow

PART 3 EXECUTION

3.01 INSTALLATION

- A. All butterfly valves shall be installed in accordance with AWWA Standards and the Supplier's printed recommendations, and in accordance with the applicable provisions of Section entitled "Valves, General."
- B. The rectangular butterfly valves shall be mounted in an oversized cast channel groove, then clamped in place with stainless steel bolts and nuts. If a stainless steel channel with concrete anchors is not used to form the channel, then stainless steel bearing plates shall be used. A rubber gasket shall be furnished and installed with the valve to provide a tight seal to the channel.

END OF SECTION

SECTION 400526

CHECK VALVES

PART 1 GENERAL

1.01 WORK INCLUDED

- A. The Contractor shall furnish and install all check valves in the types and sizes shown and specified, complete and operable, including epoxy coating, appurtenances, and accessories, in accordance with the requirements of the Contract Documents.

PART 2 PRODUCTS

2.01 SWING FLEX CHECK VALVES (3-INCH AND LARGER)

- A. General. Swing Flex Check Valves shall be of the Swing Flex full body flanged type with only one moving part, the valve disc and shall be used only where specifically delineated on the Drawings. Valves shall be rated for a working pressure of 200 psi and shall have a flanged cover piece to provide access to the disc.
- B. Body. The valve body and cover shall be of cast iron to ASTM A 126, with flanged ends to ANSI/ASME B 16.1, Class 125, or mechanical joint ends, as shown. The interior of the valve shall be coated with an epoxy suitable for potable water. The exterior shall be coated with a universal primer compatible with the specified painting system.
- C. Disc. The valve disc shall be of a one piece 316 stainless steel construction.
- D. Nuts, Bolts, Studs, Washers. All fasteners shall be AISI Type 304 or 316 S.S.
- E. Suppliers, or Equal:
 - 1. Val-Matic Model Series 500

PART 3 EXECUTION

3.01 GENERAL

- A. All valves shall be installed in accordance with provisions of Section entitled, "Valves, General."
- B. The swing check valves shall be adjusted in the field to prevent any surge or water hammer due to actual pumping conditions.

END OF SECTION

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SECTION 400528

GATE VALVES

PART 1 GENERAL

1.01 WORK INCLUDED

- A. The Contractor shall furnish and install gate valves, complete and operable, as shown and specified herein, including manual, electric, hydraulic, and pneumatic operators, epoxy coating, control units, and appurtenant work, all in accordance with the requirements of the Contract Documents.

PART 2 PRODUCTS

2.01 GENERAL

- A. All buried valves shall be of the inside screw type. Valves shall be capable of being repacked under line pressure. Valves 14-inch and larger installed in vertical pipes with their stems horizontal shall be fitted with bronze slides, tracks, rollers, and scrapers to assist the travel of the gate assembly. Quick opening valves shall have quick opening levers and cams in lieu of handwheel operators. For other operators, see Section entitled "Valves General". All ferrous surfaces of the valves, 3-inch and larger, which will be in contact with the process fluid shall receive a fusion-bonded epoxy coating conforming to AWWA C550.

2.02 GATE VALVES (LARGER THAN 3-INCH)

- A. The gate valves shall conform to the applicable requirements of AWWA and C509. Valves shall be of the resilient seat type in accordance with and not limited to the following:

Installation:	Horizontal. Buried and/or submerged.
Pressure (working):	250 psi, cast on outside of pipe.
Body and Bonnet:	Ductile Iron conforming to ASTM A536 and Table 2 Section 4-4 AWWA C509. Body and bonnet coated on all exterior and interior surfaces with a fusion bonded epoxy conforming to AWWA C550.
External Fasteners:	SST bolts and nuts.
Stem:	Bronze.
Stem Nut:	Bronze.
Gate:	Completely covered with rubber over all interior and exterior ferrous surfaces.
Operating Nut:	Ductile Iron conforming to ASTM A536.
"O" Ring Stem Seal:	Replaceable under pressure with valve fully open.
Body Interior:	Free of pockets or ledges.
Valve Operation:	Designed so that there is no friction or rubbing together of gate and body that can wear any rubber or epoxy coating. Manufacturer to provide certification from an independent testing laboratory that its valve can operation through 1,000 cycles at 250 psi unbalanced pressure without causing damage to any of the epoxy coating on body and gate and rubber coating on gate.

Stops:	Fully open and fully closed.
Open:	Counter-clockwise.
Operator:	Totally enclosed, permanently lubricated for buried and/or submerged service with standard 2" x 2" AWWA operating nut. Handwheel operator for above ground, exposed service.
Extension Shaft:	Complete with coupling, 2" x 2" nut with skirt, shear pins and stainless steel centering-identification plate as shown on Drawings. Shaft shall be furnished by valve manufacturer to operate safely with an input torque of 300 foot-pounds.
Plate Information:	Stamped lettering 3/8" height valve manufacturer, valve type, size, class, number of turns, serial number.

B. Suppliers, or Equal:

1. American Flow Control - Series 2500.
2. U.S. Pipe – USP Series.
3. Mueller – 2360 Series

2.03 GATE VALVES (SMALLER THAN 3-INCH)

- A. Construction: Gate valves, smaller than 3-inch, for general purpose use shall be heavy duty type for industrial service, with screwed or soldered ends to suit piping. The bodies and stems shall be solid 85-5-5-5 ASTM B62 bronze with screwed tops or union bonnets, solid wedges, metal handwheels, and Teflon-impregnated or other acceptable packing. All valves shall have non-rising stems unless otherwise specified or shown. All valves shall have a minimum pressure rating of 250 psi cold water, unless otherwise specified or shown.

B. Suppliers, or Equal:

1. Crane Company;
2. Milwaukee Valve Company;
3. Wm. Powell Company;
4. Stockham Valves and Fittings

PART 3 EXECUTION

3.01 INSTALLATION

- A. All gate valves shall be installed in accordance with AWWA Standards and the Supplier's printed recommendations, and in accordance with the applicable provisions of Section entitled "Valves, General".

END OF SECTION

SECTION 400531
GLOBE STYLE VALVES

PART 1 GENERAL

1.01 SUMMARY

- A. This section includes materials of construction, fabrication, installation and testing of exposed service valves and appurtenances.

1.02 SECTION INCLUDES

- A. Pressure Relief Valves.

1.03 REFERENCES

- A. ANSI/AWWA C550 - Protective Epoxy Interior Coatings for Valves and Hydrants.
- B. ANSI/AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
- C. ANSI/AWWA C111/A21.11 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pipe and Fittings.
- D. ANSI/AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
- E. ASTM A 48 - Standard Specification for Gray iron Castings.
- F. ASTM A 126 - Standard Specification for Gray-Iron Castings for Valves, Flanges and Pipe Fittings.
- G. ASTM A 240 - Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels.
- H. ASTM A 276 - Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes.
- I. ASTM A 436 - Standard Specification for Austenitic Gray iron Castings.
- J. ASTM A 536 - Standard Specification for Ductile Iron Castings.
- K. ASTM B 16 - Specification for Free-Cutting Brass Rod, Bar, and Shapes for Use in Screw Machines.
- L. ASTM B 62 - Specifications for Composition Bronze or ounce Metal Castings.
- M. ASTM B 271 - Specification for Copper-Base Alloy Centrifugal Castings.
- N. ASTM B 505 - Specifications for Copper-Base Alloy Continuous Castings.
- O. ASTM A 546 - Specification for Electric Fusion Welded Ni-Fe-Cr-Si Alloy Pipe.
- P. ANSI/NSF 61, Drinking Water System Components - Health Effects.
- Q. ANSI B16.1 - Cast-Iron Pipe Flanges and Flanged Fittings.

1.04 SUBMITTALS

- A. Submit manufacturer's catalog cuts and product data in accordance with Section 013300 showing all

valve parts and describing materials of construction by referenced Standard, grade and/or type. Clearly indicate make, model, location, type, size, and pressure rating. Indicate valve linings and coatings.

- B. Show valve dimensions including laying lengths. Show dimensions and orientation of valve operators, to be installed on the valves.
- C. Submit certification from manufacturer that butterfly valves are ANSI/NSF 61 listed, including the certifying agency.
- D. Provide Operation and Maintenance information per Section 018300 for specific valves.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle valves and other components in accordance with manufacturer's recommendations.

1.06 WARRANTY

- A. Provide a three year warranty against defects in workmanship and materials for all valves and valve components from the date of Substantial completion.
- B. Under this warranty, cover all costs for part(s), labor and materials to repair failed part(s).
- C. Utilize only new replacement part(s) under this warranty.

PART 2 PRODUCTS

2.01 BOLTS AND NUTS FOR VALVES

- A. Provide bolts and nuts for flanged, mechanical joint, or restrained joint valves as specified for connecting pipe.

2.02 PRESSURE RELIEF VALVE

- A. These valves shall open if pressure exceeds a set level. When the upstream pressure becomes equal to the spring setting of the pressure relief control, the valve opens quickly to vent excess water to atmosphere. The valve will have speed controls on both open and close operations to allow it to slowly return closed following initial opening.
- B. The valve shall be hydraulically operated diaphragm actuated globe or pattern. The stem shall be guided by an integral bearing in the seat and a cover bearing. It shall contain a resilient, synthetic rubber disc with a rectangular cross section contained on 3 ½ sides. The manufacturer shall have utilized the same valve design for no less than 10 years. A piston style control valve or rolling diaphragm design will not be allowed.
- C. The pressure relief pilot control shall be direct acting; adjustable, spring-loaded pilot designed to permit flow when controlling pressure exceeds the adjustable spring setting. It shall be adjustable from 30-300 PSI.
- D. The valves shall be Ductile Iron, Stainless Steel Trim, with Epoxy Coating inside & out, 150# Flanged and shall be rated for 250 PSI. It shall include a strainer, X101 position indicator, opening and closing speed controls, one (1) X141 pressure gauge mounted on the upstream side of the valve, and shall include manual operator. The valve will also include Anti-Cavitation trim. The valve shall be a Cla-Val Model 50-01PSVKO or Engineer approved equal.
- E. Start-up shall be by factory trained personnel of the valve manufacturer and shall include 1 hour of training

in addition to start-up.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Make sure joint sealing surfaces, body seats, and disc seats are clean.
- B. Check bolts on valve and actuator for loosening in transit.
- C. Open and close the valve to make sure it operates properly. Close valve before installation.
- D. Verify the compatibility of valve joint connections, including class and drilling of flanges with the connecting pipe prior to installation.

3.02 GENERAL INSTALLATION

- A. Install valves in accordance with manufacturers written instructions.
- B. Threaded joints: Clean threaded joints by wire brushing or swabbing. Apply Teflon joint compound or Teflon tape to pipe threads before installing threaded valves. Joints shall be watertight.
- C. Flanged joints: Bolt holes of flanged valves straddle the horizontal and vertical centerlines of the pipe run to which the valves are attached. Clean flanges bolts and nuts by wire brushing before installing flanged valves. Lubricate threads with oil or graphite, and tighten nuts uniformly and progressively. If flanges leak during pressure testing, loosen or remove the nuts and bolts, reseal or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.
- D. Mechanical or restrained joints: Clean joint surfaces bolts and nuts by wire brushing before installing valve. Lubricate gasket with pipe joint lubricant. Lubricate threads with oil or graphite, and tighten nuts uniformly and progressively. If mechanical or restrained joint leaks during pressure testing, loosen or remove the nuts and bolts, reseal or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.

3.03 VALVE LEAKAGE TESTING

- A. Test valves for leakage at the same time that the connecting pipelines are tested. See Section 02510 for pressure testing requirements.
- B. Protect or isolate any parts of valves, operators, or control and instrumentation systems whose pressure rating is less than the pressure test.
- C. No valve leakage is allowed. Repair or replace leaking valves and retest.

3.04 VALVE FIELD TESTING

- A. Operate manual valves through 10 full cycles of opening and closing. Valves shall operate from full open to full close without sticking or binding. If valves stick or bind, repair or replace the valve and repeat the tests.
- B. Verify that air valves properly release air and shut tightly with no leakage once valve is closed.
- C. Witness operation of check valves and make adjustments or, if necessary, provide top mounted dashpot at no additional cost to the Owner.
- D. Verify relief valve setting by closing isolation valve and running pump. Make adjustments as necessary

for proper operation of the valve.

END OF SECTION

SECTION 409000
INSTRUMENTATION AND CONTROL

PART 1 GENERAL

1.01 WORK INCLUDED

- A. System Monitoring and Control.
- B. Startup and Training.

1.02 INTEGRATOR QUALIFICATIONS

- A. This section covers the furnishing of components of an integrated instrumentation and control system as specified herein and as indicated on the drawings, for installation by the General Contractor. Preapproved integrators include:
 - 1. None.
- B. General Contractors may propose additional integrators for Engineer's approval no less than 14 days prior to bid. Proposed integrator shall meet the following minimum requirements:
 - 1. Must have 10 years experience performing systems integration in the Water & Wastewater field of practice.
 - 2. Must be a top-tier integrator in the SCADA software provider's integrator program.
 - 3. Must be a recognized integrator of the PLC manufacturer's integrator program. Must have one member on staff that has completed factory-recognized PLC training program.
 - 4. Must be located or have a designated service agent located within 150 miles of the WTP.

1.03 GENERAL SYSTEM DESCRIPTION

- A. Raw water from Lake Nighthorse is pumped through a single intake pump at the Intake Pump Station, with that pump's speed modulating to provide a constant discharge pressure as required to provide approximately 30 psi at the suction of the Booster Pump Station.
- B. Pressure is boosted at the Booster Pump Station by using a combination of two booster pumps. The pumps are sequenced and their speeds modulated as required to pump at an operator-selected flow rate to Lake Durango.
- C. Remote monitoring of system parameters and alarms is provided by an internet-enabled cellular gateway installed at a remote location.

1.04 RESPONSIBILITIES OF SUPPLIER

- A. The Supplier shall furnish and install all proposed instrumentation, computer hardware and software, programmable controller hardware and software, and all required interfaces as shown on the drawings

and as specified herein. The total instrumentation and control systems shall be the unit responsibility of one supplier. The instrumentation installation and wiring connections to instruments and peripheral equipment shall be the responsibility of this supplier using qualified personnel possessing the necessary equipment and having experience in making similar installations.

- B. It is the responsibility of the Supplier to integrate into a properly functioning and communicating system the instruments, programmable controllers, and central computer system.
- C. All calibration and final checkout of the instrumentation system shall be witnessed by the Owner's Representative to determine if the instrumentation systems comply with the contract documents.
- D. The single instrument supplier shall be responsible for coordinating and interfacing with equipment supplied under other divisions of the contract documents, which are an integral part of the instrumentation system. This interfacing shall be incorporated in the detailed systems drawings and data section of the contract documents.
- E. The proposed instrumentation system components shall be new and electrically and mechanically compatible with each other.

1.05 REFERENCES

- A. National Electrical Code.
- B. Applicable FCC Rules and Regulations.
- C. NEMA.
- D. U.L.
- E. ANSI
- F. ASCII Standard Character Codes.

1.06 SUBMITTALS

- A. Shop drawings and product data under the provisions of Section 013300.
- B. Detailed System Drawings and Data: The Contractor shall submit detailed drawings and data prepared and organized by the single instrument supplier and computer/programmable controller supplier designated at the time of bidding. These drawings and data shall be submitted as a complete package at one time and shall include:
 - 1. Submittals shall be in three-ring hardcover binders, Borum and Pease No. 619, and arranged for convenient use, including tab sheets, all indexed and cross-referenced.
 - 2. Detailed JIC-Style schematic diagrams of each equipment item.
 - 3. Detailed instrumentation diagrams of each control sequence.
 - 4. Detailed written description of the operation of each control sequence.

5. Data sheets for each component, together with a technical product brochure or bulletin. The data sheets shall show:
 - a. Component name.
 - b. Manufacturer's model number.
 - c. Project tag number.
 - d. Project location.
 - e. Input and output characteristics.
 - f. Scale range and units (if any) and multiplier (if any).
 - g. Requirements for electric supply (if any).
 - h. Requirements for air supply (if any).
 6. Instrument interconnect drawings showing the interconnecting wiring between each instrument including equipment supplied under other sections requiring interfacing with instrumentation.
 7. Arrangement and construction drawings for the instrument control panel and for other special enclosed assemblies for field installation. These drawings shall include dimensions, identification of all components, preparation and finish data, nameplates, and the like. These drawings also shall include enough other details to define the style and overall appearance of the assembly; a finish treatment sample shall be included.
 8. Installation, mounting, and anchoring details for all components or entry details.
 9. Accuracy calculations for each process control system.
 10. Complete detailed bills of material.
- C. Operation, Maintenance, and Repair Manuals: The organization of the initial submittal required above shall be compatible to eventual inclusion as one volume of the operation, maintenance, and repair manuals.
1. Operation manuals shall be prepared and submitted to the Owner's Representative for preliminary review in two copies. When the Owner is satisfied that these are complete and properly prepared, four final sets shall be delivered to the Owner's Representative as a condition of acceptance of the project.
 2. It is intended that the complete operation manual contain all the information included in the preliminary equipment submittal, the detailed installation submittal, and the additional information required herein, all bound in hard-cover binders and arranged for convenient use, including tab sheets, all indexed and cross referenced and all final as-built drawings.
 3. The operation manuals shall contain:
 - a. Instrument system operating instructions written for the benefit of plant operating personnel for normal operational conditions and utilizing names of controls as they appear on nameplates.

- b. Calibration and maintenance instructions.
- c. Troubleshooting instructions.
- d. Instructions for ordering replacement parts.

1.07 GUARANTEE

- A. The supplier assuming unit responsibility shall guarantee the entire instrumentation system for a period of five years after acceptance of the contract by the Owner and shall repair or replaced any defective components and correct any faulty workmanship at no cost to the Owner within this guarantee period. Services shall be performed within five (5) calendar days after notification by the Owner.

1.08 CONTROL SEQUENCES

- A. The control sequence descriptions together with the detail drawings and instrumentation diagrams comprise the functional design criteria of the instrumentation and control system.
- B. The instrumentation diagrams represent the basic concept of the instrumentation and controls, whereas the control sequence descriptions supplement the instrumentation diagrams.
- C. The single instrument supplier shall utilize the control sequence descriptions and instrumentation diagrams as the basic criteria for the design of the instrumentation and control schematics, preparation of instrument data sheets, wiring diagrams, software, piping layouts, assembly drawings, and other requirements set forth in these specifications.
- D. Unless approved by the Engineer, all control sequences shall reside in the PLC programming. PLCs should be capable of sustaining autonomous control of the process during lapses of communication with the central computer.
- E. In most instances, the central computer interaction with control sequences should be limited to:
 - 1. Monitoring control outputs, including recording data and generating alarms.
 - 2. Adjusting setpoints stored in PLC memory.
 - 3. Opening/closing a contact or manipulating a register, indicating to the PLC the beginning or end of a control sequence.

1.09 INTAKE OPERATION

- A. Intake operation sequences, except for handshake and exchange of start/stop signals, should operate independent of communication with the booster pump station.
- B. Upon receipt of a relayed start command from the booster pump station, the pump should start to an operator-adjustable fixed operating speed. Once the target speed is reached, a P-I-D loop should take over control to modulate pump speed to maintain the setpoint discharge pressure.

- C. A stillwell will be fastened to the pump column piping through which a transducer can be installed to provide continuous level measurement of the water level in the intake caisson.
 - 1. An analog signal proportional to water depth is sent to the PLC.
 - a. An operator-adjustable low level alarm will notify the operator when the water level is near the minimum submergence level for the pump.
 - b. An operator-adjustable low-low level alarm will begin a shutdown of the intake pump system.
- D. A pressure transducer will be installed in the discharge manifold of the pumps to indicate discharge pressure.
 - 1. An analog signal proportional to discharge pressure is sent to the PLC.
 - a. An operator-adjustable setpoint will define the setpoint discharge pressure for intake pump PID control.
 - b. An operator-adjustable high discharge pressure alarm will notify the operator when the discharge pressure is near the pressure-relief setpoint of the pressure relief valve.
- E. A pressure switch will be installed in the discharge manifold of the pumps.
 - 1. Upon triggering of the pressure switch, a discrete signal will be received at the PLC where a high-high discharge pressure alarm will begin a shutdown of the intake pump system.
- F. A pressure relief valve connected to the discharge manifold will protect discharge piping and equipment from excessive pressure by allowing water to discharge into the intake caisson. The pressure relief valve will have a valve position indicator.
 - 1. An analog signal proportional to valve position is sent to the PLC.
 - a. Upon detection of the valve opening, a relief valve open alarm will notify the operator when the valve has opened. After the valve has remained open for an operator-adjustable time period, the intake pump system shall shutdown.
- G. The station will utilize a transit-time sonic flowmeter installed in a vault outside the building. See Section 409123 for meter requirements.
 - 1. An analog signal proportional to flow rate is sent to the PLC.
- H. The PLC shall maintain historical data for the following parameters:
 - 1. Indicate/record station flow rate.
 - 2. Totalize and record station flow.
 - 3. Indicate/record pump discharge pressure.
 - 4. Indicate/record alarms as described above.

1.10 BOOSTER PUMP STATION OPERATION

- A. Booster pump station operation sequences, except for handshake and exchange of start/stop signals, should operate independent of communication with the intake station.
- B. The booster pump station PLC shall initiate system startup. Upon receipt of a local or remote start command, the station PLC should relay a start signal to the intake station. Once an operator-adjustable minimum suction pressure is detected, a setpoint always greater than minimum suction pressure, pumps should start to modulate pump speed to maintain the setpoint flow rate using PID control.
 - 1. Pumps should be sequenced on to provide optimal pump operation and energy efficiency. Below a setpoint flowrate of 500 gpm, only one pump should be in operation.
 - 2. Pumps should alternate each time the system is started and at an operator-defined elapsed time.
- C. A pressure transducer will be installed in the suction manifold of the pumps to indicate suction pressure.
 - 1. An analog signal proportional to suction pressure is sent to the PLC.
 - a. An operator-adjustable low suction pressure alarm will notify the operator when the suction pressure is near the minimum allowable suction pressure. This setpoint may also be used to indicate a permissive condition for station start.
- D. A pressure switch will be installed in the suction manifold of the pumps.
 - 1. Upon triggering of the pressure switch, a discrete signal will be received at the PLC where a low-low suction pressure alarm will begin a shutdown of the booster pump system.
- E. A pressure transducer will be installed in the discharge manifold of the pumps to indicate discharge pressure.
 - 1. An analog signal proportional to discharge pressure is sent to the PLC.
 - a. An operator-adjustable high discharge pressure alarm will notify the operator when the discharge pressure is near the pressure-relief setpoint of the pressure relief valve.
- F. A pressure switch will be installed in the discharge manifold of the pumps.
 - 1. Upon triggering of the pressure switch, a discrete signal will be received at the PLC where a high-high discharge pressure alarm will begin a shutdown of the booster pump system.
- G. A pressure relief valve connected to the discharge manifold will protect discharge piping and equipment from excessive pressure by allowing water to discharge to atmosphere outside the building. The pressure relief valve will have a valve position indicator.
 - 1. An analog signal proportional to valve position is sent to the PLC.
 - a. Upon detection of the valve opening, a relief valve open alarm will notify the operator when the valve has opened. After the valve has remained open for an operator-adjustable time period, the booster pump system shall shutdown.

H. The station will utilize a magnetic flowmeter installed in a vault outside the building. See Section 409721 for meter requirements.

1. An analog signal proportional to flow rate is sent to the PLC.

I. The PLC shall maintain historical data for the following parameters:

1. Indicate/record station flow rate.

2. Totalize and record station flow.

3. Indicate/record pump suction pressure.

4. Indicate/record pump discharge pressure.

5. Indicate/record alarms as described above.

1.11 AIR BURST CONTROL

A. The air burst system will be provided as a package unit from the intake screen manufacturer.

1. The instrumentation and control system will monitor automatic operation of the system, including logging either upper or lower screen system actuation, air receiver pressure, and compressor run/fault signals.

1.12 REPEATER STATION

A. A telemetry repeater station will be placed at the Lake Nighthorse Dam Operations Building to provide cellular access to station parameters and transmission of alarms. No local data, other than radio loss of communication is required at this site.

1. The repeater station will make the following parameters available via a read-only internet-accessible interface:

a. Station Status

b. Booster Station Flowrate

c. Intake Station Discharge Pressure

d. Intake Caisson Level

e. Current Alarms

f. Intake Station Totalized Flow

2. The repeater station shall be capable of transmitting all alarms via SMS text messaging. Alternate alarm distribution methods may be proposed by the Contractor.

1.13 DOOR AND GATE ALARMS

A. A limit switch on each exterior door and the Intake Station Gate will provide entry alarms for each of these locations.

1. A red lighted pushbutton on the control panel with no exterior label will serve as the entry alarm acknowledge button. If this button is pressed within an operator-adjustable period of time following trigger of an entry alarm limit switch the entry alarm will be disabled until all entry alarm switches are reset.
2. Entry alarm is a silent alarm and will only trigger operator notification.

1.14 TOUCHSCREEN DISPLAYS

- A. Each station control panel will have a touchscreen display capable of displaying all operating setpoints and parameters, alarms, and operational data.

1.15 POWER MONITORS

- A. The main power distribution panel at both the WTP and the Wellfield will be equipped with customer-side power metering equipment. This equipment will generate an Ethernet signal encoded with various power and power quality parameters. These parameters will be received at the local PLC, where they will be displayed and logged.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.01 EQUIPMENT INSTALLATION

- A. Components, Materials, and Workmanship: It is the intent of this section to require high quality in all components and materials, together with excellent workmanship, in order to provide complete operating installations, systems, circuits, and processes.
- B. Components and Materials: All components and materials shall be of industrial grade for computer and telemetry equipment with standard construction. Components shall be of sturdy and durable design and manufacture and shall be proven capable of long, reliable, and trouble-free service.
- C. Components and materials which are of fragile and competitive grade construction for light-duty commercial applications or which are of unproved or doubtful durability, accuracy, reliability, and service life are not acceptable and shall not be used. In case of doubt, the Owner's Representative may require that a list of at least five successful, representative, similar installations be submitted so that he may verify that a proposed component, in fact, has proven to be capable of long, reliable, and trouble-free service.
- D. Workmanship: Installation, programming, connection, calibration, testing, and adjustment work shall be performed by qualified, experienced personnel who are technically skilled in their trade, are properly instructed, and are closely supervised. The resulting systems shall reflect professional quality work and through, competent supervision.

- E. Uniformity of Components: Components that perform the same or similar functions shall, to the greatest degree possible, be of the same or similar type, the same manufacture, the same grade of construction, the same size, and the same appearance.
- F. Conduits and Conductors for I/O Terminals: Provide to the General Contractor a diagram showing all conduits and conductors required for a complete and operable system between field mounted and panel mounted I/O terminals to make a complete system. All conductors and conduits shall be furnished and installed in accordance with Section 260519. All special conductors shall be furnished under this section by the Control and Instrumentation Supplier and installed in accordance with the manufacturer's recommendation. Each analog, digital, peripheral, and telemetry circuit conductor connected to a given electrical point to and from the I/O terminal panel shall be designated by a single unique number as assigned by the single instrument manufacturer. The Supplier shall supervise the tagging of each conductor.
- G. In the event equipment other than those specified are furnished and, as a result, wiring changes are required, the Supplier shall be responsible for furnishing and installing such wiring at no additional expense to the Owner. The Supplier shall instruct the parties concerned as to how this work will be accomplished. All such changes and the proposed method of accomplishing the work shall be submitted for review by the Owner's Representative prior to commencing the work.

3.02 MOUNTING OF EQUIPMENT AND ACCESSORIES

- A. Instrumentation and Control equipment shall be mounted in accordance with the installation detail drawings as prepared by the Supplier and reviewed by the Engineer. Equipment shall be mounted so that they are rigidly supported, level and plumb, and in such a manner as to provide accessibility; protection from damage; isolation from heat, shock, and vibration; and freedom from interference with other equipment, piping, and electrical work. Consoles, cabinets, and panels shall not be installed until heavy construction work adjacent to control equipment has been completed to the extent that there shall be no damage to the instrumentation and control equipment.
- B. All devices, including accessories, shall be located where they shall be accessible from grade, except as shown otherwise.
- C. All local PLC's and instrumentation equipment shall be mounted in cabinets or as specified under this contract. Associated I/O terminals shall be mounted on a common panel or rack.
- D. The Supplier shall coordinate the installation of the electrical service to components related to the system to assure a compatible and functionally correct system. All accessories shall be coordinated and installation verified by the Supplier.
- E. The completed system shall be tested after installation to insure that all components are operating with the specified range and all interlocks are functioning properly.

3.03 CALIBRATION, TESTING, STARTUP & OPERATORS TRAINING

- A. Calibration: All instrumentation and control systems shall be calibrated after installation in conformance with the component manufacturer's instructions. This shall provide that those

components having adjustable features be set carefully for the specific conditions and applications of this installation and that the components and/or systems be within the specified limits of accuracy. Defective elements that cannot achieve proper calibration or accuracy, either individually or within a system shall be replaced. This calibration work shall be accomplished by a technical field representative of the Supplier. He shall certify in writing to the Engineer that all calibrations have been made and that all systems are ready to operate.

- B. Factory Testing: The PLC's, and control components shall be successfully submitted to a factory acceptance test before shipment to the job site. The Engineer may elect to be present to witness the test procedure.
- C. Prior to factory system testing, a written detailed test procedure shall be submitted for review by the Engineer. The Engineer shall be notified in writing four weeks in advance of the schedule testing.
- D. A one-day training session shall also be provided by the Supplier to familiarize the Owner and the Engineer with the Supplier's system.
- E. Operational tests shall demonstrate that the system will perform with both hardware and software each operation required by these specifications for all specified conditions, including both normal and emergency operations and conditions. A certification and log of all tests shall be furnished to the Owner for review and comment. All panel wiring shall be checked against drawings approved by the Supplier. Any changes made during testing of the equipment shall also be recorded on the record drawings and submitted to the Engineer. The factory witness test shall take as long as necessary to demonstrate to the Owner and the Engineer that the system performs each operation as required under this Contract.
- F. Field Testing: All systems shall be exercised through operational tests in the presence of the Owner in order to demonstrate achievement of the specified performance.
- G. Operational tests dependent upon completion of work specified elsewhere in these specifications: The scheduling of tests shall be coordinated among all parties involved so that the tests may proceed without delays or disruption by uncompleted work.
- H. Startup: When all systems are assessed to have been successfully carried through a complete operational test and the Owner concurs in this assessment, a date for system startup involving the Owner's operating personnel will be agreed upon.
- I. The computer and control system each shall be rechecked at this time to verify proper operation, and final adjustments shall be made. The computer system testing shall consist of 30 consecutive days of system testing. The operational tests shall have a success factor of 98% system uptime. Uptime shall be defined as the period of operation when the entire system is operating and no errors or faults occur due to software, hardware, or peripheral equipment malfunction. If the system should fall below the 98% factor, the system problems shall be corrected and the system startup shall start over again from day one. This will continue until the system functions for 30 consecutive days with a 98% uptime success factor.
- J. Operator Training: The Owner's operating personnel shall be provided with 20 days of formal instruction in the functions and operations of each system provided under this contract. The training shall cover overall system theory, hardware architecture, the operating system, programming

instruction in the applicable languages, utility programs, report generation, and diagnostics. The programming instruction shall include program development, coding, sample programs, and debugging at every programming level. Actual programming exercises and hands-on experience shall be emphasized. Emphasis shall also be placed on safety features and features that may require readjustment, resetting or checking and recalibration of operating personnel from time to time.

- K. The training sessions shall be provided at the Owner's facilities and on the equipment furnished under this Contract. The education and instruction of operating personnel shall be by a qualified instructor familiar with the requirements for this project. Each training session shall be for eight hours of formal instruction. Session dates shall be directed by the Owner.

END OF SECTION

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BARTLETT —
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SECTION 409100
PRIMARY PROCESS MEASUREMENT DEVICES

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section includes materials, installation, and testing of:
 - 1. Pressure Transmitters – Submerged type.
 - 2. Pressure Transmitters / Differential Pressure Transmitters.

1.02 SUBMITTALS

- A. This submittal shall provide complete documentation of all field instruments using ISA-S20 format. A complete Bill of Materials (BOM) listing all instrumentation equipment shall be provided.
- B. Submit shop drawings in accordance with the General Conditions and Section 013300.
- C. Provide affidavit of compliance with applicable standard.
- D. Data Sheets
 - 1. Provide data sheets for each instrument listing model numbers, options, and ancillary devices that are being provided.
 - 2. The data sheets shall be provided with an index, proper identification, and cross referencing. The data sheets shall include, but not be limited to, the following information:
 - a. Plant Equipment Number and ISA tag number per the Loop Diagrams.
 - b. Product (item) name used herein and on the Contract Drawings.
 - c. Manufacturer's complete model number.
 - d. Location of the device.
 - e. Input - output characteristics.
 - f. Range, size, and graduations.
 - g. Physical size with dimensions, enclosure NEMA classification, and mounting details.
 - h. Materials of construction of all components
 - i. Instrument sizing calculations where applicable
- E. Equipment Specification Sheets
 - 1. Provide equipment specification sheets that shall fully describe the device, the intended function, how it operates and its physical environmental and performance characteristics. Each data sheet shall have appropriate cross references to loop or equipment identification tags. As a minimum the specification sheets shall include the following:
 - a. Dimension, rigid-clearances
 - b. Mounting or installation details
 - c. Connection
 - d. Electrical power or air requirements
 - e. Materials of construction
 - f. Environmental characteristics

- g. Performance characteristics
 - h. Complete information regarding the field instruments as required by ISA 5.4 standards shall be provided under this contract.
- A. Submit submittal, production, testing, and installation schedules.
- B. Manuals
- 1. The supplier shall provide operating instruction manuals with adequate information pertaining to the following:
 - a. System specifications
 - b. Electrical power requirements
 - c. Application considerations
 - d. Assembly and installation procedures
 - e. Power up procedures
 - f. Troubleshooting procedures
 - g. Programming procedures
 - h. Explanation of internal fault diagnostics
 - i. Shut down procedures
 - j. Recommended spare parts list

1.03 SOFTWARE

- A. One fully licensed copy of any software required to program or configure the devices shall be provided to the Owner. Software shall be full version; no shareware or demo software will be accepted.
- B. In cases where the supplier does the programming, final device configurations and programming should be downloaded and written to disk for archival. A printed copy should be included in Operating and Maintenance submittals. Archived configurations should be provided to both the Engineer and Owner.

1.04 SERVICE

- A. The supplier shall provide a network of field sales and support personnel located in key cities throughout the United States and internationally. The supplier shall also provide a field service department with experienced representatives stationed in major cities with the capability to provide telephone consultation, prompt on-site service, and field replacement stock.
- B. The supplier shall provide product application assistance by trained and experienced engineers to assist the customer with program and system development through telephone consultation and on-site checkout, debug, and start-up assistance.
- C. The supplier shall provide a customer training program designed to teach the customer's personnel in the understanding and application of the programmable controller. The training program shall include training manuals and "hands-on" programming experience on a device of a type similar to that provided by the supplier.
- D. The supplier shall have the capability to conduct on-site training programs at a location provided by the customer.
- E. The supplier shall be capable of providing troubleshooting software.

PART 2 MATERIALS

2.01 PRESSURE TRANSMITTERS – SUBMERGED TYPE

- A. This specification has been developed to establish minimum requirements for a submerged pressure-actuated transmitter specifically designed for operation in a raw sewage, wastewater environment. The controller shall be supplied with the sensor, transmitter, configuration and calibration equipment, and all power and interface cables necessary to function as a complete and operable system.
- B. Pressure transmitter shall be LevelRat as manufactured by Keller America; Series 705 Submersible Level Transducer as manufactured by KPSI/Measurement Specialties; A1000i as manufactured by Siemens or approved equal.
- C. General
 - 1. The submerged pressure transmitter shall be capable of reading the pressure in tank or vessel and reporting that reading to the SCADA system.
- D. Hardware
 - 1. Unit shall be a self-contained, one piece waterproof housing constructed of 316 stainless steel or titanium, combining the sensor and transmitter.
 - 2. Pressure shall be sensed by a diaphragm device using no moving parts, such as levers and pivots.
 - 3. The sensor shall have a multi-ported pressure-sensing end that protects the diaphragm while sensing the level of viscous liquids or slurries.
 - 4. The device shall be supplied with sufficient factory installed non-spliced suspension cable to the location indicated on the Drawings or as specified. The suspension cable shall have a polyethylene jacket and internal venting to provide for atmospheric sensing of the non-process side of the diaphragm. A vent filter and aneroid bellows shall be provided to prevent moisture from entering the vent tube.
 - 5. The transducer shall have a combined error (linearity and hysteresis) of $\pm 0.25\%$ full scale and be temperature compensated to $\pm 2.5\%$ per 100 degrees Fahrenheit.
 - 6. The unit shall be capable of a three times full scale overpressure without damage or change of calibration.
 - 7. Nominal pressure range shall be 0-10 psi or as required for the individual instrument setting.
- E. Input and Output, Communications Interfaces
 - 1. The unit shall be a true two-wire device, generating an analog (4-20 mA) or HART signal, proportional to pressure.
- F. Power Supply
 - 1. The device shall be loop-powered, operate in compliance with an electrical service of 24 VDC nominal.
- G. Environmental
 - 1. Temperature: 0°C to +60°C (32°F to +140°F)
 - 2. Minimum IP68 Rating
- H. Agency Approvals
 - 1. UL Listed

2.02 PRESSURE TRANSMITTERS / DIFFERENTIAL PRESSURE TRANSMITTERS

- A. This specification has been developed to establish minimum requirements for a pressure-actuated transmitter. The controller shall be supplied with the sensor, transmitter, configuration and calibration equipment, and all power and interface cables necessary to function as a complete and operable system.
- B. Pressure transmitter shall be Rosemount, Foxboro, or approved equal.
- C. General
 - 1. The pressure transmitter or differential pressure transmitter shall be capable of reading the pressure or pressure difference between two points in a piping or process system and reporting that reading to the SCADA system.
- D. Hardware
 - 1. Unit shall be a self-contained, one piece assembly combining the sensor, transmitter, and, if specified, local LCD display. Display shall be visible without removing an end cover.
 - 2. Pressure shall be sensed by a diaphragm device using no moving parts, such as levers and pivots.
 - 3. The transducer shall have a combined error (linearity and hysteresis) of $\pm 0.25\%$ full scale and be temperature compensated to $\pm 2.5\%$ per 100 degrees Fahrenheit.
 - 4. The unit shall be capable of a three times full scale overpressure without damage or change of calibration.
 - 5. The unit shall have a $\frac{1}{4}$ " or $\frac{1}{2}$ " NPT process pressure connection.
- E. Input and Output, Communications Interfaces
 - 1. The unit shall be a true two-wire device, generating an analog (4-20 mA) or HART signal, proportional to pressure or differential pressure.
- F. Power Supply
 - 1. The device shall be loop-powered, operate in compliance with an electrical service of 24 VDC nominal.
- G. Environmental
 - 1. Temperature: 0°C to +60°C (32°F to +140°F)
 - 2. Minimum IP56 Rating
- H. Agency Approvals
 - 1. UL Listed
 - 2. Suitable for operation in Class 1, Div 2, Groups A, B, C, & D hazardous locations.

PART 3 EXECUTION

3.01 DEVICE INSTALLATION

- A. Install and configure all logic devices. Installation shall include all steps necessary, including hardware and software configuration, to enable units to perform as part of an integrated network system.

3.02 TRAINING

- A. Contractor shall supply factory product representative(s) to conduct on-site training sessions. Owner shall receive hands-on instruction of necessary steps to configure, maintain, and utilize each data device.

- B. Initial training shall consist of one 8-hour day for each component. All costs associated with training, including labor, travel, meals, lodging, and per-diem expenses, shall be included in the contract price.
- C. Follow-up training shall take place three to six months after final acceptance of the Work. Contractor shall contact Owner two weeks in advance of desired date to coordinate scheduling. Follow-up training shall consist of one 8-hour day for each component. All costs associated with follow-up training, including labor, travel, meals, lodging, and per-diem expenses, shall be included in the contract price.
- D. Contractor may request Owner/Engineer's authorization to combine training time for like components.

END OF SECTION

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BARTLETT —
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SECTION 409123
TRANSIT-TIME SONIC FLOWMETERS

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section describes requirements for transit-time sonic flowmeters for use in raw wastewater flow measurement.

1.02 SUBMITTALS

- A. Submit shop drawings in accordance with the General Conditions and Section 013300.
- B. Submit manufacturer's catalog data and detail drawings showing dimensions, pressure rating, coatings, and meter parts and describe by material of construction specifications (such as AISI, ASTM, SAE, or CDA) and grade or type.
- C. Show meter dimensions including laying lengths.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Transit-time sonic meters shall be Accusonic Model 8510-4ACR6.
- B. Meter, transducers, sensors, and gauges shall be by the same manufacturer.

2.02 METER DESIGN

- A. The flowmeter shall be a fixed installation ultrasonic flowmeter. The flowmeter shall be microprocessor based, utilizing the transit-time flow measuring technique employing coded burst transmission in conjunction with digital signal processing and cross correlation techniques.
- B. The flowmeter shall provide transducer spacing and the following diagnostics: liquid sound speed, signal strength, transit-time both upstream and downstream, Reynold's number, upstream and downstream signal quality.

2.03 CONSTRUCTION

- A. The transducers shall be wetted ports and constructed of metal. They shall operate at 1.0-MHz frequency using a shear wave. Each transducer (two) shall be capable of both sending and receiving ultrasonic signals.
- B. The flowmeter electronics shall be housed in a NEMA 4X enclosure with window.
- C. Wetted Parts Material:
 - 1. Transducer: Accusonic Model 7601-454-ISE or 7601-454-OSE
 - 2. Transducer: Type 316 stainless steel.
 - 3. Jacking Tool w/ Valve: Accusonic Model 7642

2.04 TRANSMITTER

- A. Power Requirements: 100 to 130 volts a-c $\pm 10\%$, 60 hertz.
- B. Power Consumption: 12 watts maximum.
- C. The flowmeter shall provide two 4- to 20-mA current signal outputs proportional to the calibrated flow range, one for each flow direction.
- D. The flowmeter shall have the ability to display flow rate, flow velocity, and total flow in both directions.
- E. The flowmeter shall provide self and application diagnostics to isolate any fault conditions to either equipment failure or abnormal process conditions. A relay shall be provided for remote failure indication.
- F. Provide a transmitter programming device.
- G. Provide RG-59 transducers to transmitter interconnecting cables.

2.05 SPOOL

- A. Furnish a flanged Class 53 ductile-iron or standard weight steel spool with gaskets for each sonic flowmeter.
- B. Ends shall be flanged, Class 150 or 300 per ANSI B16.5 as indicated in the subsection on "Service Conditions." Flanges shall be flat faced.

2.06 PRESSURE RATING

Process Pressure Limits:	Minimum: Full Vacuum Maximum:
Size (inches)	Pressure Limit (psi)
4 to 12	250
14	240
16	210
18	250
20	225
24	235
30	225
36	188
42	215

2.07 PERFORMANCE

- A. Overall system performance shall be as follows:
- B. Accuracy of the flowmeter shall be $\pm 2.0\%$ of reading for velocity greater than 1 fps and ± 0.025 fps for velocity less than 1 fps.
- C. Rangeability: 400:1.
- D. Repeatability: $\pm 0.5\%$ of full scale.

E. Process Temperature Limits: -40°F to +212°F.

F. Ambient Temperature Limits: -40°F to +140°F.

PART 3 EXECUTION

3.01 SERVICE CONDITIONS

A. SONIC FLOWMETER AND INDICATOR/TOTALIZER

1.	Service	Raw Water
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2.	Tag No.	M-1
3.	Metering Tube	Epoxy-Coated Steel
	Size Flg.	30
	Rating (psi)	225
5.	Elec. Class.	NEMA 4X

6.	Tag No.	M-1
7.	Flow Rate Ind. Scale	0-12000 gpm
8.	Flow Totalizer Multiplier	100
9.	Aux. Output Signal	4-20 mA
10.	Aux. Output Signal To	PLC
12.	Mounting	Wall Mount

14.	Spec. Gravity	1.0
15.	Percent Solids (min/max)	0.0/1.0
16.	Flow (gpm) (min/max)	460/10,000
17.	Velocity (fps) (min/max)	0.19/4.22
18.	Press. (psig) (min/max)	0/225
19.	Temp. (°F) (min/max)	40/65

3.02 PRESSURE TESTING

- A. Pressure test meters along with the connecting piping. Test in accordance with Section 400515.

3.03 ADJUSTMENTS

- A. It shall be possible to recalibrate the 4- to 20-mA output in the field with an output monitor as the only necessary test equipment. Internal test circuits shall accurately simulate full-scale flow.

END OF SECTION

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BARTLETT & WEST

SECTION 409443
PROGRAMMABLE LOGIC PROCESS CONTROLLERS

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section includes materials, installation, and testing of:
 - 1. Programmable Logic Controllers (Fixed I/O).

1.02 GENERAL

- A. The supplier shall provide all necessary software programming and configuration to demonstrate the PLC-based system functionality during the Factory Test, Operational Readiness Test, and Functional Demonstration Test. This programming shall include, but not be limited to, input/output (I/O) mapping, a skeleton PLC database, and development of a temporary test screen.

1.03 SUBMITTALS

- A. Submit shop drawings in accordance with the General Conditions and Section 013300.
- B. Provide affidavit of compliance with applicable standard.
- C. Submit fully dimensioned drawings of product. Show and identify all connection locations and types.
- D. Submit installation schedule.
- E. Manuals
 - 1. The supplier shall provide operating instruction manuals with adequate information pertaining to the following:
 - a. System specifications
 - b. Electrical power requirements
 - c. Application considerations
 - d. Assembly and installation procedures
 - e. Power up procedures
 - f. Troubleshooting procedures
 - g. Programming procedures
 - h. Explanation of internal fault diagnostics
 - i. Shut down procedures
 - j. Recommended spare parts list

1.04 SOFTWARE

- A. In cases where the supplier does the programming, final device configurations and programming should be downloaded and written to disk for archival. A printed copy should be included in Operating and Maintenance submittals. Archived configurations should be provided to both the Engineer and Owner.

1.05 SERVICE

- A. The supplier shall provide a network of field sales and support personnel located in key cities throughout the United States and internationally. The supplier shall also provide a field service department with experienced representatives stationed in major cities with the capability to provide telephone consultation, prompt on-site service, and field replacement stock.
- B. The supplier shall provide product application assistance by trained and experienced engineers to assist the customer with program and system development through telephone consultation and on-site checkout, debug, and start-up assistance.
- C. The supplier shall provide a customer training program designed to teach the customer's personnel in the understanding and application of the programmable controller. The training program shall include training manuals and "hands-on" programming experience on a device of a type similar to that provided by the supplier.
- D. The supplier shall have the capability to conduct on-site training programs at a location provided by the customer.
- E. The supplier shall be capable of providing troubleshooting software.

PART 2 MATERIALS

2.01 PROGRAMMABLE LOGIC CONTROLLERS (FIXED I/O)

- A. This specification has been developed to establish minimum requirements for a solid-state Programmable Controller designed to provide high reliability in industrial applications. The internal wiring of the controller is to be fixed, with the logic functions it must perform in a given application to be programmed into its memory. The controller shall be supplied with the CPU, input/output scanner, inputs, outputs, memory, power supply, and all power and interface cables necessary to function as a complete and operable Programmable Controller system.
- B. Programmable Controller shall be Allen-Bradley MicroLogix 1400, or approved equal.
- C. General
 - 1. A major consideration of the controller system shall be its all-in-one design, with I/O expansion. This allows the user to quickly and easily install, service, and replace the controller and expansion modules if necessary.
 - 2. The supplier must have available a number of I/O options for the controller that include:
 - a. Power: 120 VAC, 24 VDC
 - b. Inputs: 120 VAC, 240 VAC, 24V dc sink, 24 VDC source, 4-20 ma Analog , 0-10v Analog, RTD and Thermocouple
 - c. Outputs: Relay (some of which must have individual isolation), 24 VDC source, 4-20ma Analog, 0-10v Analog and TRIAC
 - 3. The controller must be part of a larger family of packaged and modular programmable controllers that provide program transport (ability to move a customer's program between platforms in both directions), and also share programming tools, a common instruction set, and common communications to serial based devices (computers, electronic operator interfaces, etc).
- D. Controller Hardware
 - 1. The CPU shall be a self-contained unit, and will provide control program execution and support remote or local programming. This device will also supply I/O scanning, inter-processor, and peripheral communication functions.
 - 2. All components of the controller system shall be housed in a single chassis. (Power supply,

embedded I/O circuitry, CPU, Memory, and communications shall be resident in one enclosure.)

3. The CPU within the system shall perform internal diagnostic checking and give visual indication to the user by illuminating a "green" indicator when no fault is detected and a "red" indicator when a fault is detected.
4. The packaged controller shall be designed to operate in a free airflow environment. (Convection cooling only, no fans or other air moving devices shall be required).
5. The controller shall provide a simple embedded Human Machine Interface (HMI). This HMI must provide the ability to monitor/change user data and to display messages and data to the user. The ability to receive numeric input from the HMI that can be utilized by the controller's program must also be supported.
6. The controller must provide a mechanism to manually set the communication port to a known state (factory out of box preferred). Systems that do not provide a mechanism to manually set the communications port to a known state are not acceptable.
7. The controller must provide at least two digital trim potentiometers that are accessible from the front of the controller while the controller is operating.
8. The controller must support front accessible memory modules that can be inserted or removed while the system is operating (in run).
9. The main front panel of the controller shall include the following indicators:
 - a. Power
 - b. Run
 - c. Fault
 - d. Force
10. Processor mode shall be selected by a command from a programming device. Available settings must include modes:
 - a. RUN: Control program executing
 - b. PROGRAM: Controller not executing, user program can be uploaded or downloaded
 - c. SINGLE SCAN TEST: The PLC scans and solves the user program once, does NOT control the real world outputs, and stops.
 - d. CONTINUOUS SCAN TEST: The PLC continuously scans the user program, but does NOT control the real world outputs
11. Non-volatile memory shall store the operating system, user program, and all user data to protect against memory loss in the case of power loss or system shutdown.

E. Input and Output

1. A minimum of two isolated digital input groups, one isolated analog input group and six isolated output groups shall be located on the self-contained controller. All relays shall be individually isolated.
2. The system must support up to 80 discrete I/O points using expansion I/O modules. All I/O modules shall be of the maximum I/O count available in that module type.
3. Isolation shall be between all internal logic and external circuits.
4. Each input and output point shall have a visual indicator to display ON/OFF status.
5. All user wiring to I/O modules shall be through a heavy-duty terminal strip. Pressure-type screw terminals shall be used to provide fast, secure wire connections.
6. Inputs shall have adjustable filter time constants to improve input performance in high speed applications, and to limit the effects of voltage transients.
7. The system must support four expansion modules (input/output, discrete, or analog).

8. The controller manufacturer shall offer input/output hardware consisting of the following types:
- a. Standard Inputs:
 - (1) Inputs: 120 VAC, 240 VAC, 24 VDC sink, 24 VDC source, 4-20 ma Analog , 0-10 V Analog, RTD and Thermocouple
 - b. High Speed Counter
 - (1) Each controller with 24 VDC inputs must have a high-speed counter (HSC) capable of detecting a 20 kHz pulse stream built onboard.
 - (2) The HSC must be capable of detecting pulses as narrow as 25 microseconds (20 kHz) and directly control (turn on or off) controller outputs independent of the processor scan.
 - (3) The HSC must be cable of detecting single ended inputs, quadrature inputs, and high-speed inputs with external controls (hold and reset).
 - (4) The HSC must be completely configurable (input filters, modes of operation, etc.) using computer based software. Runtime control of the HSC must be allowed through commands (instructions) in the user (ladder) program (Reset accumulator, change presets, change output patterns and setpoints, enable/disable HSC operation etc).
 - (5) Data and status within the HSC must also be accessible from external devices through the controller's communications port.
 - c. High Speed Inputs
 - (1) Each controller with 24 VDC inputs must have at least four inputs that can catch and hold for one inputs scan a 25-microsecond input signal.
 - (2) Each controller with 24 VDC inputs must have four high-speed inputs capable of generating an input interrupt. When used for input interrupt functionality, the controller must be capable of executing a predefined range of logic. Each input must be configurable to run its own user defined block of logic.
 - d. Standard Outputs
 - (1) Outputs: Relay (some of which must have individual isolation), 24 VDC source, 4-20 ma Analog, 0-10 V Analog and Triac.
 - (2) Relay outputs for DC devices that operate at 5 to 125 VDC, with 2 amp continuous current capacity at 24 VDC and 1 amp continuous current capacity 125 VDC.
 - (3) Relay outputs for AC devices that operate at 5 to 264 VAC with 5 amp continuous current capacity for UL 508 up to 40°C (3A above 40°C) and 3 amp continuous current capacity for UL 1604, Class 1, Division 2, Hazardous Locations, Groups A, B, C, D.
 - e. High Speed Output
 - (1) Each controller with 24 VDC outputs must have at least two high-speed outputs. The outputs must be capable of generating PTO (pulse train output) signals. The PTO signals must be capable of generating motion profiles using either trapezoid or S curve acceleration and deceleration profiles.
 - (2) The outputs must also be configurable for PWM (pulse width modulated) signals. When configured for PWM the controller must provide trapezoid acceleration/deceleration of either the frequency or the duration portions of the PWM waveform.

F. Program Creation and Storage

- 1. The program storage medium shall be a solid-state non-volatile type.
- 2. The controller shall be capable of addressing up to a minimum of 4K data words, where each word is comprised of 16 data bits.
- 3. Available user memory shall consist of a minimum of 8K words of program and data.

4. Controller shall support up to 128K bytes for data logging.
5. Controller shall support up to 64K bytes for recipe.
6. The controller must provide the capability to use a non-volatile memory module that can be inserted or removed while power is applied to the controller.
7. The memory module must support the ability to selectively protect multiple areas of user data from being overwritten if/when a download occurs.
8. Memory modules must be capable of write once read many operations. This is a write once feature that if enabled inhibits a user from clearing the program currently stored in the memory module.
9. The memory module must support automatic program download whenever power is applied.
10. The memory module must support the ability to detect if a fault is present during the power up sequence, if a fault is present download the program that is in the memory module and enter the run mode. If a fault is not present the controller proceeds normally without memory module intervention.
11. The operator should be able to backup memory, including data and program logic onto computer storage media or a memory module.
12. The packaged controller system must be capable of storing the following data:
 - a. External Output Status
 - b. External Input Status
 - c. Timer Values
 - d. Counter Values
 - e. Signed Integer Numbers (16-bit)
 - f. Signed Integer Numbers (32-bit)
 - g. Binary data (bit, BCD, HEX)
 - h. ASCII String Data
 - i. Internal Processor Status Information
13. The above listed data shall be distinguishable to the CPU by the addressing format. Management of the data into memory subsections shall be an automatic function of the CPU operating system. Data can be displayed in Binary, Hexadecimal, or Decimal. Function-specific data such as processor status shall have dedicated displays that annotate the meaning of specific control bits and words within them and allow for selective control where appropriate.
14. If contacts or entire rungs are intentionally deleted from an existing logic program, the remaining program shall be automatically repositioned to fill this void. Whenever contacts or entire rungs are intentionally inserted into an existing program, the original program shall automatically be repositioned to accommodate the enlarged program.
15. The controller must support a minimum of four pulse inputs. Pulse inputs allow a fast signal to be captured and held long enough for the controller to detect the signal, once read the signal is automatically reset.
16. The number of times that a normally open (N.O.) and/or normally closed (N.C.) contact of an address can be programmed shall be limited only by the memory capacity to store these instructions.
17. The programming format shall be relay ladder diagram.
18. Ladder logic programs must have immediate access to the sub elements of control structures (timers, counters, sequencers etc.) by word (presets, accumulators etc.) and bit (status bits).
19. It shall be possible to program a maximum instruction matrix containing as many as 128 instructions.
20. The capability shall exist to change a contact from normally open to normally closed, add

- instructions, change addresses, etc. It shall not be necessary to delete and reprogram the entire rung.
21. It shall be possible to insert relay ladder diagram rungs anywhere in the program, even between existing rungs, provided there is sufficient memory to accommodate these additions.
 22. It shall be necessary to issue a two-part command in order to delete all relay ladder rungs from memory. This will provide a safeguard wherein the operator must verify their intentions before erasing the entire program.
 23. Latch functions shall be internal and programmable.
 24. The system must support up to 255 data files. Each data file must be configurable from 1 to 255 data elements, and type (timers, counters, integer (16 or 32bit), string, message or PID) Any number of timers, counters and internal bits up to a maximum of 2k words of data.
 25. All management of instructions and data in memory shall be handled by the CPU. Instructions shall permit programming timers in the "ON" or "OFF" delay modes. Timer programming shall also include the capability to interrupt timing without resetting the timers. Counters shall be programmable using up-increment, down-increment, or both. All timer and counter data must be accessible from the ladder program and any communications device.
 26. Timer instructions shall include selectable time bases in increments of 1.0, 0.01, and 0.001 second. The timing range of each timer shall be from 0 to 32,767 increments. It shall be possible to program and display separately the timer's preset and accumulated values.
 27. The controller shall use a signed integer data format. The signed integer format (-32,768 to +32,767) must be used throughout the controller, (counters, storage registers, math operations etc).
 28. The controller shall support signed integer math functions consisting of addition, subtraction, multiplication, division, scale with parameters, and square root.
 29. Instructions shall be provided for file manipulation instructions such as "file fill", "first in-first out", "last in-first out" shall be supported by the system. Four function math instructions and instructions for performing "logical OR", "logical AND", "exclusive OR", and comparison instructions such as "less than", "greater than", and "equal to" shall be included within the system. All instructions shall execute on single words, double words, or files.
 30. The system shall contain instructions for reading, writing, and manipulation of ASCII data, including instructions such as string extraction, concatenation, and byte swapping of data.
 31. The system shall contain instructions that will construct synchronous 16-bit word shift registers. Additional instructions shall be provided to construct synchronous bit shift registers.
 32. The controller shall have a jump instruction that will allow the programmer to jump over portions of the user program to a portion marked by a matching label instruction.
 33. The controller shall have an instruction that will allow the programmer to display a combination of bits, integers, and strings to the embedded HMI and optionally to receive bits, integers, or long integers from the HMI.
 34. In applications requiring repeatable logic rungs, it shall be possible to place such rungs in a subroutine section. Instructions that call the subroutine and return to the main program shall be included within the system. It shall be possible to program several subroutines and define each subroutine by a unique label. The processor will support nesting of subroutines. The program format as displayed on the CRT shall clearly define the main program and all subroutines.
 35. The program format shall display all instructions on a CRT programming panel with appropriate mnemonics to define all data entered by the programmer. The system shall be capable of providing a "HELP" instruction which when called by the programmer will display on the CRT a list of instructions and all data required to enter an instruction into the system memory.
 36. At the request of the programmer, data contained in system memory shall be displayed on the CRT programming panel. This monitoring feature shall be provided for input/output status, timer/counter data, files, and system status. Ladder logic rungs shall be displayed on the CRT with rung numbers in sequential order.

37. The system shall have the capability to enter rung comments above ladder logic rungs. These comments may be entered at the same time the ladder logic is entered.
38. It shall be possible to manually set (force) either on or off all hardwired input or output points. Removal of these forced I/O points shall be either individually or totally through selected keystrokes. The programming terminal shall be able to display forced I/O points.
39. The execution of the program logic shall be accelerated by scanning the rung only until a positive decision as to the state of the outputs has been made. In many cases, this will mean skipping over logic elements if the output condition has been predetermined.
40. A means to program a fault recovery routine shall exist. When a major system fault occurs in the system, the fault recovery routine shall be executed and then the system shall determine if the fault has been eliminated. If the fault is eliminated, program execution resumes. If the fault still exists, the system will shut down.
41. An interrupt routine shall be programmable such that the routine shall be executed regularly. The interval at which the routine is executed shall be user-specified in the range of 1 to 32767 milliseconds in one msec increments. This routine must be able to close an asynchronous control loop consisting of 32 Input points, 32 output points, 100 contact/coils, 10 addition instructions, 10 subtraction instructions and 32 circular comparison (Limit) instructions while never exceeding a 3 millisecond interval. The measurement of this interval is from after the Input filter delay time to the time that the physical outputs start to transition.
42. The ability to program ladder logic via symbols from the global database of the packaged controller shall exist.
43. The CPU shall support indirect addressing of inputs and outputs, along with all data table words (integer, binary, timers, and counters) for the software instruction set.
44. The system shall support both bit and word level diagnostic instructions.
45. To facilitate conditional event detection programming, output instructions shall include a "one shot" instruction that may be triggered on the low-to-high (rising) rung condition.
46. The processor shall support Master Control Reset (Relay) type functionality to selectively disable sections of relay ladder logic.

G. Communications Interfaces

1. The Programmable Controller shall have at least one dedicated serial port that supports RS-232 signals. It shall be usable for programming and data monitoring purposes. The serial port will also provide support for ASCII communications.
2. If required by the I/O communications plan, the Programmable Controller shall have at least one dedicated serial port or CAN interface that supports either Modbus/RTU or DeviceNet protocols.
3. The Programmable Controller shall have at least one dedicated Ethernet port that supports standard TCP/IP communications over an IEEE 802.3 standard physical and data link. The Ethernet port shall be capable of communicating using either Ethernet/IP (CIP) or Modbus/TCP protocols. The unit shall also be capable of peer-to-peer communications and receiving programming using this interface.

H. Environmental

1. Temperature: 0°C to +60°C (32°F to +140°F)
2. Humidity: 5-95% at 40°C (104°F), non-condensing
3. The Programmable Controller processor shall be able to withstand conducted tests as outlined in the following:

Environmental Test	Industry Standard
ESD Immunity	IEC 61000-4-2

Radiated RF Immunity	IEC 61000-4-3
EFT/B Immunity	IEC 61000-4-4
Surge Transient Immunity	IEC 61000-4-5
Conducted RF Immunity	IEC 61000-4-6

I. Power Supply

1. The packaged controller shall operate in compliance with one of two types of electrical service:
 - a. 120/240 VAC, single phase, in power systems that operate on 50/60 Hz. It must be capable of auto-detect to operate with these AC voltages or frequencies without the user needing to jumper or setup the unit.
 - b. 24 VDC, Class 2 SELV
2. All AC powered controllers with 24 VDC inputs must be capable of supplying a minimum of 24 VDC at 200 ma. This can be used to provide external 24 VDC power for input devices (sensors, switches, etc.).
3. The onboard power supply must be capable of supplying all necessary power to all subsystems (CPU, Memory, local I/O, etc.) in addition to a minimum of four expansion I/O modules, without external wiring.
4. The power supply shall provide surge protection, isolation, and power outage carry-over of at least 1 cycle of the AC line.
5. In cases where the AC line is especially unstable or subject to unusual variations, it shall be possible to install a constant voltage transformer having a sinusoidal output waveform.
6. At the time of power-up, the power supply shall inhibit operation of the processor and I/O modules until the DC voltages are within specifications.

J. Agency Approvals

1. UL Listed
2. Suitable for operation in Class 1, Div 2, Groups A, B, C, & D hazardous locations.

PART 3 EXECUTION

3.01 DEVICE INSTALLATION

- A. Install and configure all logic devices. Installation shall include all steps necessary, including hardware and software configuration, to enable units to perform as part of an integrated network system.

3.02 TRAINING

- A. Contractor shall supply factory product representative(s) to conduct on-site training sessions. Owner shall receive hands-on instruction of necessary steps to configure, maintain, and utilize each data device.
- B. Initial training shall consist of one 8-hour day for each component. All costs associated with training, including labor, travel, meals, lodging, and per-diem expenses, shall be included in the contract price.
- C. Follow-up training shall take place three to six months after substantial completion. Contractor shall contact Owner two weeks in advance of desired date to coordinate scheduling. Follow-up training shall consist of one 8-hour day for each component. All costs associated with follow-up training, including labor, travel, meals, lodging, and per-diem expenses, shall be included in the contract price.
- D. Contractor may request Owner/Engineer's authorization to combine training time for like components.

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BARTLETT & WEST

SECTION 409513
CONTROL PANELS AND HARDWARE

PART 1 GENERAL

1.01 SCOPE

- A. Cabinets and panels shall be assembled, wired, and tested in the instrumentation subcontractor's own facilities. All components and all necessary accessories, such as power supplies, conditioning equipment, mounting hardware, signal input and output terminal blocks, and plug strips that may be required to complete the system shall be provided.

1.02 GENERAL INFORMATION

- A. All equipment shall be identified with nameplates. The equipment shall be mounted such that service can occur without removal of other equipment. Face mounted equipment shall be flush or semi flush mounted with flat escutcheons. All equipment shall be accessible such that adjustments can be made while the equipment is in service and operating. All cabinets and panels shall fit within the allocated space, as shown on the Contract Drawings.
- B. Manufacturer standard cabinetry may be furnished subject to the requirements of the drawings and specifications and favorable review by the Owner.
- C. Cabinets and Control Panels shall be fabricated and listed under all applicable UL ratings and shall display "UL rated" decals.

1.03 SPARE PARTS

- A. The Instrumentation Contractor shall provide an inventory of recommended spare parts for items used to assemble the panel. Consumable items such as paper, ink, fuses, bulbs, etc., shall also be included in the list.

PART 2 PRODUCTS

2.01 CABINETS AND PANELS

- A. Cabinets and panels (including field panels) shall be formed or welded construction, reinforced with Unistrut, Powerstrut, or equal to facilitate mounting of internal components or equipment. Sufficient access plates and doors shall be provided to facilitate maintenance and testing of the supplier's equipment. Doors shall be removable. All units shall be provided with jackscrews for leveling. Provide removable lifting lugs designed to facilitate simple, safe moving and lifting of the panel during installation. All doors shall be fitted with common-keyed locks. All interior wiring shall be color-coded and tagged with machine printed plastic sleeves. Signal wire number shall be the ID number listed in the process I/O schedule. Explosion proof cabinets or panels shall be provided in designated explosion hazard areas.
- B. Cabinets and panels shall be 14 USS gauge for units with no dimension greater than 24-inches and 12 gauge for units having any dimension greater than 24 inches but less than 36-inches. Cabinets and panels having any dimension of 36-inches or more shall be 10 USS gauge.
- C. The panels shall be constructed so that no screws or bolt heads are visible when viewed from the front. Punch cutouts for instruments and other devices shall be cut, punched, or drilled and smoothly finished with rounded edges.
- D. Cabinets and panels located inside buildings shall be, as a minimum, 304 stainless steel, NEMA 4

weatherproof construction unless located in the controlled environment of an electrical or control room, or as specified for explosion proof (NEMA 7) or submersible (NEMA 6) applications. Epoxy coated, cast, copper free, aluminum construction, conforming to Division 26, and shall be acceptable for NEMA 4, 6 and 7 applications. Welded stainless steel shall be type 304L.

- E. Freestanding panels shall be provided with louvers and/or forced ventilation as required to prevent temperature buildup due to electrical devices mounted in or on the panel. The doors of the panel shall be rubber-gasketed with continuous hinge. Smaller panels shall be sized to adequately dissipate heat generated by equipment mounted inside on the panel face.
- F. Panels for the noted environments shall be enclosures conforming to the requirement of the National Electrical Manufacturer's Association as follows:
 - 1. Indoor, air-conditioned: NEMA 12
 - 2. Hazardous locations: NEMA 7
 - 3. Prolonged water submersion at a limited depth: NEMA 6
 - 4. All other areas: NEMA 4
- G. Closure mechanisms shall be No. 3 S.S. fasteners with No. 3 keepers as manufactured by Simmons Fasteners or approved equal.
- H. Cabinets shall be constructed such that contained equipment may be programmed and indicators observed while maintaining NEC arc-flash protection. Incorporation of a polycarbonate (Lexan™), PMMA (Plexiglas™), or tempered glass viewing window and external power and network interfaces may be necessary to meet this requirement. If required, external power and network interface shall be GracePort P-R2-F3R0 or equal.

2.02 FIELD PANELS

- A. Field panels for outdoor service shall be thermal insulated 304 stainless steel NEMA 4 weatherproof construction, with a clear polycarbonate framed window in a hinged and gasketed door, to permit full view of all enclosed instrumentation and/or controls without opening. All doors shall be fitted with common keyed locks. Panels shall be suitable for wall or pipe mounting. Panels housing instrumentation and/or controls shall be insulated and equipped with external sun shields. Welded stainless steel shall be type 304L.

2.03 RECEIVERS AND CONTROLLERS

- A. Electronic Indicators: In panels and where factory installed indicators are not provided with instrumentation, indicators shall be a 4 inch, LCD or LED loop powered type provided with nameplate and scale calibrated to match the calibration of the primary element. Where indicators are field mounted, indicators shall be mounted in field panels in accordance with, Division 26 of the Specifications. Explosion-proof enclosures shall be provided in designated explosion hazard areas.
- B. Signal Converters: Signal converters shall be provided as required to interface instrumentation and controls, equipment panels, motor control centers and other instrumentation and controls supplied under divisions to the plant process control system.
 - 1. General
 - a. Converters shall be of the miniature type, utilizing all solid-state circuitry suitable for rack mounting within existing cabinetry. Where sufficient cabinet space is not available sub panels or supplemental panels shall be provided. Power supply shall be 120V, 60 hertz where required by the converter. Reproduction shall be 0.1% of span; deadband shall be 0.1% span, maximum. Where specific converters are not listed, but are required to interface with the process control system, they shall comply with the general requirements stated herein.
 - 2. Voltage to Current Transducer

- a. Voltage to current (or current to voltage) transducers shall convert a voltage signal of one magnitude to a 4-20 milliamp DC current signal. The output current shall be directly proportional to the input signal voltage. Transducers shall be sized such that loop resistance does not exceed maximum rated resistance. Transducers shall be as manufactured by AGM.
3. Interposing Relays
 - a. Where required to interface between motor control centers, equipment controls/control panels, and valve discrete output loads, interposing relays and associated control-wiring circuitry shall be furnished and installed to provide the monitoring and/or control functions specified herein. Interposing relays shall be miniature type 4-P DT, 15 amp, 120 VAC contact rating. Relay coils shall be 120/240 VAC or 24 VDC as required. Relays shall be industrial track mount type Square D Type-X, or equal.
4. Frequency to Current Transducer
 - a. Frequency to current transducers shall convert pulse-rate and pulse-duration signals to 4-20 mA, 24 VDC analog signals. Converters shall include field-adjustable input frequency range. Converter power shall be 120 VAC, 60 hertz. Transducers shall be sized such that loop resistance does not exceed maximum rated resistance. Transducers shall be as manufactured by AGM.
5. Electronic Switches (Alarm Relays)
 - a. The electronic switches shall be furnished with a calibrated dial for adjusting set points. The input to the switch shall be 4-20 mA, and the set point shall be adjustable over the full range. Unless otherwise noted, the dead band shall be fixed at less than 2 percent of span. The set point stability shall be $\pm 0.1\%$ per degree F. The repeatability shall be $\pm 0.1\%$ of span. The units shall be furnished with SPDT relays rated at 10 amperes at 115 VAC. The electronic switches shall be as manufactured by AGM.

2.04 ACCESSORIES

- A. Multiple position selector switches, key operated selector switches, and pushbutton switches for panel mounting shall be miniature, nonilluminated, oil-tight, with legend plates, as indicated on the Instrumentation Drawings. Switches shall be Square D, Class 9001 or equal. Pushbutton switches shall be spring release type, provided with full guard.
- B. Panic stop/alarm pushbuttons shall be mushroom type, red color with manual-pull release.
- C. Pilot lights shall be push to test, miniature, oil-tight, transformer type, with legend plates as indicated on the Instrumentation Drawings, Square D, Class 9001 or equal. Glass color caps shall be furnished as follows:
 1. Green: Running (Closed)
 2. Red: Ready (Open)
 3. Amber: Fault
 4. White: Other Data
- D. Displays shall be 4 inch, LED type provided with nameplate, and scale calibrated to match the calibration of the primary element. Indicators shall be ASCII Bustle, as manufactured by Nationwide Electronic Systems, Streamwood, IL, or equal.
- E. Alarm horns shall be general-purpose type, flush panel mount, 115 VAC power supply or 24 VDC power supply, suitable for indoor or weatherproof service, as required.
- F. All panel-mounted equipment shall conform to the same NEMA rating specified for the panel construction.
- G. Alternator. When specified, an alternating relay, such as Time Mark Model 261DX, shall be provided to alternate pumps on each successive cycle of operation. Alternately, this functionality may be

programmed into the control system logic.

2.05 ELECTRICAL TRANSIENT PROTECTION

- A. All electrical and electronic elements shall be protected against damage due to electrical transient induced in interconnecting lines from lightning discharges and nearby electrical systems. Circuit protection within the panel must be engineered for compliance with NEC, UL, and safety, beginning with the incoming power source and carrying through to the field devices that are energized by this system.
- B. Manufacturer's Requirements: All surge suppressor devices shall be manufactured by a company that has been engaged in the design, development, and manufacture of such devices for at least 5 years.
- C. Suppressor Locations: As a minimum, provide surge suppressors at the following locations:
 - 1. At any connections between AC power and electrical and electronic equipment, including panels, assemblies, and field mounted analog transmitters.
 - 2. At the field, panel, or assembly connections of all analog signal circuits that have any portion of the circuit extending outside of a protecting building.
- D. Surge Suppressor Assemblies for 120 VAC Power Supply Connectors: Surge suppressors for connections to AC power supply circuits shall be assemblies that:
 - 1. Have been provided with two 3-terminal barrier terminal strips capable of accepting No. 12 AWG solids or stranded copper wire. One terminal strip shall be located on each end of the suppressor unit.
 - 2. Are epoxy encapsulated within a nonflammable phenolic enclosure with provision for mounting to interior of equipment racks, cabinets, or to the exterior of freestanding equipment. Epoxy encapsulation shall be flame retardant.
 - 3. Are constructed as multistage devices. The first stage shall be a high-energy metal oxide varistor element. The second stage shall consist of fast-acting high power bipolar silicon avalanche devices. First and second stages shall be interconnected through a series air core inductor of sufficient current-carrying capacity to permit a continuous operating current of 15 amperes. Inductors having ferrous or other high permeability core materials are not acceptable. Suppressor assemblies shall be the automatic recovery type.
 - 4. Meet or exceed the following performance criteria based on a test surge wave shape with an 8-microsecond rise time and a 20-microsecond exponential decay time:
 - a. Minimum Operating Voltage: 130 VAC
 - b. Maximum Breakdown Voltage: 150 VAC
 - c. Maximum Operating Current: 15 amps
 - d. Peak First Stage Surge Current: 20,000 amps
 - e. Maximum First Stage Clamping Voltage: 350 volts
 - f. Maximum Second Stage Clamping Voltage: 210 volts
 - g. Ambient Temperature Range: -20° C to +85 °C
- E. Surge Suppressors for Analog Signal Connections: Surge suppressors for analog signal circuits shall:
 - 1. Have four lead devices with a threaded mounting/grounding stud.
 - 2. Have a circuit consisting of a 3-electrode gas tube and silicone avalanche devices to clamp each line to ground. High-energy gas tube and silicone avalanche devices shall be separated by a series impedance.
 - 3. Be epoxy encapsulated with a nonflammable phenolic enclosure. Epoxy encapsulation shall be flame retardant.

4. Limit line-to-ground and line-to-line voltage to 30 volts on 24 VDC circuits.
5. Meet or exceed the following performance criteria based on a test surge wave with 8-microsecond rise time and 20-microsecond exponential decay time:
 - a. Recovery: Automatic
 - b. Peak Source Current: 10,000 amps
 - c. Pulse Lift Before Failure: 100 occurrences
 - d. Minimum Voltage Clamp Rating: 30 volts
 - e. Series Impedance: 24 ohms total
 - f. Temperature Range: -20 degrees C to +85 degrees C
 - g. Operating Voltage: Less than 30 VDC
 - h. Operating Current: 4 to 20 mA DC
 - i. Resistance Line-to-Ground: Greater than 1 megohms

2.06 WIRING AND CABLES

- A. Wiring shall comply with accepted standard instrumentation and electrical practices. Power, control, and signal wiring shall comply with Division 26 of the specifications. For each pair of parallel terminal blocks, the field wiring shall be between the blocks.
- B. All wiring shall be bundled and run open or enclosed in vented plastic wireway, as required. All conductors run open shall be bundled and bound at regular intervals, not exceeding 12 inches, with nylon cable ties. Care shall be taken to separate electronic signal, discrete signal, and power wiring. A 1/4 by 1-inch copper ground bus shall be installed the full length of each cabinet. Interior panel wiring and field wiring shall be tagged at all terminations with machine-printed plastic sleeves. The wire number shall be the ID number listed in the input/output schedules.
- C. All instrumentation and controls cables shall be UL-listed.
- D. Discrete Signal and Power wiring:
 1. Wire shall be 14-gauge minimum stranded THN wire for all discrete and power wires.
 2. Individual wires shall be color coded as follows:
 - a. White: Neutral
 - b. Green: Ground
 - c. Red: Power
 - d. Black and White: Signal
 - e. Violet: Control
 - f. Blue: Special
- E. Analog and Smart Analog (HART) cables:
 1. Analog cables shall be one-pair 22 AWG minimum shielded cable, UL AWM Style 2092, with bonded jacket and shield, and polyethylene insulation shall be used for all analog input and output signals. Cable shall be Belden 9461 or equal.
- F. DeviceNet cables:
 1. DeviceNet cables shall be UL-listed, and OVDA-compliant. Cables shall be sized to accommodate 500 Kbps data communication rate at required cable length.
- G. Serial communications cables:

1. Serial communication cables shall be two-pair 24 AWG minimum shielded cable with polyethylene insulation. Cable shall be Belden 9842 or equal.

H. Ethernet cables:

1. Ethernet cables shall be 4-pair or 8-pair, EIA-568 Category 5e or Category 6 twisted-pair cable.
2. Cable and terminations shall be OVDA-compliant for use in Ethernet/IP networks.
3. Cables shall be terminated in either RJ45 or M12 connectors using EIA-T568A pin assignments.
4. Jacket material shall be suitable for use in the environment that the cable will be installed.

2.07 CORROSION PROTECTION

- A. All indoor and outdoor cabinets, panels, and consoles shall be fitted with vapor phase corrosion inhibitor capsules; ZERUST Model VC-"X"-2, or equal. "X" shall be based on both the volume and radius of protection. Capsules shall be labeled with the date of activation. Two spare capsules shall be furnished.

2.08 UNINTERRUPTIBLE POWER SUPPLY

- A. All devices within the panel, along with external communication devices, shall be powered via an uninterruptible power supply (UPS). The UPS shall be capable of providing 120 VAC to all devices for a period of 10 minutes at 50% of altitude-derated full load without interruption. The UPS shall be SOLA S3K Series or equal.

PART 3 EXECUTION

3.01 FABRICATION

- A. Cabinets and panels shall provide mounting for power supplies, control equipment, input/output subsystems, and panel mounted equipment and appurtenances. Ample space shall be provided between equipment to facilitate servicing and cooling.
- B. The rack framework shall be welded steel construction, 1-5/8 x 5/8-inch, using Powerstrut, Unistrut, or equal and/or angle iron to provide a rigid assembly. Racks shall be of open, boy-like framework with all frame supports welded and ground smooth. Steel straps shall be used for locating terminal blocks. The terminal blocks shall be factory assembled on a miniature mounting channel and the channel bolted to the steel strap. Terminals shall be miniature screw type unless otherwise required and shall be rated at least 300 volts, 20A, Square D Type G, or equal.
- C. The terminals shall be marked vertically with a permanent, continuous marking strip from top to bottom. One side of each terminal strip shall be reserved exclusively for field incoming conductors. Common connections and jumpers required for internal wiring shall not be made on the field side of the terminal. Subject to the approval of the Engineer, a vendor's pre-engineered and prefabricated wiring termination system will be acceptable.
- D. Cabinet and panels shall be provided with a power distribution panels complete with a main circuit breaker and a circuit breaker on each individual branch circuit distributed from the panel. Main breaker and branch breaker sizes shall be coordinated such that a fault in a branch circuit will trip only the branch breaker but not the main breaker.
- E. Cabinets and panels shall be provided with 120 VAC duplex receptacles for service equipment and fluorescent service lights. Provide separate 120 VAC feeder circuits complete with circuit breaker.
- F. Cabinets and panels shall be furnished with red laminated plastic warning signs in each section. The sign shall be inscribed "WARNING - This Device Is Connected To Multiple Sources Of Power." Letters shall be 1-inch high, white.

- G. Cabinets and panels shall have equipment racks mounted on rails to permit withdrawal of the equipment for maintenance or adjustment. Panels and cabinets shall be designed to permit front access for all service and removal of equipment. Front access panels shall be hinged, removable with common keyed locking hardware. The interconnection between equipment and panel shall be by means of flexible cables provided to permit withdrawal of the equipment from the cabinet without disconnecting the plugs.

3.02 PAINTING

- A. All steel panels and cabinets shall be free from dirt, grease, burrs, and sharp edges and shall be treated with a phosphatizing metal conditioner before painting. All surfaces shall be filled, sanded, and finish coated by spraying a 1-2 mil epoxy prime coat and smooth, level, high grade textured finish between flat and semigloss shine. The color shall be gray.
- B. Materials and techniques shall be of types specifically designed to produce a finish of superior quality with respect to adherence, as well as impact and corrosion resistance.
- C. Panels fabricated from stainless steel shall not be painted.

END OF SECTION

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BARTLETT & WEST

SECTION 409533
PROCESS CONTROL NETWORK DEVICES

PART 1 GENERAL

1.01 DESCRIPTION

This section includes materials, installation, and testing of:

- A. Ethernet Data Radios (Unlicensed, 900 MHz).
- B. Radio Antennas.
- C. Industrial-Grade Managed Layer 2 Ethernet Switches.
- D. Cellular Ethernet Gateways
- E. Industrial-Grade Internet Firewall/Router/VPN appliances.

1.02 SUBMITTALS

- A. Submit shop drawings in accordance with the General Conditions and Section 013300.
- B. Provide affidavit of compliance with applicable standard.
- C. Submit fully dimensioned drawings of product. Show and identify all connection locations and types.
- D. Submit installation schedule.
- E. Radio Antennas
 - 1. Submit product information, including make, model, wind loading, wind velocity rating, resonant frequencies, bandwidth, gain, impedance, and efficiency.
 - 2. Submit manufacturer's antenna polar radiation diagram showing signal gain across full 360 degrees.
- F. Submit radio propagation field study report, including the following:
 - 1. Test procedure.
 - 2. Test equipment list.
 - 3. FCC License (if required) for the test procedure.
 - 4. Latitude, longitude, and elevation of test locations.
 - 5. United States Geological Survey (USGS) 7.5-minute quadrangle map showing test locations and radio paths.
 - 6. Available fade margin (in dB) at each station location.
 - 7. Test conclusions, including proposed antenna heights, transmitter power, and antenna gain necessary to ensure adequate fade margin at each location.

1.03 SOFTWARE

- A. One fully licensed copy of any software required to program or configure the devices shall be provided to the Owner. Software shall be full version; no shareware or demo software will be accepted.
- B. When possible, final device configurations should be downloaded and written to disk for archival. Archived configurations should be provided to both the Engineer and Owner.

PART 2 MATERIALS

2.01 ETHERNET DATA RADIOS (UNLICENSED, 900 MHZ)

- A. Data radio transceiver shall be standard "un-modified" ISM radio service radio, capable of transmitting to and receiving Ethernet communications from similar radio transceivers in the 902-928 MHz unlicensed ISM frequencies.
- B. General
 - 1. Make/Model: GE MDS INET-II 900, or equal.
 - 2. Operational Modes: Access Point, Remote Gateway
 - 3. Modulation: CPFSK
 - 4. Data Rate: 512 Kbps or 1 Mbps
 - 5. Frequency Band: 902-928 MHz DTS/FHSS
 - 6. Telcordia MTBF: >300,000 hrs
- C. Transmitter
 - 1. Carrier Power: 0.1 to 1.0 Watt, Field Programmable
 - 2. System Gain: 139 dB @ 512 Kbps, 134 dB @ 1 Mbps
 - 3. Output Impedance: 50 Ohms
- D. Receiver
 - 1. Sensitivity: -97 dBm @ 512 Kbps (10^{-6} BER), -92 dBm @ 1 Mbps (10^{-6} BER)
- E. Interfaces
 - 1. Ethernet: 10BaseT, RJ-45
 - 2. Serial: Dual RS232, DB9 Male or Female. At least one port shall be capable of operation with RTS/CTS flow control.
 - 3. Antenna: TNC Female
 - 4. LED Indicators: LAN, COM1, COM2, Power, Link
- F. Environmental
 - 1. Temperature: -30°C to +60°C (-22°F to +140°F)
 - 2. Humidity: 95% at 40°C (104°F), non-condensing
- G. Electrical
 - 1. Primary Power: 10 to 30 VDC
 - 2. TX Current: 510 mA @ 13.8 VDC
 - 3. RX Current: 200 mA @ 13.8 VDC
- H. Protocols
 - 1. Wireless: CSMA/CA
 - 2. Ethernet: IEEE 802.3, IGMP, IEEE 802.1Q
 - 3. Encryption: RC4-128 with automatic key rotation
 - 4. Serial: PPP, Encapsulation over IP.
 - 5. Management: HTTP/HTTPS, SSH, TELNET, SNMP v1/v2/v3, local console
- I. Agency Approvals

1. FCC Part 15 (DTS)

2.02 RADIO ANTENNAS

- A. Radio antennas shall be frequency and impedance matched to individual radios. Antennas shall have a power rating 150% of the connected radio's output.
- B. Antennas shall be omnidirectional or directional; whip, low profile, yagi, panel, or parabolic as defined in application criteria either in drawings or schedules, or as determined by radio path study.
- C. Antenna Effective Radiated Power (ERP) shall not exceed FCC limits or license restrictions.
- D. Unless used indoors, antenna and mounting system shall be rated for 100 mph wind velocity, with or without 1/2-inch of radial ice.
- E. Antennas shall be vertically polarized.
- F. In all cases, antenna leads shall be routed such that antennas terminate outside of enclosures. To prevent unwanted EMI and potential radio damage, all antenna connectors shall be terminated.
- G. All antennas should maintain adequate surge protection. In the case of exterior antennas, provisions for lightning protection shall be made.
- H. Acceptable Manufacturers:
 - 1. GE MDS.
 - 2. Moxa.
 - 3. Phoenix Contact.
 - 4. Approved Equal.

2.03 INDUSTRIAL-GRADE MANAGED LAYER 2 ETHERNET SWITCHES

- A. Industrial-Grade Ethernet switch shall be a managed 5, 8, or 16-port Layer 2 switch supporting speeds up to Fast Ethernet (100T).
- B. General
 - 1. Make/Model: Moxa 500 series or equal.
 - 2. IP 30, DIN Rail Mountable Enclosure
 - 3. Telcordia MTBF: >247,000 hrs
- C. Performance
 - 1. Priority Queues: 4
 - 2. Available VLANs: 64
 - 3. IGMP Groups: 256
- D. Standards Supported
 - 1. IEEE 802.1D, 802.1Q, 802.1p, 802.1w, 802.1x, 802.3, 802.3u, 802.3x, 802.3ad
 - 2. IPv6
 - 3. Management: SNMP, local console
- E. Interfaces
 - 1. Diagnostic/Management: RS232, DB9, Female
 - 2. Copper Ethernet: 5, 8, or 16 RJ-45 ports, 10/100Base-T, Auto MDI/MDIX

3. Fiber Ethernet: 2 Multi-mode or Single-Mode 100Base-FX, SC or ST connectors.

F. Environmental

1. Temperature: -40°C to 75°C (-40°F to 167°F)
2. Humidity: 90% at 40°C (104°F), non-condensing

G. Electrical

1. Input Voltage: 12-45 VDC, redundant dual inputs, reverse polarity protection
2. Input Current: <0.36A @ 24 VDC, overload current protection

H. Agency Approvals

1. EMI: FCC Part 15
2. IEC 60068-2-27 (Shock), 60068-2-32 (Freefall), 60068-2-6 (Vibration)
3. Safety: UL 508, 60950-1

2.04 CELLULAR ETHERNET GATEWAYS

- A. Data radio transceiver shall be standard "un-modified" GSM/GPRS/EDGE cellular radio service IP gateway, capable of bridging Ethernet and serial devices with the internet. Device will have a built-in "dialer" and management software such that connected serial devices speak their native protocol. Modems requiring stand-alone dialers or external controllers using "AT" commands will not be accepted.

B. General

1. Make/Model: Moxa OnCell G3470A-LTE-US, or equal.
2. Operational Modes: Router, TCP Server, TCP Client, UDP, Real COM, Ethernet modem, Virtual modem, SMS tunnel, and RFC2217.
3. Serial Data Rate: 50 bps to 921.6 Kbps
4. Frequency Band: Quad-band 850/900 and 1800/1900 MHz
5. EDGE Multi-slot Class: Class 12
6. GPRS Multi-slot Class: Class 12
7. GPRS Terminal Device Class: Class B
8. GPRS Coding Schemes: CS1 to CS4
9. Carrier Power: 1 watt GSM 1800/1900, 2 watts EGSM 850/900
10. SIM Control: Two Slots, 3 V
11. MTBF: 339,045 hours

C. Interfaces

1. LAN: 10/100BaseT, RJ-45, Auto MDI/MDIX
2. Serial: One RS232, DB9 Female, 15 KV ESD line protection, 2 KV EFT/Surge protection.
3. Serial: One RS422/485, 5-pin terminal block connector, 15 KV ESD line protection, 2 KV EFT/Surge protection.
4. Antenna: SMA Female.
5. LED Indicators

D. Environmental

1. Temperature: -30°C to +55°C (-22°F to +131°F)
2. Humidity: 95% at 40°C (104°F), non-condensing

- E. Electrical
 - 1. Primary Power: 12 to 48 VDC
 - 2. Peak Current: 1185 mA @ 12 VDC
- F. Protocols
 - 1. Wireless: GSM/GPRS/EDGE
 - 2. Network: ICMP, TCP/IP, UDP, DHCP, Telnet, DNS, SNMP, HTTP, HTTPS.
 - 3. Router/Firewall: NAT, port forwarding.
 - 4. Authentication: Local username and password.
 - 5. Management: HTTP/HTTPS, SSH, TELNET, SNMP v1/v2/v3, local console
- G. Agency Approvals
 - 1. FCC Part 15 subpart B, Class A

2.05 INDUSTRIAL-GRADE INTERNET FIREWALL/ROUTER/VPN APPLIANCES

- A. Industrial-Grade Internet Firewall/Router/VPN Appliance shall be capable of supporting a secure interface to the internet or otherwise separate secure networks from unsecure networks at speeds up to Gigabit Ethernet (1000T).
- B. General
 - 1. Make/Model: Moxa EDR-G903 series or equal.
 - 2. IP 30, DIN Rail Mountable Enclosure
- C. Performance
 - 1. RJ-45 Ports: 10/100/1000BaseT, auto negotiation speed
 - 2. Fiber Ports: 100/1000BaseSFP slot
 - 3. Firewall: Stateful inspection; IP, MAC, port, and/or protocol based rules
 - 4. NAT: N-to-1, 1-to-1, and port-forwarding
- D. Standards Supported
 - 1. 802.3, 802.3u, 802.3x, 802.3z, 802.3ad
 - 2. Management: SNMP, HTTP/HTTPS
 - 3. DHCP Server/Client, Dynamic DNS, QoS
 - 4. VPN: IPsec
- E. Interfaces
 - 1. WAN 1: 1 RJ-45/SFP combo port
 - 2. WAN 2: 1 RJ-45/SFP combo port, DMZ capable
 - 3. LAN: 1 RJ-45/SFP combo port
 - 4. LED Indicators: PWR1, PWR2, FAULT, 10/100/1000M, DMZ/WAN
- F. Environmental
 - 1. Temperature: -40°C to 75°C (-40°F to 167°F)
 - 2. Humidity: 95% at 40°C (104°F), non-condensing
- G. Electrical
 - 1. Input Voltage: 12-45 VDC, redundant dual inputs, reverse polarity protection

H. Agency Approvals

1. EMI: FCC Part 15
2. IEC 60068-2-27 (Shock), 60068-2-32 (Freefall), 60068-2-6 (Vibration)
3. Safety: UL 508

PART 3 EXECUTION

3.01 DEVICE INSTALLATION

- A. Install and configure all data communications devices. Installation shall include all steps necessary, including hardware and software configuration, to enable units to perform as part of an integrated network system.

3.02 RADIO PROPOGATION ANALYSIS

- A. Proposed antenna location and design has been determined as part of computer propagation analysis. Contractor shall perform field propagation study as design confirmation prior to installation of equipment.
1. When possible, test should be conducted during times of maximum foliage coverage. Weather should be fair, with normal solar ionization potential.
 2. Prior to conducting study, Contractor shall develop test procedure for Engineer's approval.
 3. Omnidirectional signals shall be tested at no less than the following locations:
 - a. Along fixed receiving station ordinate paths, with no less than one test in each 90 degree compass quadrant. Test locations should represent anticipated worst-case signal paths.
 4. Point-to-point directional links may require initial mast or tower construction prior to study. Directional links do not need to be tested at intermediate distances or azimuths, but instead can be tested at the endpoints only.
 5. Study should provide final antenna design, coaxial cable design, elevation, and transmission frequency and power required to provide required fade margin at receiver locations. Antenna System ERP shall be limited to applicable FCC limits and license restrictions.
 6. Required Fade Margin:
 - a. Fixed Receiver Locations: 20 dB.

3.03 TRAINING

- A. Contractor shall supply factory product representative(s) to conduct on-site training sessions. Owner shall receive hands-on instruction of necessary steps to configure, maintain, and utilize each data communication device.
- B. Initial training shall consist of one 8-hour day for each network component. All costs associated with training, including labor, travel, meals, lodging, and per-diem expenses, shall be included in the contract price.
- C. Follow-up training shall take place three to six months after substantial completion. Contractor shall contact Owner two weeks in advance of desired date to coordinate scheduling. Follow-up training shall consist of one 8-hour day for each network component. All costs associated with follow-up training, including labor, travel, meals, lodging, and per-diem expenses, shall be included in the contract price.
- D. Contractor may request Owner/Engineer's authorization to combine training time for like components.

END OF SECTION

DISCRETE INPUTS

TAG NO.	DESCRIPTION	TO	FROM
DI-001	Pump Discharge Pressure Switch (PS-01)	PLC-01	PS-1
DI-002	Pump Discharge Pressure Switch (PS-03)	PLC-02	PS-3
DI-003	Pump Discharge Pressure Switch (PS-04)	PLC-02	PS-4
DI-004	SCV-1 Not Closed Limit Switch (ZSNC-SCV-1)	PLC-01	SCV-1
DI-005	SCV-2 Not Closed Limit Switch (ZSNC-SCV-2)	PLC-02	SCV-2
DI-006	Pump Suction Pressure Switch (PSL-2)	PLC-02	PSL-2
DI-007	Pump Suction Pressure Switch (PSL-3)	PLC-02	PSL-3
DI-008	Receiver Auto Drain Hand	PLC-02	Air Burst CP
DI-009	Receiver Auto Drain Off	PLC-02	Air Burst CP
DI-010	Receiver Auto Drain Auto	PLC-02	Air Burst CP
DI-011	Receiver Heat Trace Hand	PLC-02	Air Burst CP
DI-012	Receiver Heat Trace Off	PLC-02	Air Burst CP
DI-013	Receiver Heat Trace Auto	PLC-02	Air Burst CP
DI-014	Air Burst Valve 1 Hand	PLC-02	Air Burst CP
DI-015	Air Burst Valve 1 Off	PLC-02	Air Burst CP
DI-016	Air Burst Valve 1 Auto	PLC-02	Air Burst CP
DI-017	Air Burst Valve 2 Hand	PLC-02	Air Burst CP
DI-018	Air Burst Valve 2 Off	PLC-02	Air Burst CP
DI-019	Air Burst Valve 2 Auto	PLC-02	Air Burst CP
DI-020	Air Burst Valve 3 Hand	PLC-02	Air Burst CP
DI-021	Air Burst Valve 3 Off	PLC-02	Air Burst CP
DI-022	Air Burst Valve 3 Auto	PLC-02	Air Burst CP
DI-023	Compressor Hand	PLC-02	Air Burst CP
DI-024	Compressor Off	PLC-02	Air Burst CP
DI-025	Compressor Auto	PLC-02	Air Burst CP
DI-026	Compressor Run	PLC-02	Air Burst CP
DI-027	Compressor Fault	PLC-02	Air Burst CP
DI-028	Air Burst System Ready	PLC-02	Air Burst CP
DI-029	Air Burst System Burst in Progress	PLC-02	Air Burst CP
DI-030	Air Burst System Fault	PLC-02	Air Burst CP
DI-031	Air Burst System High Pressure	PLC-02	Air Burst CP
DI-032	Air Burst System Low Pressure	PLC-02	Air Burst CP
DI-033	VFD-1 Run	PLC-01	VFD-1
DI-034	VFD-1 Off	PLC-01	VFD-1
DI-035	VFD-1 Fault	PLC-01	VFD-1
DI-036	VFD-1 Hand	PLC-01	VFD-1
DI-037	VFD-1 Auto	PLC-01	VFD-1
DI-038	VFD-1 Remote Inhibit Active	PLC-01	VFD-1
DI-039	VFD-1 Ready for Remote	PLC-01	VFD-1
DI-040	VFD-2 Run	PLC-02	VFD-2
DI-041	VFD-2 Off	PLC-02	VFD-2
DI-042	VFD-2 Fault	PLC-02	VFD-2
DI-043	VFD-2 Hand	PLC-02	VFD-2
DI-044	VFD-2 Auto	PLC-02	VFD-2
DI-045	VFD-2 Remote Inhibit Active	PLC-02	VFD-2
DI-046	VFD-2 Ready for Remote	PLC-02	VFD-2
DI-047	VFD-3 Run	PLC-02	VFD-3
DI-048	VFD-3 Off	PLC-02	VFD-3
DI-049	VFD-3 Fault	PLC-02	VFD-3
DI-050	VFD-3 Hand	PLC-02	VFD-3
DI-051	VFD-3 Auto	PLC-02	VFD-3
DI-052	VFD-3 Remote Inhibit Active	PLC-02	VFD-3
DI-053	VFD-3 Ready for Remote	PLC-02	VFD-3
DI-054	Intrusion Alarm	PLC	DOOR LIMIT SWITCH
DI-055	Intrusion Alarm Acknowledge	PLC	DOOR LIMIT SWITCH

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BARTLETT & WEST

SECTION 409721
MAGNETIC FLOW METERS

PART 1 GENERAL

1.01 SCOPE

- A. This section includes the materials of construction, fabrication, installation and testing of electro-magnetic flow meters for wastewater service, flow transmitters and remote mounted recording station/flow chart recorder.
- B. The Contractor shall furnish, install, test, calibrate and place in satisfactory operation the magnetic flow meters, transmitters, totalizer and recording station, including all spare parts, accessories, and appurtenances as specified herein, shown on the Drawings or required for proper installation and operation.

1.02 SUBMITTALS

- A. Submit manufacturer's catalog cuts in accordance with Section 013300, Submittals, showing dimensions, coatings, and materials of construction by ASTM reference and grade, for each component or device identified.
- B. Submit operation and maintenance manuals for equipment in accordance with Section 017823.

PART 2 PRODUCTS

2.01 GENERAL

- A. Accuracy: Plus or minus 0.5% of the actual flowrate over the range of flows provided in the Flowmeter Schedule.
- B. Flowtube shall be wet calibrated with transmitter to verify their specified accuracy with traceability to the U.S. National Institute of Science and Technology (NIST).
- C. Minimum Pressure Rating: As per flowmeter schedule.
- D. Flanges: Provide ANSI Class 300 pound flanges unless otherwise specified.
- E. Power Supply: 120 VAC, 60 Hz.
- F. Electrode Materials: 316 Stainless Steel.
- G. Outputs: Isolated 4-20 mA signal.
- H. Lining and Coating: Metering tube liner shall be EPDM. The liner shall be designed to withstand movement, severe temperature, vibration, and pressure/vacuum applications. Provide a field finish coat per the Painting Section. Match color of adjacent piping.

- I. Provide remote, wall mounted recording station with digital readout of instantaneous flow for each flow meter. Readout should display gallons per minute (gpm) for instantaneous flow and U.S. gallons in 1,000 gallon increments for totalized flow. The recording station shall be installed in the electrical room in the pump building.

2.02 MAGNETIC FLOWTUBE

- A. The Flowtube shall be used with an intelligent transmitter to measure the volumetric flow rate of virtually any conductive liquid. The flow metering tube shall be constructed of AISI type 304 stainless steel with ANSI Class 300 flanges and 316 stainless steel electrodes. The Magnetic Flowtubes shall conform to the face to face overall lengths defined in ISO/CD Standard 13359.
- B. The Flowtube shall be designed to operate in harsh in-plant or outdoor environments. The enclosure shall be weatherproof as defined in IEC EP66, and provides the watertight and corrosion-resistant protection of NEMA Type 4X.
- C. The Flowtube shall be calibrated for use with pulse dc coil excitation.
- D. The Flowtube shall have a factory 2 year warranty.
- E. The Magnetic Flowtube shall be SITRANS FM Mag 3100 as manufactured by Siemens, or approved equal.
- F. Grounding electrodes shall be built integral with the tube or grounding rings and straps shall be provided with each flowtube.

2.03 MAGNETIC FLOW TRANSMITTER

- A. The Magnetic Flow Transmitter shall have intelligent microprocessor-based electronics with automatic zeroing and built-in calibration. Mechanical adjustments or external calibration equipment will not be accepted. The microprocessor shall include diagnostic software to provide external indication of a fault and the fault location.
- B. The keypad/display shall consist of a 32 alphanumeric character, 2-line, back-lighted LCD display and 5-button keypad. The display shall indicate positive total, negative total, net total, net inventory, total, and rate in conventional flow units. A (+) or (-) indicator shows flow direction.
- C. Transmitters shall be factory-calibrated to their specified accuracy with calibration equipment with traceability to U.S. National Institute of Science and Technology (NIST).
- D. The analog output signal shall be a 4-20mA and can be configured to operate in unidirectional (single range), unidirectional (multiple range), bidirectional, and bidirectional split range. The Transmitter shall be programmable for up to three different flow ranges when measuring flow in one direction. For bidirectional flow, the Transmitter shall allow a separate flow range for the forward and reverse flow directions.
- E. The Transmitter shall provide two programmable relay outputs which can be used to indicate High or Low flow rate, reverse flow and to indicate alarm conditions.

- F. The Transmitter shall be compatible with the flowtubes.
- G. The inputs span adjustment shall be continuous from 0-1.65 and 0-33 feet per second. The accuracy shall be + or - .5% of reading as system accuracy. The pulse rate shall be adjustable from 10 - 10,000HZ.
- H. Digital communication shall allow for remote reconfiguration and the receiving of continuous self-diagnostic data over the same two wires used for the measurement signal without disturbing the measurement signal. Reading of:
1. Engineering Units (gpm)
 2. Flow Upper Range Value(s)
 3. Flow Rate in Engineering Units
 4. Displayed Upper Range Value(s)
 5. Pulse Output Upper Range Value(s)
 6. Electronic Damping Factor
 7. Data Transfer Rate (600 or 4800 Baud)
 8. Line Size (Nominal)
 9. Meter Factor (Calibration Factor)
 10. Tag Number or Tag Name
 11. Geographical Location
 12. Device Name
 13. In addition, the configuration from the transmitter may be copied with a Hand Held Terminal or PC10 laptop and downloaded to another transmitter or saved for future reference.
- I. The Flow Transmitter shall provide mounting features to include pipe and/or surface mounting and shall be housed in a NEMA type 4X enclosure.
- J. The Transmitter shall withstand 1000 V common mode and 500 V normal mode, 1.2 x 20 μ s impulse per ANSI/IEEE Standard C62.41-1980 and IEC Standard 801-5.
- K. The Transmitter shall withstand a high frequency transient of 2000 V common mode, 5 x 50 ns impulse, per IEC Standard 801-4.
- L. The Transmitter shall withstand application of 6000 V contact discharge or 8000 V air discharge of an electrostatic field per IEC Standard 801-2.
- M. All wiring (cables) between Magnetic Flowmeter and transmitter shall be provided by the instrument manufacturer.
- N. The Magnetic flowmeter system shall be designed to consume less than 24W of power at reference voltage and frequency.

- O. The transmitter shall have a 2 year warranty.
- P. The Magnetic Flowmeter Transmitter shall be SITRANS FM Mag 5000 as manufactured by Siemens, or equal.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install meters, totalizer, and grounding rings in accordance with manufacturers written instructions and as shown in the Drawings.

3.02 HYDROSTATIC TESTING

- A. Hydrostatically test the installed meters at the same time the piping system is tested per Section 400522.

3.03 MANUFACTURERS' FIELD SERVICES

- A. Coordinate date of manufacturer's field services so that electrical specialists, Engineer's representative, and Owner's operating personnel are present.
- B. Provide equipment manufacturer's services at the job site for a minimum of one man-day to check the installation, supervise start-up, perform testing, calibration, and adjustments of equipment, and instruct the Owner's personnel in the operation and maintenance of the equipment.
- C. Provide adequate training to Owner's personnel in the proper operation and maintenance of the equipment.

3.04 FLOWMETER SCHEDULE

TAG NO	SERVICE	MIN. PRESSURE RATING	SIZE	TYPE	FLOW RANGE (GPM)	TRANSM. REQ'D	REMARKS
M-2	Raw Water	160 psi	8"	MAG	400-1,800	YES	PROVIDE 300#

END OF SECTION

SECTION 411920
PRESSURE GAUGES

PART 1 GENERAL

1.01 GENERAL

- A. The Contractor shall furnish and install all analog dial-type pressure gauges and all other appurtenances required for a complete installation at the locations indicated on the Drawings and as specified herein.

1.02 SUBMITTALS

- A. Shop Drawings shall be submitted in accordance with the Section entitled "Submittals" and approved prior to ordering or delivering any equipment or materials.
- B. Operation and Maintenance Manual: Copies of complete O & M manuals shall be submitted in accordance with the Section entitled "Operation and Maintenance Data". The manuals shall be prepared by the manufacturer and shall show the address of the nearest representative for both service and spare parts.

1.03 QUALITY ASSURANCE

- A. Governing Standard. All gauges shall conform to the requirements of ANSI B40.1, except as modified or supplemented herein.

PART 2 PRODUCTS

2.01 PRESSURE GAUGE

- A. A pressure gauge assembly shall be provided on each of the pump discharges as shown on the drawings.
- B. Gauge Construction:
 - 1. Unless otherwise specified, gauges shall be indicating dial type with C-type phosphor bronze Bourdon tube; stainless steel rotary geared movement; phenolic or polypropylene open front turret case; adjustable pointer; glycerin filled, stainless steel, phenolic, or polypropylene ring; and acrylic plastic or shatterproof glass window.
 - 2. The dial shall be 4 1/2 inch size with white background and black markings. The units of measurement shall be indicated on the dial face. Subdivisions of the scale shall conform to the requirements of the governing standard. Pointer travel shall be not less than 200 degrees nor more than 270 degrees of arc.
 - 3. All gauges shall be provided with 1/2 inch NPT connections.
 - 4. The range shall be 0-300 psi.
 - 5. Pressure gauges shall conform to ANSI B40.1.

- C. Accuracy Grade: Unless otherwise specified, gauge accuracy shall be ANSI Grade A or better. Overall accuracy for diaphragm seal protected and liquid filled gauges shall be ANSI Grade B or better.

2.02 GAUGE ACCESSORIES

- A. Isolation Valves. Each gauge shall be provided with a threaded end ball-type shutoff valve with a stainless steel body and stainless steel ball. Seats shall be Teflon reinforced and stems shall be blow off design of stainless steel with reinforced Teflon seal. Ball valves shall be Jamesbury, Wm. Powell or Apollo.
- B. Piping shall be 316 Stainless Steel. Dielectric nipples, where required to provide isolation between dissimilar metals, shall be Perfection Corporation Clearflow nipples and fittings shall be 316 SS as specified in the miscellaneous piping section.
- C. Connection to discharge piping shall be made with a service saddle as specified in the section titled "PIPING, GENERAL".
- D. Diaphragm Seals: Unless otherwise specified, a diaphragm seal shall be provided. Diaphragm seals shall be thread-attached type with removable AISI Type 316 stainless steel diaphragm and upper and lower housing. The upper housing shall be contoured to fit and provide a seat and seal for the diaphragm and shall be designed to permit removal of the gauge with the system under pressure. The lower housing shall be provided with a tapped and plugged 1/4 inch NPT flushing connection.
- E. Each isolator and diaphragm seal and the gauge served shall be factory assembled, filled with a suitable fluid, and calibrated as a unit.

2.03 MANUFACTURERS

- A. Pressure gauges shall be Type 1279 as manufactured by Ashcroft/Dresser Industries, Model MPB/SC as manufactured by McDaniel Controls, Inc. or approved equal.
- B. Diaphragm seals shall be Type 401 as manufactured by Ashcroft/Dresser Industries or similar model as manufactured by McDaniel Controls, Inc. or approved equal.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Gauges shall be installed at the locations indicated on the drawings. Installation configurations shall conform to the requirements of the applicable figures at the end of this section.
- B. Unless otherwise specified herein, direct tapping of pipe walls for installation of gauge connections will not be permitted.
- C. All gauges and diaphragm seals shall be installed in the vertical upright position or as directed by the Engineer. Teflon thread tape or Teflon thread sealer shall be used in the assembly of threaded connections. All connections shall be free from leaks.

- D. Lines shall be purged of trapped air at gauge locations prior to installation of the gauge or diaphragm seal.

END OF SECTION

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SECTION 412200
CRANES, HOISTS, AND TROLLEYS--GENERAL

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section describes the general standards, materials, installation, and testing of motorized cranes, hoists, and trolleys.

1.02 SUBMITTALS

- A. Submit shop drawings in accordance with the General Conditions and Division 01 Specification Sections.
- B. Submit manufacturer's catalog data and dimensioned drawings for bridge cranes, trolleys, hoists, rails, and controls.
- C. Show areas to be coated and type of coating.
- D. Submit electrical drawings showing wiring, disconnect switch, terminals, limit switches, and fuses. Label each terminal showing which control or electric power wire connects to each terminal. Submit motor data showing motor horsepower, enclosure, and NEMA design classification.
- E. Submit manufacturer's field assembly and installation instructions.
- F. Submit calculations showing that runway and trolley stops resist the forces applied.
- G. Submit test report describing procedures and results of both shop and field tests.

1.03 MANUFACTURER'S SERVICES

- A. Provide equipment manufacturer's services at the jobsite for the minimum labor days listed below, travel time excluded:
- B. One labor day to check the installation and advise during start-up, testing, and adjustment of each bridge crane in the project.
- C. One labor day to instruct the Owner's personnel in the operation and maintenance of each bridge crane in the project.

PART 2 PRODUCTS

2.01 MOTORIZED HOISTS (SECTIONS 412220, 412210, 412212, 412214, AND 412218)

- A. Hoists shall be electric, wire-rope type. Hoisting machinery shall consist of a rope drum driven through gear reductions by an electric motor with hoisting rope, sheaves, and hoist brake. Hoist and trolley shall be a standard package of a single trolley/hoist manufacturer. Provide true vertical lift. Design and construct hoists in accordance with ANSI HST-4-1999 (reaffirmed 2004) and CMAA 70 and CMAA 74 as appropriate.
- B. Provide drums grooved to 50% (minimum) of the rope diameter to protect against rope pileup. Hoisting rope shall be of plow steel or improved plow steel, flexible, designed and manufactured for crane and hoist service, and complying with ANSI HST-4-1999 (reaffirmed 2004).

- C. Provide two brakes for hoist, each brake capable of independently holding the hoist's rated load capacity. One brake shall be a fail-safe electric type, connected to the motor shaft or to a shaft in the hoist gear train. The second brake shall be a mechanical load brake mounted in the gearbox and operating in a continuous oil bath. Both brakes shall operate when power to the motor is shut off or there is a power failure. Hoist brakes shall comply with ANSI HST-4-1999 (reaffirmed 2004).
- D. Provide upper and lower adjustable geared limit switch.
- E. Design load hook so that it opens slowly before hook failure when the hoist is overloaded. Provide hook latch. Provide gauge marks to show if hook has opened up.
- F. Provide hoist block with steel-enclosed housing.
- G. Provide mechanical or electrical overload protection to prevent lifting of loads exceeding the rated capacity of the crane.

2.02 MOTORIZED TROLLEYS (SECTIONS 412220, 412210, 412212, 412214, AND 412218)

- A. Trolley frame shall be welded steel, cast steel, or ductile iron.
- B. Design wheel and axle system to prevent a drop of more than 1 inch in case of axle failure.
- C. Trolley drive shall consist of a drive shaft driven by an electric motor through a gear reduction unit. The trolley drive shall drive the trolley wheels either directly or through another gear reduction at the wheels.
- D. Gears shall be of the helical, spur, worm, or herringbone type, made from rolled or cast steel, with machine-cut teeth having a 20-degree pressure angle. Horsepower ratings shall be in accordance with AGMA standards for the service factor associated with the ANSI HST trolley service classification. Gears shall be AGMA Class II service. Gearing shall be oil splash lubricated.
- E. Provide trolley brakes designed in accordance with ANSI HST-4-1999 (reaffirmed 2004).
- F. Provide mechanical stops and limit switches at both ends of trolley travel.
- G. Wheels shall be drop forged or rolled steel with heat-treated treads and flanges or cast iron with chilled tread. Wheels and wheel bearings shall comply with ANSI HST-4-1999 (reaffirmed 2004).

2.03 MOTORS (SECTIONS 412220, 412210, 412212, 412214, AND 412218)

- A. Motors shall be NEMA Design D with high starting torque, low starting current, and high slip at full load.
- B. Provide separate motors for bridge, hoist, and trolley drives when motorized units are specified. Provide one motor for hoist. Provide one or two motors for trolley.
- C. Motors shall be totally enclosed nonventilated (TENV), with Class B or F insulation, 40°C ambient temperature, and with a temperature rise that does not exceed the insulation class at the duty rating listed in the subsection on "Service Conditions." Provide thermal overload protection either of the thermostatic type in the motor starter or of the relay type in the motor windings. Provide integral motor starters for the bridge, hoist, and trolley motors.
- D. Motors shall be single or two speed and have voltage and frequency ratings as specified in the subsection on "Service Conditions." Motor speed shall not exceed 1,800 rpm. Determine the required motor horsepower for the trolley and hoist and bridge per ANSI MH27.1 and ANSI HST-4-1999 (reaffirmed 2004).

2.04 MULTIPLE GIRDER BRIDGES (SECTION 412210)

- A. The crane girders shall be wide-flange girders, standard I-beams, welded structural box beams, reinforced beams, or box sections fabricated from structural steel shapes. Material of construction shall conform to ASTM A36.
- B. Design bridge end trucks in accordance with CMAA 70. Provide end trucks with rail sweeps and impact absorbing bumpers. Attach runway stops to resist the force applied when contacted. Locate runway stops at the limits of travel of the bridge. Runway stops shall not engage the wheels.
- C. Provide limit switches at both ends of the bridge travel.
- D. Gears shall be of the helical, spur, worm, or herringbone type, made from rolled or cast steel, with machine-cut teeth having a 20-degree pressure angle. Horsepower ratings shall be in accordance with AGMA standards for the bridge service rating, per CMAA 70. Gears shall comply with AGMA Class II service. Gearing shall be oil-splash lubricated.
- E. Provide alloy steel wheel axles, machined and ground to receive inner bearing races. When rotating axles are used, mount the wheels on axles with a press fit and keys or with keys alone.
- F. Bearings shall be combination radial and thrust type, consisting of either double-row angular contact ball bearings or single-row tapered roller bearings. Bearings shall be lifetime lubricated and sealed or fitted with ZERK fittings for pressure lubrication.
- G. Bridge drive shall be Type A-1 or A-4 per CMAA 70.
- H. Provide bridge brakes designed per CMAA 70.

2.05 BRIDGE AND TROLLEY WHEELS (SECTIONS 412210, 412212, AND 412240)

- A. Track wheels shall be double flanged, rolled, wrought or forged steel, with hardened treads, machined or ground diameter. Drive wheels shall be matched pairs. Wheels shall be rim toughened or induction hardened to a minimum hardness of 320 Brinell.

2.06 RUNWAYS FOR OVERHEAD AND TOPRUNNING BRIDGE CRANES (SECTIONS 412210, 412212, AND 412240)

- A. Provide runways including rails, beams, brackets, and framework on which the crane operates. Railways shall be 60-pound ASCE rails, minimum. Comply with Section 051210.

2.07 CONTROLS

- A. Bridge, trolley, and hoist controls shall be by a floor-operated push-button pendant station and a radio control system.
- B. Push-Button Pendant Station: Provide momentary contact push buttons. Mount controls in a NEMA 12 enclosure. For direct-hung pendants, provide an offset swing arm. Provide cable lengths such that floating pendants hang 36 inches off the floor and direct-hung pendants hang 12 inches off the floor.
- C. Radio Control System: Bridge control shall be mounted on bridge and actuated from a radio control system. Provide controls on the bridge catwalk to allow operator control while standing on the catwalk. Provide radio control receiver with antenna and transmitter. System shall control main hoist, auxiliary hoist, bridge and trolley and shall enable two-speed control for all motions. Mount receiver in NEMA 12 enclosure with antenna. Transmitter shall be hand-held, battery operated provided with battery and battery charger. Provide two hand-held transmitters and one battery charger. Bridge crane manufacturer shall provide radio control system. Provide backup pendant controls coiled on bridge.

2.08 ELECTRICAL EQUIPMENT FOR BRIDGE CRANES (SECTIONS 412210, 412212, AND 412214)

- A. Bridge conductors shall be of the cable-reel type.
- B. Hoist and trolley conductors shall be of the cable-reel type.
- C. Cable reel conductors shall consist of a flexible conductor cable housed on a circular wheel, which utilizes a counter-torque spring to retrieve the flexible conductor cable during the bridge or trolley travel. Cable reel conductor sag shall not be more than 18 inches below the connection point on the hoist or trolley at maximum travel.
- D. Provide control transformers to supply 120-volt a-c for control power.
- E. Provide an alarm gong for motorized bridges and trolleys that shall operate whenever either the bridge or the trolley is in motion.

2.09 FACTORY TESTING OF MOTORIZED BRIDGE CRANES (SECTIONS 412210, 412212, AND 412214)

- A. Test cranes having motorized bridges at the factory. Assemble the crane at the factory. Provide no-load manufacturer-certified, nonwitnessed running tests of the bridge and trolley. Perform running tests with the pendant control that will operate the crane in service.

PART 3 EXECUTION

3.01 LABELING AND MARKING

- A. Provide labels and marking per Section 400775. Provide capacity plates on each side of the trolley/hoist and on bridge. Plates shall be legible from the floor.
- B. Provide tags on each piece of equipment requiring lubrication. Tag shall state the following information:
 - 1. Manufacturer's recommended lubricant, by brand name and number or code.
 - 2. Frequency of lubrication.
 - 3. Provide removable paper date calendar on which maintenance personnel can fill in dates of lubrication. Enclose calendar in a plastic shield. Attach calendar to equipment by means of a stainless steel or brass chain.

3.02 LUBRICATION

- A. Provide the manufacturer's recommended lubricants for motors, gears, and other equipment.

3.03 INSTALLING SINGLE AND MULTIPLE GIRDER BRIDGE CRANES (SECTIONS 412210, 412212, 412240, AND 412214)

- A. For electrical cranes, install runway conductors before the runway rails. The alignment of the conductors shall be horizontal and vertical within a tolerance of $\pm 1/4$ inch. Install the runway rail adjacent to the conductors next.
- B. For manually actuated cranes, install one rail, with horizontal and vertical alignments within a tolerance of $\pm 1/4$ inch.
- C. Install the opposite runway rail and align to correct span and straightness with the first rail. The runway rails shall be horizontal and parallel. The distance center-to-center and the elevation of the rails shall be as shown in the drawings within a tolerance of $\pm 1/8$ inch.
- D. Bolt the rail sections together. The rail joints shall be tight and provide a smooth running surface.

- E. After assuring that rail alignment is correct, securely fasten the rails to their supports.
- F. Install crane runway end stops before placing crane on the runway. Faces of the two end stops at each end of the runway shall form a line perpendicular to the runway rails. Install bridge and trolley per the manufacturer's instructions. After crane is placed on runway, assure that both bridge bumpers contact the end stops at the same instant. If this does not occur, check the bridge for squareness. If bridge is square, either adjust the stops or place shims behind the bumpers.

3.04 PAINTING AND COATING

- A. Coat track, bridge, trolley, hoist, gear reducer enclosures, and motors per Section 099000. Apply prime coat at factory. Color of finish coat shall be OSHA Safety Yellow.

3.05 TEST LOAD BLOCK

- A. The test loads used in the field testing shall be the property of the Owner upon successful completion of the field testing. Place the test loads at the location on the site directed by the Owner. Provide labels on the test loads describing the equipment for which the loads are to be used, tag number, and weight of the loads.

3.06 FIELD PERFORMANCE TESTING FOR ELECTRICALLY POWERED CRANES, HOISTS, AND TROLLEYS (SECTIONS 412220, 412210, 412212, 412214, AND 412218)

- A. Perform a no-load test and a load test on each crane or monorail system in the presence of the Owner's Representative as follows:
- B. No-Load Test:
 - 1. Raise empty block to within about 2 feet of its upper position and stop.
 - 2. Raise empty block until the upper limit trips and stops the hoisting motion. Assure that limit switch trips at the specified setting.
 - 3. Adjust upper limit switch if necessary. Repeat Steps a and b.
 - 4. Lower the block to about 2 feet above its lower position and stop.
 - 5. Lower empty block until the lower limit switch trips and stops the lowering motion. Assure that limit switch trips at the specified setting.
 - 6. Adjust lower limit switch if necessary. Repeat Steps d and e.
 - 7. Do not lower the block beyond the point at which two wraps remain at each end of the drum.
 - 8. Move the trolley.
- C. Trolley Test:
 - 1. Move the trolley to within about 2 feet of its farthest left limit switch position and stop.
 - 2. Move the trolley to the left until the limit switch trips and stops the trolley motion. Assure that limit switch trips at the specified setting.
 - 3. Adjust limit switch if necessary. Repeat Steps a and b.
 - 4. Repeat Steps a, b, and c for the right limit switch.
- D. Load Test: After the no-load test has been completed, test the system with loads in the following manner:
 - 1. Raise a load equal to 50% of the rated load no higher than required to clear its supports and stop. Adjust brakes if necessary. Raise load about 3 feet above its supports and stop. Lower load about 12 inches and stop. Check drift of load during stopping. If load drifts, brakes are not in proper

adjustment and shall be corrected. Repeat this operation until proper adjustment of the brakes is obtained. Lower load carefully back to its supports.

2. Follow the same procedure as indicated in Step a above except with a 125% test load; then hoist the load high enough to clear all obstructions. Move trolley across the entire span of bridge or length of track. Transport the test load by means of the bridge or monorail for full length of the runway in one direction with the trolley at one extreme end of the crane and in the other direction with the trolley at the extreme opposite end of the crane. Lower load carefully onto its supports.
- E. Crane or monorail system shall run smoothly, with no binding, stopping, or sticking. Adjust and realign equipment and retest if binding, stopping, or sticking occurs. Motors shall not be overloaded.

END OF SECTION

SECTION 412210
OVERHEAD TRAVELING BRIDGE CRANES

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section includes materials, fabrication, installation, and testing of overhead traveling bridge cranes with electric controls, motors, trolleys, and hoists.

1.02 SUBMITTALS

- A. See Section 412200.

1.03 MANUFACTURER'S SERVICES

- A. See Section 412200.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Traveling bridge cranes with motorized hoists and trolleys shall be manufactured by Whiting Corporation; U.S. Crane, Inc.; or equal.

2.02 STANDARDS, SPECIFICATIONS, AND CODES

- A. See Section 412200.

2.03 MOTORIZED HOIST

- A. See Section 412200.

2.04 MOTORIZED TROLLEY

- A. See Section 412200.

2.05 MOTORS

- A. See Section 412200.

2.06 BRIDGE

- A. See Section 412200.

2.07 RUNWAYS

- A. See Section 412200.

2.08 BRIDGE AND TROLLEY WHEELS

- A. See Section 412200. Wheel sizes and maximum loading shall comply with paragraph 4.13.3 in CMAA 70.

2.09 ELECTRICAL EQUIPMENT

- A. Provide electrification per Section 412200 and CMAA 70, Section 5. Provide electrical equipment for the crane, including motors, controls, wire, and conduit.
- B. Bridge, trolley, and hoist control shall be per Section 412200 and CMAA 70, Section 5. Provide floating pendant operating on its own track independent of the trolley.

2.10 FACTORY TESTING

- A. See Section 412200.

PART 3 EXECUTION

3.01 LABELING AND MARKING

- A. See Section 412200.

3.02 LUBRICATION

- A. See Section 412200.

3.03 INSTALLATION

- A. See Section 412200.

3.04 PAINTING AND COATING

- A. See Section 412200.

3.05 SERVICE CONDITIONS

- A. Traveling bridge crane performance conditions and design data shall be as shown below.
- B. Equipment Tag Number:

General	
Location:	La Plata County, Colorado
Service:	Indoors environmental temperature range of 20°F to 100°F
Altitude:	6900 feet above mean sea level
Relative Humidity:	10% to 50%
Equipment Capacity:	10 tons
Modify service class to suit project. See CMAA 70. See Section 412200 (14600) for service class descriptions. Service Class:	A per CMAA 70 specifications
Main Power Supply:	460 volts, 60 hertz, 3 phase

Control:	Push-button pendant
Bridge	
Bridge Speed:	75 fpm maximum
Motor Duty Rating:	30 minutes per CMAA 70 specifications
Motorized Trolley	
Trolley Speed:	Two speed: 50 and 100 fpm
Motor Duty Rating:	30 minutes per CMAA specifications
Left Trolley Limit Switch:	5 feet from left end of bridge
Right Trolley Limit Switch:	5 feet from right end of bridge
Motorized Hoist	
Service Class:	H3 H4 minimum per ANSI HST-4-1999
Lift Speed:	Single speed: 15 fpm maximum
Lift:	118.2 feet
Lower Limit Switch Setting:	115 feet below floor
Upper Limit Switch Setting:	3.2 feet below bridge

3.06 FIELD PERFORMANCE TESTING

A. See Section 412200.

END OF SECTION

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SECTION 432102
MECHANICAL SEALS AND PACKING FOR PUMPS

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section includes materials, application, and installation of mechanical seals for vertical turbine pumps. See the detailed pump specifications for the specific type of seal or packing to be provided.

1.02 SUBMITTALS

- A. Submit shop drawings in accordance with the General Conditions and Section 013300.
- B. Submit manufacturer's catalog data and detail drawings showing packing type and material and mechanical seal design and parts. Describe material of construction by specification (such as AISI, ASTM, SAE, or CDA) and grade or type.

PART 2 PRODUCTS

2.01 TYPE "F": MECHANICAL SPLIT SEAL SYSTEM FOR CLEAR WATER SERVICE

- A. Seal Type: The seal shall be of a nondestructive (nonfretting) type requiring no wearing sleeve for the shaft. Provide shafts for pumps specified with mechanical seals with no reduction in size through the seal area. Mechanical seals shall be the split type, requiring no field assembly, other than assembly around the shaft and insertion into the pump. Nonshaft O-rings shall be of ball-and-socket type requiring no gluing. Initial installation at the factory shall be with nonsplit faces, with all spare seals and spare kits to have split faces. For clear water services and solids concentrations up to 1/2% by weight, the face combination shall be hard/soft.
- B. Seal Materials:
1. Metals: Type 316 stainless steel for loaded parts over 0.060-inch cross-section. For thinner parts (springs), use Hastelloy-C®, Alloy 20®, AMS5876 (Elgiloy®), or other alloy that is not vulnerable to chloride stress corrosion.
 2. Elastomers: Fluorocarbon (Viton®).
 3. Faces: Faces shall be of homogeneous construction. Do not use surface treatments and plated faces. Acceptable hard face materials include self-sintered silicon carbide or reaction bonded silicon carbide. Acceptable soft face is carbon-graphite, either Union Carbide 658RC or Purecarbon P8412.
- C. Seal shall be hydraulically balanced and designed for the range of 28-inch Hg vacuum to 400-psig service or 200% of sealing area pressure, whichever is higher, at the design rotating speed, shaft diameter, temperature, and liquid of the pump for the service.
- D. Products: Self-aligning, self-centering, single, Chesterton 442, or equal.

2.02 TYPE "G": MECHANICAL SPLIT SEAL SYSTEM FOR SOLIDS BEARING LIQUID SERVICE

- A. Use Type "F" seal as specified above, with the following additional requirements. For solids concentrations up to 5% by weight, the face combination shall be hard/soft if a SpiralTrac bushing is used in conjunction with the seal. Otherwise, use hard/hard faces.
- B. Fit mechanical seals with Enviroseal SpiralTrac Version F, N, or D, Installation Type I, as recommended by A. W. Chesterton Company, Stoneham, Massachusetts.

- C. Material of construction shall be Type 316 stainless steel.
- D. The mechanical seal shall be drilled, tapped, and plugged for connection of a possible future clean water purge supply.

PART 3 EXECUTION

3.01 INSTALLATION OF MECHANICAL SEALS

- A. Install per API 610 (tenth edition), Section 5, paragraphs 5.8.4 through 5.8.11.

3.02 SEAL CHAMBER FACE RUNOUT

- A. Comply with API 682 (third edition), paragraph 6.1.2.13.

3.03 CARTRIDGE SEAL SLEEVES

- A. Comply with API 682 (third edition), paragraphs 6.1.3.2 through 6.1.3.9.

END OF SECTION

SECTION 432115
VERTICAL INLINE MULTISTAGE CENTRIFUGAL PUMPS

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section includes materials, installation, and testing of vertical, inline, multi-stage, split-coupled centrifugal pumps.

1.02 SUBMITTALS

- A. Submit shop drawings in accordance with the General Conditions and Section 013300.
- B. Submit dimensional drawings.
- C. Submit manufacturer's catalog data and detail drawings showing all pump parts and described by material of construction, specification (such as AISI, ASTM, SAE, or CDA), and grade or type. Show linings and coatings.
- D. Submit pump curves from manufacturer's catalog data on which the specified operating points are marked. Show efficiency and brake horsepower for the selected pump curve. Show NPSH required.
- E. Submit manufacturer's reports on hydrostatic tests and performance tests.
- F. Submit manufacturer's sample form for reporting the performance test results at least two weeks before the tests. The test form shall contain the data presented in the sample form in Appendix I of ASME B73.2 (2003) or in Section 6 of the ASME PTC 8.2 or ANSI/HI 1.6.
- G. Submit manufacturer's certified performance curves for review at least two weeks prior to shipping the units from the factory. Show pump total head, torque, brake horsepower, pump efficiency, and required NPSH. Provide copies of the data recorded during the test and methods of data reduction for determining certified test results.
- H. Submit motor data for Section 262650.

1.03 DEFINITIONS

- A. Terms shall be as defined in ANSI/HI 1.1-1.2 for horizontal pumps.

1.04 MANUFACTURER'S SERVICES

- A. Provide equipment manufacturer's services at the jobsite for the minimum labor days listed below, travel time excluded:
- B. One labor day for each service listed in the subsection on "Service Conditions" to check the installation and advise during start-up, testing, and adjustment of the equipment.
- C. One labor day to instruct the Owner's personnel in the operation and maintenance of the equipment.

PART 2 PRODUCTS

2.01 PUMP DESIGN

- A. Equipment for the pumps, including motors and baseplates, shall be provided as a complete unit by the pump manufacturer.
- B. Pumps shall be vertical, inline, multi stage. Pumps and motors shall be split coupled.
- C. Pump curve shall be continuously rising and shall be free of dips and valleys from the design point to the shutoff head. The shutoff head shall be at least 110% of the head that occurs at the BEP.
- D. The NPSH required shall be at least five (5) feet less than the minimum NPSH available at all points on the pump curve up to 110% of the flow at the BEP.
- E. Design the pumps and its components to operate continuously over a preferred operating range (POR, as defined in ANSI/HI 9.6.3-1997) of 70% to 110% of the flow at the BEP.

2.02 SUCTION AND DISCHARGE CONNECTIONS

- A. The suction/discharge base shall have ANSI Class 125 or Class 250 flange connections in a slip ring (rotating flange) design as indicated in the drawings or pump schedule.

2.03 IMPELLERS AND SLEEVES

- A. Impellers shall be of the enclosed type and shall be secured directly to the smooth pump shaft by means of a split cone and nut design.

2.04 VIBRATION AND RESIDUAL UNBALANCE

- A. The maximum vibration levels shall not exceed those shown in Figure 9.6.4.5 in ANSI/HI 9.6.4. Maximum residual unbalance in rotors shall not exceed that shown in Figure 9.6.4.15B in ANSI/HI 9.6.4.

2.05 MATERIALS OF CONSTRUCTION

- A. Materials of construction shall be as listed below.

Component	Material	Specification
Impellers, diffuser chambers, outer sleeve	Stainless steel	AISI Type 304
Suction/discharge base, pump head	Ductile iron	ASTM 65-45-12
Shaft couplings, flange rings	Ductile iron	ASTM 65-45-12
Shaft	Stainless steel	AISI Type 431
Motor stool	Cast Iron	ASTM Class 30
Impeller wear rings	Stainless steel	AISI Type 304
Intermediate Bearing Journals	Tungsten Carbide	
Intermediate Chamber Bearings	Leadless Tin Bronze	
Chamber Bushings	Graphite Filled PTFE	

Component	Material	Specification
O-rings	EPDM	

- B. Bronze shall have the following chemical characteristics:

Constituent	Content
Zinc	7% maximum
Aluminum	2% maximum
Lead	8% maximum
Copper + Nickel + Silicon	83% minimum

2.06 COUPLINGS AND COUPLING GUARDS FOR FLEXIBLE COUPLED PUMPS

- A. Provide coupling guards conforming to OSHA requirements.
- B. Shaft seal replacement shall be possible without removal of any pump components other than the coupling guard, motor couplings, motor and seal cover. Pumps with motors equal to or larger than 15 hp (fifteen horsepower) shall have adequate space within the motor stool so that shaft seal replacement is possible without motor removal.

2.07 FACTORY HYDROSTATIC TESTING

- A. Hydrostatically test casing and covers for 10 minutes minimum with water at one and one-half times the maximum design pressure corresponding to 40°C for the material of construction used, or twice the shutoff head, whichever is higher.

2.08 SPARE PARTS

- A. Provide the following spare parts for each model of pump:

Quantity	Description
2 sets	Mechanical seals (for pumps specified to have mechanical seals)
2 sets	Bearings
2 sets	O-rings

- B. Pack spare parts in a wooden box; label with the manufacturer's name and local representative's name, address, and telephone number; and attach list of materials contained within.

PART 3 EXECUTION

3.01 SHIPMENT AND STORAGE

- A. Prepare equipment for shipment including blocking of the rotor when necessary. Identify blocked rotors by means of corrosion-resistant tags attached with stainless steel wire. The preparation shall make the equipment suitable for six months of outdoor storage from the time of shipment, with no disassembly required before operation, except for inspection of bearings and seals.
- B. Identify the equipment with item and serial numbers and project equipment tag numbers. Material shipped separately shall be identified with securely affixed, corrosion-resistant metal tags indicating the item and serial number and project equipment tag numbers of the equipment for which it is intended. In addition,

ship crated equipment with duplicate packing lists, one inside and one on the outside of the shipping container.

- C. Pack and ship one copy of the manufacturer's standard installation instructions with the equipment. Provide the instructions necessary to preserve the integrity of the storage preparation after the equipment arrives at the jobsite and before start-up.
- D. Store and protect pumps per API 686 (first edition), Chapter 3, paragraphs 1.4 through 1.9, 1.15, 1.16, 1.20, and 1.21 and as described below.
- E. Coat exterior machined surfaces with a rust preventative.
- F. The interior of the equipment shall be clean and free from scale, welding spatter, and foreign objects.
- G. Provide flanged openings with metal closures at least 3/16-inch thick, with elastomer gaskets and at least four full-diameter bolts. Provide closures at the place of pump manufacture prior to shipping. For studed openings, use all the nuts needed for the intended service to secure closures.
- H. Provide threaded openings with steel caps or solid-shank steel plugs. Do not use nonmetallic (such as plastic) plugs or caps. Provide caps or plugs at the place of pump manufacture prior to shipping.
- I. Clearly identify lifting points and lifting lugs on the equipment or equipment package. Identify the recommended lifting arrangement on boxed equipment.
- J. Wrap exposed shafts and shaft couplings with waterproof, moldable waxed cloth or volatile-corrosion-inhibitor paper. Seal the seams with oil-proof adhesive tape.
- K. If electric motors are stored or installed outside or in areas subject to temperatures below 40°F or are exposed to the weather prior to permanent installation, provide the manufacturer's recommended procedures for extended storage. Provide temporary covers over the motor electrical components. Provide temporary conduits, wiring, and electrical supply to space heaters. Inspect electrical contacts before start-up.

3.02 PUMP INSTALLATION

- A. Provide the manufacturer's recommended lubricants in the pumps, bearings, and other mechanical equipment.
- B. Prepare foundation, level the base, and connect piping per ANSI/HI 1.4.
- C. Verify that the installed pump is fully self-supporting before bolting pipe flanges, so that no strain is imparted on the flanges, pipes, or pipe supports from the pump assembly. Adjust the position of the pump assembly so that the pump flanges are plumb and aligned with the adjacent pipe flanges. Do not use temporary shims or jacking nuts for leveling, aligning, or supporting equipment.
- D. Provide continuous protection of the equipment from the elements, dust, debris, paint spatter, or other conditions that will adversely affect the unit's operation until such time as the equipment is scheduled for start-up testing.

3.03 FACTORY PERFORMANCE TESTING

- A. Each pumping unit shall be subjected to a nonwitnessed laboratory performance test. Conduct tests in accordance with the ASME PTC 8.2 or ANSI/HI 1.6, using the actual job driver. The performance test shall be equivalent to Level "A" per ANSI/HI 1.6.
- B. No motor overload above nameplate rating will be allowed at any flow up to 120% of the flow at the BEP.

- C. Deviations and fluctuations of test readings shall conform to ASME PTC 8.2, 1.11 (Type A), or ANSI/HI 1.6, paragraph 1.6.5.4.2.
- D. Measure flow by the "Capacity Measurement by Weight," the "Capacity Measurement by Volume," or the "Capacity Measurement by Venturi Meter, Nozzle, or Thin Plate Orifice" methods in ASME PTC 8.2 or ANSI/HI 1.6.
- E. Perform tests and record data, including head, flow rate, speed, and power, at a minimum of seven points. These points shall include shutoff, minimum flow, midway between minimum flow and design flow, design flow, 120% of design flow, and maximum flow.

3.04 SERVICE CONDITIONS

- A. Pump hydraulic performance conditions and design data shall be as shown below.
- B. Pump Sequencing
 - 1. One pump will be in operation up to 500 gpm. When the flow requirement exceeds 500 gpm then a second pump will start up to meet the new demand. The total flow will not exceed 800 gpm.
- C. Pump Tag Numbers:
 - 1. Booster Pump 1, Booster Pump 2 (Bid Package 2, Base Bid)

Location:	Booster Pump Station
Liquid pumped:	Raw Water
Service:	Indoors; environmental temperature range of 40°F to 90°F
Elevation:	Per Plans (exceeding 6,500 feet above sea level)
Relative humidity:	0% to 90%
Fluid temperature range:	40°F to 80°F

Pump Data

Design Point	Capacity (gpm)	# of Pump in Operation	Pump Total Head (feet)	Minimum Pump Efficiency (%)
1	460	1	241	75
2	500	1	252	75
3	250	2	252	65
4	400	2	362	77

Maximum pump speed:	3,600 rpm
Motor horsepower (minimum):	60 hp
Variable speed drive required:	Yes
Manufacturers and models:	Grundfos Model CR-90-4-1 or equal.

- 2. Booster Pump 1, Booster Pump 2 (Bid Package 2, Alternate Bid 1)

Location:	Booster Pump Station
Liquid pumped:	Raw Water
Service:	Indoors; environmental temperature range of 40°F to 90°F
Elevation:	Per Plans (exceeding 6,500 feet above sea level)

Relative humidity:	0% to 90%
Fluid temperature range:	40°F to 80°F

Pump Data

Capacity (gpm)	Pump Total Head (feet)	Minimum Pump Efficiency (%)
250	184	65
400	245	77
460	178	75
500	184	75

Maximum pump speed:	3,600 rpm
Motor horsepower (minimum):	50 hp
Variable speed drive required:	Yes
Manufacturers and models:	Grundfos Model CR-90-3-1 or equal.

3. Booster Pump 1, Booster Pump 2 (Bid Package 2, Alternate Bid 2)

Location:	Booster Pump Station
Liquid pumped:	Raw Water
Service:	Indoors; environmental temperature range of 40°F to 90°F
Elevation:	Per Plans (exceeding 6,500 feet above sea level)
Relative humidity:	0% to 90%
Fluid temperature range:	40°F to 80°F

Pump Data

Capacity (gpm)	Pump Total Head (feet)	Minimum Pump Efficiency (%)
250	148	65
400	187	77
460	144	75
500	148	75

Maximum pump speed:	3,600 rpm
Motor horsepower (minimum):	40 hp
Variable speed drive required:	Yes
Manufacturers and models:	Grundfos Model CR-90-2-1 or equal.

3.05 FIELD TESTING

- A. Bump motor to ensure that motor has been connected for proper rotation.
- B. Perform field tests on pumps by measuring flows at the head points defined in Pump Data table above.

- C. If the measured flows at the above tabulated pump heads are more than 5% below the flows obtained on the laboratory or factory test, adjust the impellers or provide new impellers or otherwise repair or replace the pumps or calibrate meters or pressure gauges.
- D. Conduct vibration-level tests with pumps operating at their rated capacity. Adjust or replace pumps that exceed the maximum vibration levels.
- E. Operate each pump one at a time. Manually adjust the speed for each pump (one at a time) via the respective speed control unit such that the pump output is 30%, 40%, 50%, 60%, 80%, and 100% of the maximum capacity specified. The duration at each flow rate shall be at least 10 minutes.
- F. Assure that in the automatic mode each pump responds to its flow signal. Assure that each pump operates at a steady rate ($\pm 5\%$ of set point) at any given flow for 30%, 40%, 50%, 60%, 80%, and 100% of the maximum capacity specified, but not below manufacturer rated minimum stable continuous flow.

END OF SECTION

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BARTLETT  **WEST**

SECTION 432150
VERTICAL TURBINE PUMPS

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section includes materials, testing, and installation of vertical turbine pumps for water service.

1.02 SUBMITTALS

- A. Submit shop drawings in accordance with the General Conditions Section 013300.
- B. Submit dimensional drawings.
- C. Submit manufacturer's catalog data and detail drawings showing all pump parts and described by material of construction, specification (such as AISI, ASTM, SAE, or CDA), and grade or type. Show linings and coatings. Identify each pump by tag number to which the catalog data and detail sheets pertain.
- D. Submit pump manufacturer ISO-9001 certification per Part 2.A.1. As an alternative, provide a letter from the pump manufacturer accepting warranty responsibility for the entire pump, motor, and baseplate unit.
- E. Show shaft diameter and bearing spacing. Submit calculations showing shaft critical frequency and determination of bearing spacings. Show calculated bearing life.
- F. Submit pump curves on which the specified operating points are marked. Show efficiency and brake horsepower for the selected pump curve. Include moment of inertia of the complete pump unit including driver, impeller, and liquid pumped. Show required submergence and NPSH.
- G. As part of the field test procedure for the pumps, record measurements for impeller adjustment at the top of shaft and total radial shaft deflection (shaft runout) above the stuffing box or seal chamber.
- H. Submit manufacturer's sample form for reporting performance test results at least two weeks before the tests. The test form should contain the data presented in the sample form in Section 6 of the ASME PTC 8.2 or ANSI/HI 2.6.
- I. If pump is tested with job motor, do not correct test results for speed. If factory motor is used, correct speed to that indicated for the job motor.
- J. Submit manufacturer's certified performance curves for review at least two weeks prior to shipping the units from the factory. Show pump total head, torque, brake horsepower, pump efficiency, required submergence, and required NPSH. Provide copies of the data recorded during the test and methods of data reduction for determining certified test results.
- K. Submit motor data per Motors specification.
- L. Submit manufacturer's requirements for pump alignment limits.
- M. Submit detailed drawings and data showing the following information for each size and model of pump:
1. Design, dimensions, configuration, and wall thicknesses of nozzles.
 2. Connection details of nozzles to discharge head.
 3. Wall thickness of pump discharge heads. Include designs and dimensions of supporting or reinforcing gussets, if used.

4. Design and dimensions of discharge baseplate, including plate thickness and method of attachment of baseplate to discharge head.
5. Wall thickness and diameter of pump column.
6. Dimensions and thicknesses of bowls.
7. Pump column lengths between flanges or couplings.
8. Shaft diameters and support spacings.
9. Size of motor and method of mounting to pump discharge head.
10. Weights of the above-mentioned components.

It is the intent that the Owner will review and analyze the pump designs for compatibility with the existing intake well. This review will include analyses of natural frequencies and potential resonance issues. The Owner may recommend modifications to the pump discharge heads and baseplates, which may consist of increasing the wall thicknesses, adding gussets, and other modifications. The pump manufacturer shall not begin fabricating the pumps until these reviews and analyses have been completed. It is estimated that the reviews and analyses will take 30 days after the receipt of the submittal data.

1.03 DEFINITIONS

- A. Terms shall be as defined in ANSI/HI 2.1-2.5 for vertical pumps.
- B. Additional terms are defined below:

Submergence: Vertical distance in feet between the pumping water level and the bottom of the suction bell.

1.04 MANUFACTURER'S SERVICES

- A. Provide equipment manufacturer's services at the jobsite for the minimum labor days listed below, travel time excluded:
- B. Two labor days for each service listed in the subsection on "Service Conditions" to check the installation and advise during start-up, testing, and adjustment of the equipment.
- C. One labor day to instruct the Owner's personnel in the operation and maintenance of the equipment.

PART 2 PRODUCTS

2.01 PUMP DESIGN

- A. Equipment for the pumps, including discharge heads, shafting, columns, motors, bases, and anchor bolts, shall be provided as a complete unit by the pump manufacturer in an ISO 9001 certified facility or by a pump manufacturer accepting warranty responsibility for the complete pump unit. Pump units assembled by entities other than the pump manufacturer will not be acceptable.
- B. Each pump shall be capable of at least a 10% head increase at normal operating conditions by installing a larger impeller or an impeller of different hydraulic design.
- C. Pump curve shall be continuously rising and shall be free of dips and valleys from the design point to the shutoff head. The shutoff head shall be at least 120% of the head that occurs at the design point.
- D. The NPSH required shall be at least five (5) feet less than the minimum NPSH available at all points on the pump curve up to 120% of the flow at the BEP.

- E. Design the pump and its components to operate continuously over a preferred operating range (POR, as defined in ANSI/HI 9.6.3-1997) of 70% to 120% of the flow at the BEP.

2.02 MOTORS

- A. Motors shall be vertical high thrust, hollow shaft. Motors shall be as further described in the subsection on "Service Conditions." For pumps with mechanical seals and hollow shaft motors, provide steady bushings.
- B. The driver motor thrust bearing loading shall include the total pump lineshaft downthrust. Design the motor bearings to withstand any momentary total upthrust equivalent to at least 30% of the maximum downthrust developed.

2.03 COUPLINGS AND COUPLING GUARDS

- A. For hollow shaft motors, provide a threaded coupling. Provide coupling guards conforming to OSHA requirements.

2.04 DISCHARGE HEADS OR MOTOR STANDS

- A. Provide a fabricated steel or cast-iron discharge head. The discharge head shall have bolted register or rabbet-fit connections for the motor. Discharge head shall have connections for the pump column and shall support the loadings which it imposes as well as contain the pump pressure.
- B. Design columns and discharge heads for 150% of the pump discharge pressure (suction pressure plus pump differential pressure) at shutoff.
- C. Access to the seal chamber or stuffing box shall be through windows placed 90 degrees from the discharge. Fit handholes and/or windows with Type 304 stainless steel expanded metal guards per OSHA requirements. Provide hinged or removable Type 304 stainless steel guards.
- D. Design fabricated steel discharge head to be aesthetically compatible with the mounted motor and with adjacent pumping units. Where the motor is smaller in horizontal dimension than the discharge pipe, shape a skirt to transition between the two masses. Where the motor is larger than the discharge head, a skirt of approximately motor diameter dimension shall enclose the discharge head so as to provide an adequate-appearing support.
- E. The discharge shall be flanged, having a pressure rating as shown in the subsection on "Service Conditions."
 - 1. Class 125 or 150 flanges shall comply with AWWA C207, Class E.
 - 2. Flanges shall be flat face.
 - 3. Groove welds shall be full penetration welds. Fabricated flanges shall be welded both inside and out.
 - 4. Fabricated steel discharge elbows shall have at least three pieces per AWWA C208, Table 2.
- F. Provide for lifting the heads by means of lifting eyes that are capable of sustaining the weight of the complete unit less the motor.
- G. Provide a 1-inch steel half coupling welded to the discharge column for an air release. Provide plug.

2.05 SEAL CHAMBERS OR STUFFING BOXES FOR OPEN LINESHAFT PUMPS

- A. The design of the seal chambers or stuffing boxes shall provide space and clearance for removal and service for any of the following types of packing or seals per Section 432102 without moving or disconnecting the motor: Type G.

2.06 LUBRICATION

- A. Pumps shall have self-lubricated open lineshafts.

2.07 COLUMN PIPE

- A. The column pipe joints shall be flanged and bolted to the discharge head and to the pump bowl assembly and shall have register fits at each end. Material shall be as listed in the subsection on "Pump Materials of Construction." Provide bearing retainer containing a neoprene bearing as an integral part of the top end of each section where a lineshaft bearing is used. As an alternative, provide a separate retainer that is registered in the pipe flanges and easily removable for maintenance.
- B. Top and bottom column pipe sections shall not exceed 5-foot length.
- C. Column pipe joints shall be flanged for columns 6 inches and larger and threaded or flanged for smaller sizes.

2.08 SHAFTS AND BEARINGS

- A. Support the shafting by bearings at intervals so that the first natural frequency of the rotating assembly is at least 30% above the maximum operating speed. Provide an additional bearing retainer just below the head for added support. Calculate and size the shaft diameter for the pump shutoff head and the maximum horsepower conditions.
- B. For metal or rigid bearings, support the shafting at intervals per API 610, paragraph 8.3.6, with a maximum spacing of 5 feet.
- C. For pumps having operating speeds 1,800 rpm and less with water-lubricated neoprene bearings, the bearing spacing for the intermediate columns shall not exceed 10-foot lengths. The bearing spacings for the top and bottom column sections shall not exceed 5 feet.
- D. Tolerance on the shaft diameter, with the shaft rotated on centers, shall not exceed 0.001-inch TIR. Shaft runout on the stuffing box or seal chamber face and at the impeller shall not exceed 0.002-inch full indication movement. The shaft stiffness shall limit the total deflection under the most severe dynamic conditions over the allowable operating range of the pump, with the maximum impeller diameter installed, to 0.002 inch at the primary seal faces or at the stuffing box faces.
- E. Pump shafts shall be machined or ground and finished throughout their entire length. The total indicated runout shall not exceed 0.0005 inch per foot of length. Total runout shall not exceed 0.003 inch over total shaft length. The pump shaft shall be in one piece unless otherwise approved by the Owner (because of total shaft length or shipping restrictions).
- F. Shaft couplings for shaft diameters 2 inches or larger shall be of the key and thrust-ring types or other nonthreaded design. Threaded couplings may be used for shaft diameters 1-15/16 inches or smaller. Thrust rings, cap screws, and keys where used shall be Type 410 stainless steel.
- G. Provide lineshafting with hardened sleeves under neoprene bearings per API 610 (tenth edition), paragraph 8.3.10.5 and Table H.1 in Annex H.

2.09 BOWL ASSEMBLY

- A. Each bowl assembly shall consist of the bowl, impeller and impeller shafting, and bearings. Bearings shall be located above and below the impeller. Bearings (other than sleeve type) shall have an AFBMA L-10 life of at least 20,000 hours at any specified flow condition excluding the shutoff head. Impellers shall be dynamically balanced.
- B. Pump bowls shall be of the material listed under the subsection on "Pump Materials of Construction." Bowls shall be sufficiently rigid to prevent adverse changes in bearing alignment. Bowls shall be flanged with male and female rabbets or registers for joining to the suction bell and the discharge column. Waterways and the diffusion vanes shall be smooth and free from nodules, bumps, and dips.

2.10 SUCTION BELL

- A. The suction bell shall have, as an integral part, vanes supporting a central hub in which the bottom bearing is carried below the impeller. The outer suction bell entrance shall be at least the size of the maximum pump bowl dimension and as much larger as is practical. Maximum entrance fluid velocity shall not exceed 6 fps at the specified maximum flow. The contour between the outer edge and the impeller suction eye shall be smooth, continuous, and bell shaped.

2.11 IMPELLERS

- A. Pump impellers shall be of the enclosed type made of the material listed in the subsection on "Pump Materials of Construction" and shall be cast in one piece. Machine impellers to fit the contour of the bowl and hand file in the waterways. Attach impellers to the shaft in such a manner that they cannot become loose under any operating condition or under reverse rotation. Provide for adjustment of the axial position of the impeller at the top of the pump or motor so that proper clearance between bowls and impellers may be maintained.

2.12 VIBRATION AND RESIDUAL UNBALANCE

- A. The maximum vibration levels shall not exceed those shown in Figures 9.6.4.13 and 9.6.4.14 in ANSI/HI 9.6.4-2000. Maximum residual unbalance in rotors shall not exceed that shown in Figure 9.6.4.15B in ANSI/HI 9.6.4.
- B. At any operating speed, the ratio of the pump's natural reed frequency to the pump's rotating speed (f/N) shall be less than 0.8 and greater than 1.3. A factory resonance test shall demonstrate the motor/discharge head structure's natural reed frequency. Obtain a modal shape signature with an FFT analyzer and submit to Owner's Representative for review.
- C. **The Contractor shall require that the pump manufacturer determine whether the infinite mass and rigidity described in ANSI/HI 9.6.4-2000, paragraph 9.6.4.5.2 is applicable to the service conditions in this project and to select the appropriate analytical method to determine the critical speed and resonant frequencies of the pump system.** At a minimum, the pump system shall include the bowls, impellers, lineshaft diameters, lineshaft bearing spacing, column diameter and wall thickness, the design of the discharge stand or motor stand with discharge nozzle, and the baseplate and soleplate dimensions (length, width, and thickness).

2.13 PUMP MATERIALS OF CONSTRUCTION

- A. Materials of construction shall conform to the requirements listed below. Materials of construction for components not listed below shall conform to API 610, Annex H, Material Class I-2.

Component	Material
Pump shafts and couplings	Stainless steel, ASTM A276, UNS Grade S31600 or S41000

Component	Material
Bowl wear rings	Stainless steel, ASTM A743, Grade CF-8M or CA-15; or ASTM A276, Type 410; or bronze per paragraph 3 below.
Bearing retainers (fabricated integral)	Carbon steel, ASTM A283, Grade B
Bearing retainers (insert type)	Bronze; see paragraph 3 below.
Lineshaft bearings	Neoprene.
Impellers	Bronze per paragraph 3 below or stainless steel ASTM A743, Grade CF-8M.
Impeller wear rings	Stainless steel (if bowl wear rings are bronze) or bronze (if bowl wear rings are stainless steel). Stainless steel: ASTM A743, Grade CF-8M or CA-15 or ASTM A276, Type 410. Bronze: see paragraph 3 below.
Suction strainer	Stainless steel, AISI Type 316.
Pump bowls and suction bell	Cast iron, ASTM A48, Class 30 or ductile iron, ASTM A536.
Bowl bearings	Bronze; see paragraph 3 below.
All parts made of fabricated steel including discharge head	Carbon steel, ASTM A283, Grade B or C; ASTM A36; or ASTM A53, Grade B.
Column pipe	Carbon steel, ASTM A283, Grade B or C, or ASTM A53, Grade A or B.
Mounting plate	Carbon steel, ASTM A283, Grade A or B or ASTM A36.
Flanges	ASTM A105, A181, or A182.
Bolts and nuts for discharge heads, column pipe flanges, and bowl flanges. See paragraph 4 below	Bolts shall be Type 316 stainless steel conforming to ASTM A193, Grade B8M. Nuts shall be Type 316 stainless steel conforming to ASTM A194, Grade 8M.
Any bronze components in contact with water	See paragraph 3 below.

- B. Do not construct the impeller wear ring and bowl wear ring of the same material. Impeller and bowl wear ring materials shall have a minimum Brinell hardness difference of 50, unless both the stationary and the rotating wear surfaces have Brinell hardness numbers of at least 400.
- C. Bronze shall have the following chemical characteristics:

Constituent	Content
Zinc	7% maximum
Aluminum	2% maximum
Lead	8% maximum
Copper + Nickel + Silicon	83% minimum

- D. Provide flange insulation kits for the stainless steel bolts and nuts on the column and bowl flanges. Do not provide flange insulation kits for the bowls if the bowl is of a design that uses a machined mating surface with no gasket and has a cast receiving nut for the bolts.

2.14 STRAINERS

- A. Provide suction strainers on the inlet to each pump as stated in the subsection on "Service Conditions."

2.15 SOLEPLATE AND ANCHOR BOLTS

- A. The Contractor shall assign the design and construction of the pump (including bowls, column, and discharge head), motor and supporting stand, and baseplate and soleplate system to the pump manufacturer. The pump manufacturer shall design and construct an integrated system to comply with the specified restraint, deflection, vibration, and critical speed criteria.
- B. If required by manufacturer to meet vibration requirements, provide a steel soleplate for deck-mounted pumps to be permanently grouted in place. The thickness and bolting to the discharge head base shall be sufficient to restrain the discharge head against the discharge pressure at shut off head or any other pump operating condition and provide sufficient rigidity such that the pump and baseplate system meets the specified lateral vibration and critical speed criteria. Machine the soleplate topside to mate with a fully machined base of the discharge head.
- C. Provide vertical leveling screws spaced for stability on the outside perimeter of the soleplate. Locate the leveling screws adjacent to anchor bolts to minimize distortion during the process of installation. These screws shall be numerous enough to carry the weight of the baseplate, pump, and drive train components without excessive deflection, but in no case shall fewer than six screws be provided. Sandblast the grout contact surfaces of the soleplate in accordance with SSPC SP-6, and coat those surfaces with a primer compatible with epoxy grout.
- D. Provide anchor bolts of sufficient quantity and size to restrain any pump operating condition. The anchor bolts shall conform to ASTM A193, Grade 8M with nuts conforming to ASTM A194, Grade 8M

2.16 SPARE PARTS

- A. Provide the following spare parts for each model of pump:

Quantity	Description
One	Impeller wear ring
One	Bowl wear ring
Two sets	Bowl bearings
Two sets	Shaft bearings
One	Shaft coupling
Two	Mechanical seals (for pumps specified to have mechanical seals)

- B. Pack spare parts in wooden boxes; label with manufacturer's name and local representative's name, address, and telephone number; and attach list of materials contained therein.

PART 3 EXECUTION

3.01 SHIPMENT AND STORAGE

- A. Prepare equipment for shipment including blocking of the rotor when necessary. Identify blocked rotors by means of corrosion-resistant tags attached with stainless steel wire. The preparation shall make the equipment suitable for six months of outdoor storage from the time of shipment, with no disassembly required before operation, except for inspection of bearings and seals.
- B. Identify the equipment with item and serial numbers and project equipment tag numbers. Material shipped separately shall be identified with securely affixed, corrosion-resistant metal tags indicating the item and

serial number and project equipment tag numbers of the equipment for which it is intended. In addition, ship crated equipment with duplicate packing lists, one inside and one on the outside of the shipping container.

- C. Pack and ship one copy of the manufacturer's standard installation instructions with the equipment. Provide the instructions necessary to preserve the integrity of the storage preparation after the equipment arrives at the jobsite and before start-up.
- D. Store and protect pumps per API 686 (first edition), Chapter 3, paragraphs 1.4 through 1.9, 1.15, 1.17, 1.20, and 1.21 and as described below.
- E. Coat exterior machined surfaces with a rust preventative.
- F. The interior of the equipment shall be clean and free from scale, welding spatter, and foreign objects.
- G. Provide flanged openings with metal closures at least 3/16-inch thick, with elastomer gaskets and at least four full-diameter bolts. Install closures at place of pump manufacture prior to shipping. For studed openings, use all the nuts needed for the intended service to secure closures.
- H. Provide threaded openings with steel caps or solid-shank steel plugs. Do not use nonmetallic (such as plastic) plugs or caps. Install plugs at place of pump manufacture prior to shipping.
- I. Clearly identify lifting points and lifting lugs on the equipment or equipment package. Identify the recommended lifting arrangement on boxed equipment.
- J. Wrap exposed shafts and shaft couplings with waterproof, moldable waxed cloth or volatile-corrosion-inhibitor paper. Seal the seams with oil-proof adhesive tape.
- K. If electric motors are stored or installed outside or in areas subject to temperatures below 40°F or are exposed to the weather prior to permanent installation, provide the manufacturer's recommended procedures for extended storage. Provide temporary covers over the motor electrical components. Provide temporary conduits, wiring, and electrical supply to space heaters. Inspect electrical contacts before start-up.

3.02 PUMP INSTALLATION

- A. Install equipment horizontal and vertical within 1 degree and according to the manufacturer's written instructions and the contract documents. Confirm that pumps are set to meet the vertical alignment requirements established by the manufacturer.
- B. Check to ensure that pump baseplates or soleplates have been provided with vertical leveling screws, as opposed to shims or wedges. Do not use shims and wedges.
- C. Provide the manufacturer's recommended lubricants and operating fluids and verify that each piece of equipment contains the amount recommended by the manufacturer.
- D. Provide threaded caps for protection of nuts and bolt threads per Section 400500 on the bolts and nuts of the column pipe flanges and bowl flanges.
- E. Connect piping. Verify that the installed pump is fully self-supporting before bolting pipe flanges, so that no strain is imparted on the flanges, pipes, or pipe supports from the pump assembly. Adjust the position of the pump assembly so that the pump discharge flanges are plumb and aligned with the adjacent pipe flanges. Do not use temporary shims or jacking nuts for leveling, aligning, or supporting equipment. Provide final grouting of the pump assembly base according to Section 033000.
- F. When the alignment is correct, tighten the foundation bolts evenly but not too firmly. Then grout the unit to the foundation. The leveling pieces may be grouted in place. Do not tighten foundation bolts until the grout is hardened a minimum of 48 hours after pouring.

- G. Provide continuous protection of the installed equipment from the elements, dust, debris, paint spatter, or other conditions that will adversely affect the unit's operation until such time as the equipment is scheduled for start-up testing.

3.03 MOUNTING AND ALIGNMENT OF VERTICAL HOLLOW SHAFT DRIVERS

- A. Remove the clutch or coupling from the top of the hollow shaft, and mount the driver on top of the discharge head/driver stand. For pump designs requiring the pump head shaft to be installed prior to mounting the driver, lower the hollow shaft driver with care over the head shaft to be sure the latter is not damaged. Check the driver for correct rotation, as given in the manufacturer's installation instructions. Install the head shaft, if not already done, and check it for centering in the hollow shaft. If off-center, check for runout in head shaft, misalignment from discharge head to driver, or out of plumbness of the suspended pump. Shims can be placed under the discharge head to center the head shaft, but shims shall not be placed between the motor and the discharge head unless recommended by the manufacturer.
- B. Install the driver coupling or clutch, and check the nonreverse ratchet for operability, if furnished. Install the coupling gib key and the adjusting nut, and raise the shaft assembly with the impeller(s) to the correct running position in accordance with the manufacturer's instructions. Secure the adjusting nut to the clutch, and double-check the driver hold-down bolts for tightness.

3.04 WELDING PROCEDURE AND WELDER QUALIFICATIONS FOR PUMP CONSTRUCTION

- A. Welding shall comply with the ASME Boiler and Pressure Vessel Code, Section IX. Provide full penetration welds. Open seam butt welds are not permitted.

3.05 FACTORY PERFORMANCE TESTS

- A. Each pumping unit shall be subjected to a nonwitnessed laboratory performance test. Conduct tests in accordance with the ASME PTC 8.2 or ANSI/HI 2.6, using the actual job driver. The performance test shall be equivalent to ANSI/HI 2.6.
- B. No motor overload above nameplate rating will be allowed at any flow up to 120% of the flow at the BEP.
- C. Hydrostatically test columns and discharge heads at design pressure.
- D. Deviations and fluctuations of test readings shall conform to ASME PTC 8.2, 1.11 (Type A) or ANSI/HI 2.6, paragraph 2.6.5.4.1.
- E. Measure flow by the "Capacity Measurement by Weight," the "Capacity Measurement by Volume," or the "Capacity Measurement by Venturi Meter, Nozzle, or Thin Plate Orifice" methods in ASME PTC 8.2 or ANSI/HI 2.6.
- F. For pumps in variable speed service, conduct a test at each operating speed necessary to attain the design points described in the subsection on "Service Conditions."
- G. Perform tests and record data, including head, flow rate, speed, and power at a minimum of seven points. These points shall include shutoff, minimum flow, midway between minimum flow and design flow, design flow, 120% of design flow, and maximum flow.
- H. Take vibration readings at design flow at each test speed.
- I. Performance tests shall be "full-scale." The complete pump, including column and discharge elbow, shall be used. Measuring devices shall have been calibrated within the previous year.
- J. Conduct tests preferably at the same minimum submergence that will be realized in the field.

- K. Locate the pressure tap for head measurement not less than 10 pipe diameters downstream from the discharge elbow of the test pump.
- L. Should results of the full-scale tests indicate, in the opinion of the Owner's Representative, that the pumps will fail to meet any of the specified requirements, the Owner's Representative will notify the Contractor of such failure. The manufacturer shall thereupon, at no expense to the Owner, make such modifications and perform additional tests as may be necessary to comply with these specifications.
- M. Perform a hydrostatic test on pump pressure-containing components per ANSI/HI 2.6, paragraph 2.6.4.

3.06 PAINTING AND COATING

- A. Coat exterior of discharge head and motor the same as the adjacent piping. If the adjacent piping is not coated, then coat per Section 099100, System No. 29. Apply the specified prime coat at the place of manufacture. Apply intermediate and finish coats in field. Finish coat shall match the color of the adjacent piping.

3.07 SERVICE CONDITIONS

- A. Pump hydraulic performance characteristics shall be as shown below.
- B. Pump Tag Numbers: Intake Pump 1

Location:	Intake Pump Station
Type of discharge:	Surface
Service:	Indoors; environmental temperature range of 40°F to 90°F
Elevation:	Per Plans (greater than 6,800 feet above sea level)
Relative humidity:	0% to 90%
Fluid temperature range:	40°F to 80°F

Pump Data

Capacity (gpm)	Pump Total Head (feet) ⁽¹⁾	Minimum Pump Efficiency (%)
460	338	75%
460	419	75%
800 ⁽²⁾	419	80%
800	338	75%
⁽¹⁾ Pump manufacturer to add for pump internal friction losses, such as in columns and discharge heads.		
⁽²⁾ Design point.		

Liquid pumped:	Raw Water
Maximum pump speed:	1,800 rpm
Minimum submergence available:	21 feet
Motor horsepower (minimum):	150 horsepower
Motor type:	ODP
Variable speed drive required:	Yes
Minimum shaft diameter:	1 11/16 inches
Pump lubrication:	Open lineshaft
Minimum discharge connection size:	6 inches
Minimum column size:	10 inches

Minimum column wall thickness:	0.375 inch
Discharge flange rating:	Class 150
Type of packing or seals per Section 432102:	Type G
Bearing lubrication:	Water
Suction strainer:	Yes
Pump manufacturers and models:	Pentair (Fairbanks Nijhuis) 11M-SS Weir Floway Patterson

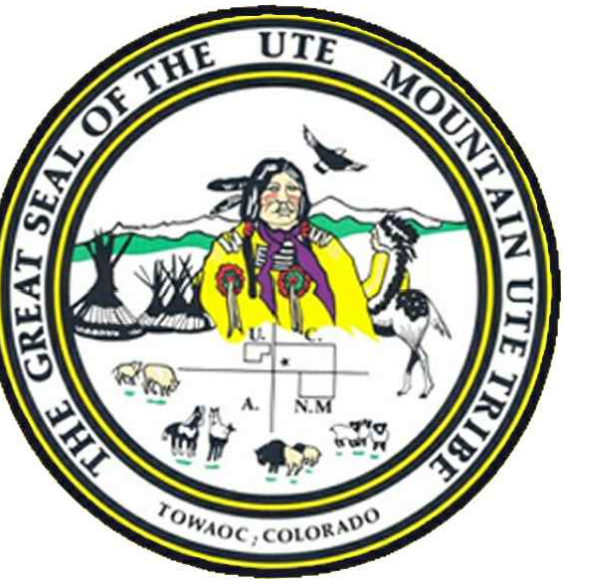
3.08 FIELD TESTING

- A. Bump motor to ensure that motor has been connected for proper rotation prior to coupling pump.
- B. Perform field tests for seven (7) consecutive days on each pump. Measure flows at the following head points:
 1. Tag Numbers: Intake Pump 1
 2. Test Points (Feet): 338 feet, 419 feet
- C. If the measured flows at the above tabulated pump heads are more than 5% below the flows obtained from the laboratory or factory test, adjust the impellers or provide new impellers or otherwise repair or replace the pumps or calibrate meters or pressure gauges.
- D. Conduct vibration level tests with pumps operating at their rated capacity. Adjust or replace pumps that exceed the maximum vibration levels.
- E. Assure that in the automatic mode each pump responds to its pressure signal. Assure that each pump operates at a steady rate ($\pm 5\%$ of set point) at any given pressure for 30%, 40%, 50%, 60%, 80%, and 100% of the maximum capacity specified, but not below manufacturer rated minimum stable continuous flow.
- F. Demonstrate that the pumping units, drivers, and control system meet the following requirements:
 1. The pumping units operate as specified without excessive noise, cavitation, vibration, and without overheating of the bearings.
 2. Automatic and manual controls function in accordance with the specified requirements.
 3. Drive equipment operates without being overloaded.

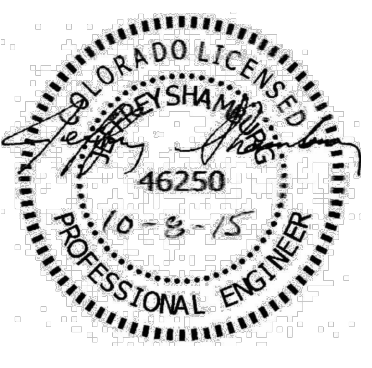

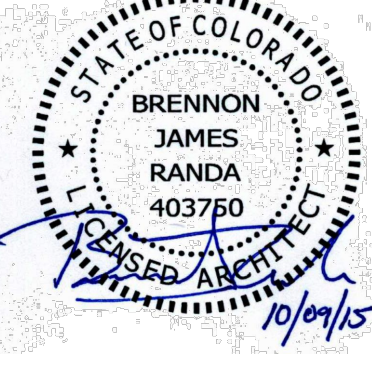
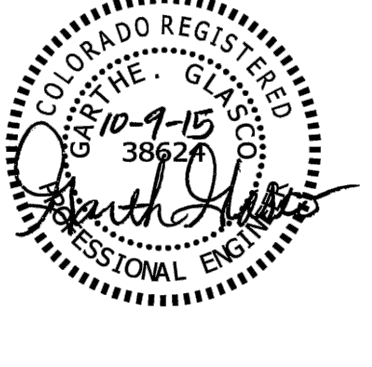

END OF SECTION

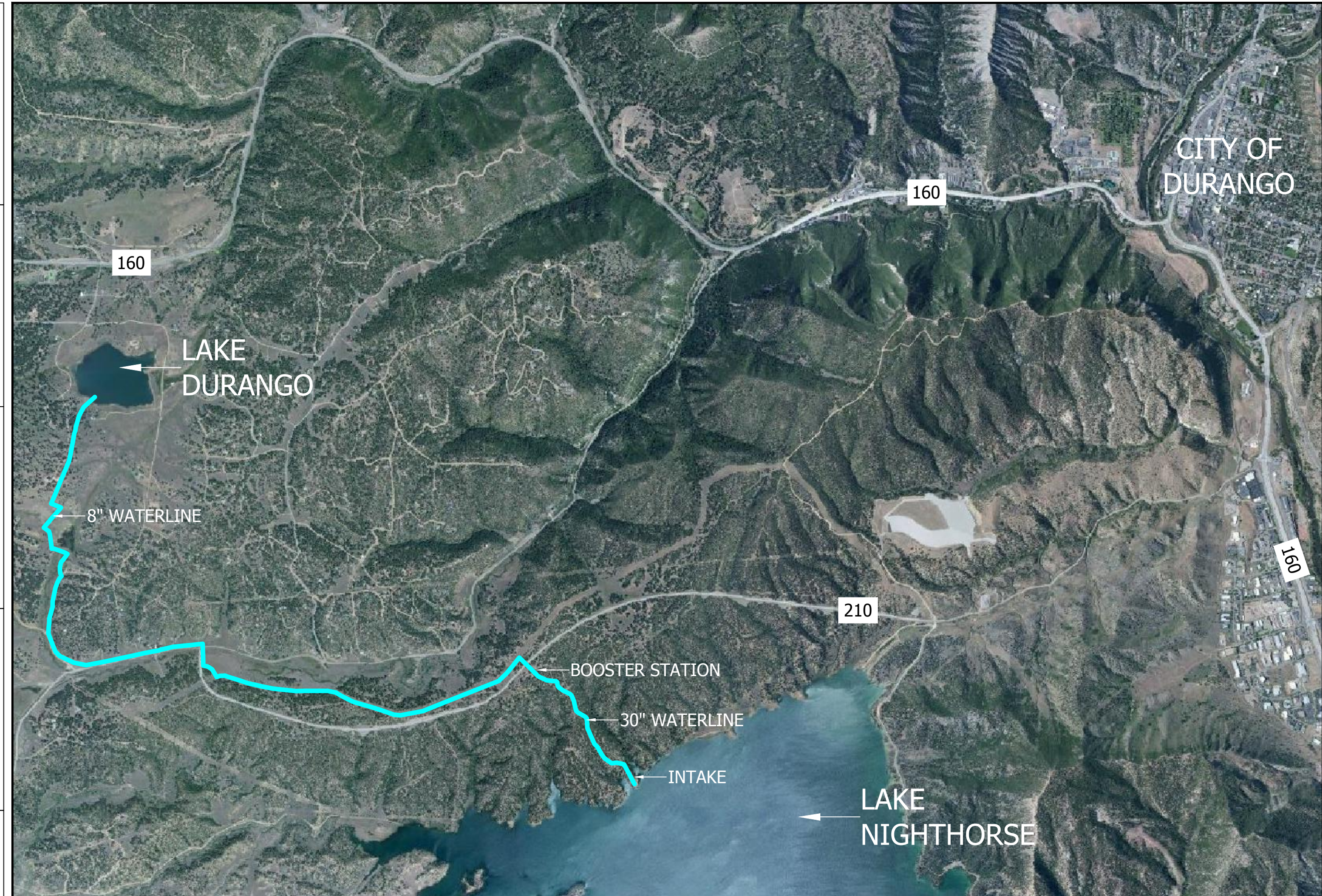
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BARTLETT —
— **& WEST**



LA PLATA WEST WATER AUTHORITY RAW WATER PROJECT DURANGO, COLORADO

	<p>I HEREBY CERTIFY THAT THIS ENGINEERING DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT PERSONAL SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF COLORADO.</p> <p>JEFFREY SHAMBURG P.E. COLORADO REG. #46250 DATE</p> <p>MY LICENSE RENEWAL DATE IS OCTOBER 31, 2017</p> <p>PAGES OR SHEETS COVERED BY THIS SEAL: G100-G106, C100-C104, C129-C159, D100-D109 & I100-I102</p>
	<p>I HEREBY CERTIFY THAT THIS ENGINEERING DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT PERSONAL SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF COLORADO.</p> <p>ROB HARRIES P.E. COLORADO REG. #35876 DATE</p> <p>MY LICENSE RENEWAL DATE IS OCTOBER 31, 2015</p> <p>PAGES OR SHEETS COVERED BY THIS SEAL: C105-C128</p>
	<p>I HEREBY CERTIFY THAT THIS ENGINEERING DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT PERSONAL SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF COLORADO.</p> <p>BRENNON JAMES RANDA P.A. COLORADO REG. #403750 DATE</p> <p>MY LICENSE RENEWAL DATE IS OCTOBER 31, 2015</p> <p>PAGES OR SHEETS COVERED BY THIS SEAL: ALL ARCHITECTURAL SHEETS</p>
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	<p>I HEREBY CERTIFY THAT THIS ENGINEERING DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT PERSONAL SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF COLORADO.</p> <p>TIMOTHY J. DIEKER P.E. COLORADO REG. #45100 DATE</p> <p>MY LICENSE RENEWAL DATE IS OCTOBER 31, 2015</p> <p>PAGES OR SHEETS COVERED BY THIS SEAL: ALL MECHANICAL, PLUMBING & ELECTRICAL SHEETS</p>



VICINITY MAP
SCALE: 1"=2000'

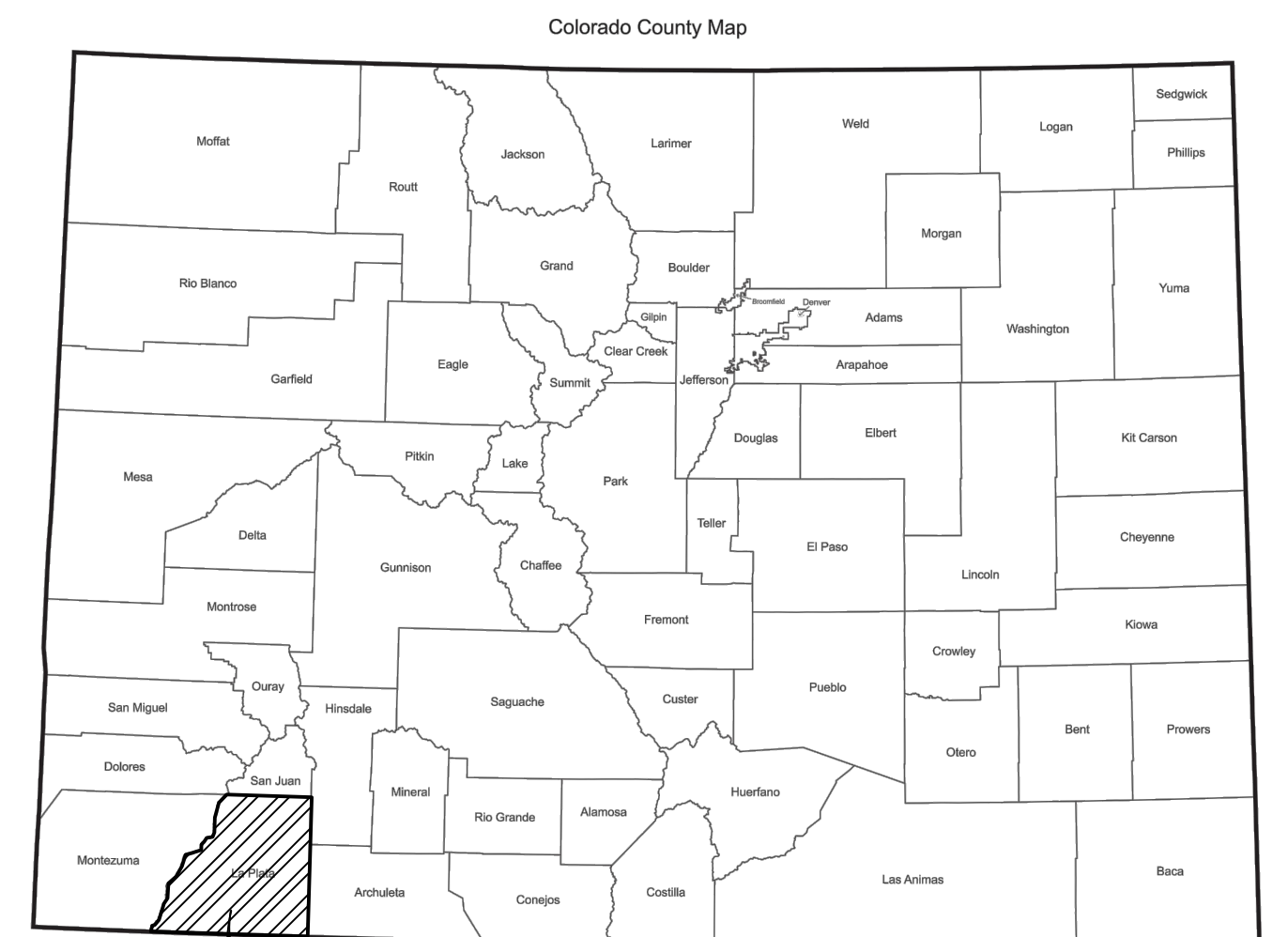


LA PLATA WEST WATER AUTHORITY
ROY HORVATH - BOARD PRESIDENT
MARDI GEBHARDT - BOARD TREASURER

LAKE DURANGO WATER AUTHORITY
RON BORREGO - BOARD REPRESENTATIVE
CHARLIE SMITH - GENERAL MANAGER

UTE MOUNTAIN UTE TRIBE
MANUEL HEART - TRIBAL CHAIRMAN
CELENE HAWKINS - ASSOCIATE COUNSEL

SOUTHERN UTE INDIAN TRIBE
CLEMENT FROST - TRIBAL CHAIRMAN
LENA ATENCIO - DIRECTOR, DEPT OF NATURAL RESOURCES



LA PLATA COUNTY

clark architecture & design
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26	C118	INTAKE ACCESS ROADWAY ROADWAY SECTIONS
27	C119	INTAKE ACCESS ROADWAY ROADWAY SECTIONS
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39	C131	WATER PIPELINE STA 70+00 - 80+00
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71	A111	BOOSTER BUILDING LEVEL-1 FLOOR PLAN
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77	A302	INTAKE BUILDING WALL SECTIONS
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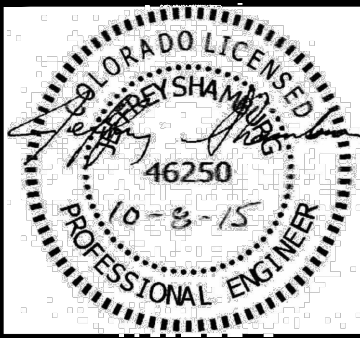
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SHEET INDEX

RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO



DESIGNED BY:	MKA
DRAWN BY:	MKA
APPROVED BY:	JAS
DESIGN PROJ:	17865.005
CONST PROJ:	----
SCALE:	AS NOTED
DATE:	OCT 2015
DRAWING NO:	G101
SHEET NO:	2 of 114

ABBREVIATIONS

AB	ANCHOR BOLT	GA	GAUGE
AC	ASPHALTIC CONCRETE	GAL	GALLON
AFF	ABOVE FINISH FLOOR	GALV	GALVANIZED
AGG	AGGREGATE	GB	GRADE BREAK
AL	ALUMINUM	GIP	GALVANIZED IRON PIPE
APPROX	APPROXIMATE	GLDS	GLANDS
ARV	AIR RELEASE VALVE	GPM	GALLONS PER MINUTE
ARV	AIR/VACUUM RELIEF VALVE	GR	GRADE
		GRTG	GRATING
		GRVD	GROOVED END
BETW	BETWEEN	HB	HOSE BIBB
BF	BLIND FLANGE	HGT	HEIGHT
BFV	BUTTERFLY VALVE	HOA	HAND-OFF-AUTOMATIC
BLDG	BUILDING	HORIZ	HORIZONTAL
BLK	BLOCK	HP	HORSEPOWER
BP	BELT PRESS	HPHB	HIGH PRESSURE HOSE BIBB
BSP	BLACK STEEL PIPE	HWL	HIGHWATER LEVEL
BTM	BOTTOM		
BV	BALL VALVE	ID	INSIDE DIAMETER
		IE	INVERT ELEVATION
CA	COMPRESSED AIR	IN	INCHES
CFM	CUBIC FEET PER MINUTE	INT	INTERIOR
CFS	CUBIC FEET PER SECOND	INV	INVERT
CIP	CAST IRON PIPE	IPS	IRON PIPE SIZE
CISP	CAST IRON SOIL PIPE		
CL	CLASS	JT	JOINT
CL	CENTER LINE		
CLR	CLEAR	L	LITER
CMLC-STL	CEMENT MORTAR LINED AND COATED STEEL	LB	POUND
CO	CLEAN OUT	LR	LONG RADIUS
COL	COLUMN	LSP	LOW SERVICE PUMP
CONC	CONCRETE	LT	LEFT
CONN	CONNECTION	LWL	LOW WATER LEVEL
CONT	CONTINUOUS		
CORP	CORPORATION	MATL	MATERIAL
CPLG	COUPLING	MAX	MAXIMUM
CSP	CORRUGATED STEEL PIPE	MB	MACHINE BOLT
CTR	CENTER	MFR	MANUFACTURER
CW	COLD WATER	MG	MILLIGRAM
		MGD	MILLION GALLONS PER DAY
DI	DUCTILE IRON	MH	MANHOLE
DIP	DUCTILE IRON PIPE	MIN	MINIMUM
DIA	DIAMETER	MIPT	MALE IRON PIPE THREAD
DIM	DIMENSION	MJ	MECHANICAL JOINT
DISCH	DISCHARGE	MTR	MOTOR
DN	DOWN		
DL	DRAINLINE	NC	NORMALLY CLOSED
DR	DRAIN	NIC	NOT IN CONTRACT
DTL	DETAIL	NO	NUMBER, NORMALLY OPEN
DWG	DRAWING	NOM	NOMINAL
		NPT	NATIONAL PIPE THREAD
EA	EACH	NPW	NON-POTABLE WATER
ECC	ECCENTRIC	NS	NEAR SIDE
EF	EACH FACE	NTS	NOT TO SCALE
EJ	EXPANSION JOINT	NWL	NORMAL WATER LEVEL
EL	ELEVATION		
ELB	ELBOW	OC	ON CENTER
ELC-STL	EPOXY LINED & COATED STEEL	OD	OUTSIDE DIAMETER
ELEC	ELECTRIC	OVFL	OVERFLOW
EMBD	EMBEDMENT	OPNG	OPENING
ENC	ENCASEMENT	OPP	OPPOSITE
EP	EDGE OF PAVEMENT		
EW	EACH WAY	ℙ	PROPERTY LINE
EXIST	EXISTING	PE	PLAIN END
EXP	EXPANSION	PL	PLATE
		PI	PI
FAB	FABRICATE	PRV	PRESSURE RELIEF VALVE
FCO	FLOOR CLEANOUT	PRV	PRESSURE REDUCING VALVE
FD	FLOOR DRAIN	PSIG	(PSI) POUNDS PER SQ INCH GAUGE
FDR	FEEDER	PT	PRESSURE TRANSMITTER
FDN	FOUNDATION	PVC	POLYVINYL CHLORIDE
FDP	FEED PUMP	PVMT	PAVEMENT
FF	FINISH FLOOR	PW	POTABLE WATER
FG	FINISH GRADE		
FH	FIRE HYDRANT		
FIG	FIGURE		
FL	FLOWLINE		
FLG FL	FLANGE		
FM	FORCE MAIN		
FPM	FEET PER MINUTE		
FS	FAR SIDE		
FT	FEET, FLOW TRANSMITTER		
FUT	FUTURE		
FTG	FITTING, FOOTING		

EQUIPMENT TAGS

BFV - BUTTERFLY VALVE
BV - BALL VALVE
CV - CHECK VALVE
GV - GATE VALVE
M - FLOW METER
ME - MISC EQUIPMENT
PCV - PUMP CONTROL VALVE
PV - PLUG VALVE
RSGV - RESILIENT SEAT GATE VALVE
SV or SOV - SOLENOID VALVE
VFD - VARIABLE FREQUENCY DRIVE

DIVISION DISCIPLINE

ARCHITECTURAL	A
CIVIL/LAND DEVELOPMENT	C
ELECTRICAL	E
EQUIPMENT	Q
FIRE PROTECTION	F
GENERAL	G
GEOTECHNICAL	B
HAZARDOUS MATERIALS	H
INSTRUMENTATION	I
LANDSCAPE	L
MANUFACTURE	MD
MECHANICAL	M
OPERATIONS	O
PLUMBING	P
PROCESS	D
RESOURCE	R
RURAL WATER	RW
STRUCTURAL	S
SURVEY/MAPPING	V
TELECOMMUNICATIONS	T

GENERAL NOTES:

- GENERAL NOTES DEFINED:
NOTES THAT APPLY TO THE ENTIRE PROJECT.
GENERAL NOTES APPLY EQUALLY TO ALL
DISCIPLINES AND TO ALL SHEETS WITHIN THE
DRAWING SET. THEY MAY ALSO INCLUDE NOTES
THAT APPLY ONLY TO THE PARTICULAR SHEET ON
WHICH THEY APPEAR.
-
-

REFERENCE NOTES:

- ① -
② -

REFERENCE NOTES DEFINED:
IDENTIFY GRAPHIC REPRESENTATIONS OF ITEMS AND
DIRECTLY REFERENCE THEM TO SPECIFIC SECTIONS IN
THE SPECIFICATIONS.

EQUIPMENT/PIPING SCHEDULE

- ① -
② -

EQUIPMENT SCHEDULE NOTES DEFINED:
IDENTIFY GRAPHIC REPRESENTATIONS OF MECHANICAL
ITEMS AND DIRECTLY REFERENCE THEM TO SPECIFIC
INFORMATION, SIZE, MAKE, MODEL, MATERIAL,
SPECIFICATIONS, ETC.

FEEDER SCHEDULE

- ① -
② -

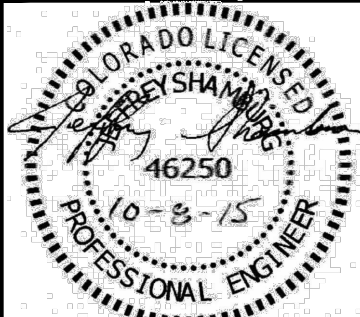
FEEDER SCHEDULE NOTES DEFINED:
IDENTIFY GRAPHIC REPRESENTATIONS OF ELECTRICAL
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INFORMATION, SIZE, MAKE, MODEL, MATERIAL,
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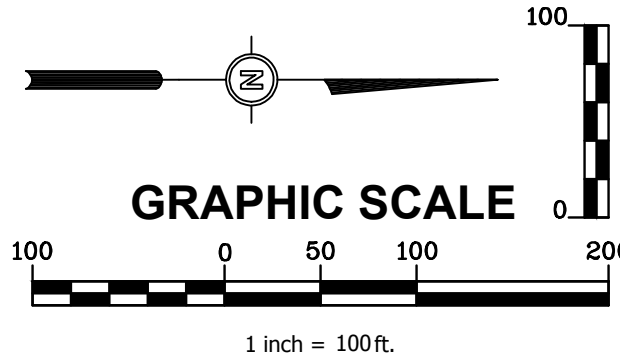
**GENERAL SYMBOLS &
ABBREVIATIONS**

**RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO**



DESIGNED BY:	MKA
DRAWN BY:	MKA
APPROVED BY:	JAS
DESIGN PROJ:	17865.005
CONST PROJ:	----
SCALE:	AS NOTED
DATE:	OCT 2015
DRAWING NO:	G102
SHEET NO:	3 of 114

NORTH DIRECTIONAL INDICATOR



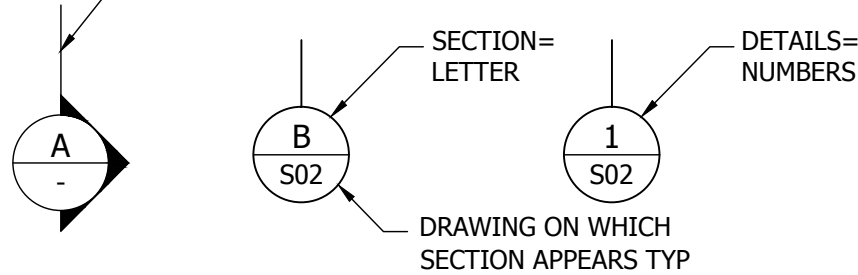
PLAN - DETAIL - SECTION

SCALE: 1/4" = 1'-0"

NOTES:

- DRAWING NUMBERS APPEARING IN DETAIL OR SECTION TITLES INDICATE THE DRAWING ON WHICH THE DETAIL OR SECTION IS CALLED OUT.

CUT SECTION DIRECTION



KEYNOTE INDICATOR
IDENTIFICATION SYMBOL

- GENERAL NOTE REFERENCE
- REVISION CALL OUT NUMBER
- EQUIPMENT/PIPING CALL OUT NUMBER
- REFERENCE CALL OUT NUMBER
- FEEDER SCHEDULE NUMBER
- PHOTO REFERENCE NUMBER AND DIRECTION

DRAWING NO:

C02

SHEET NO:

03 of 99

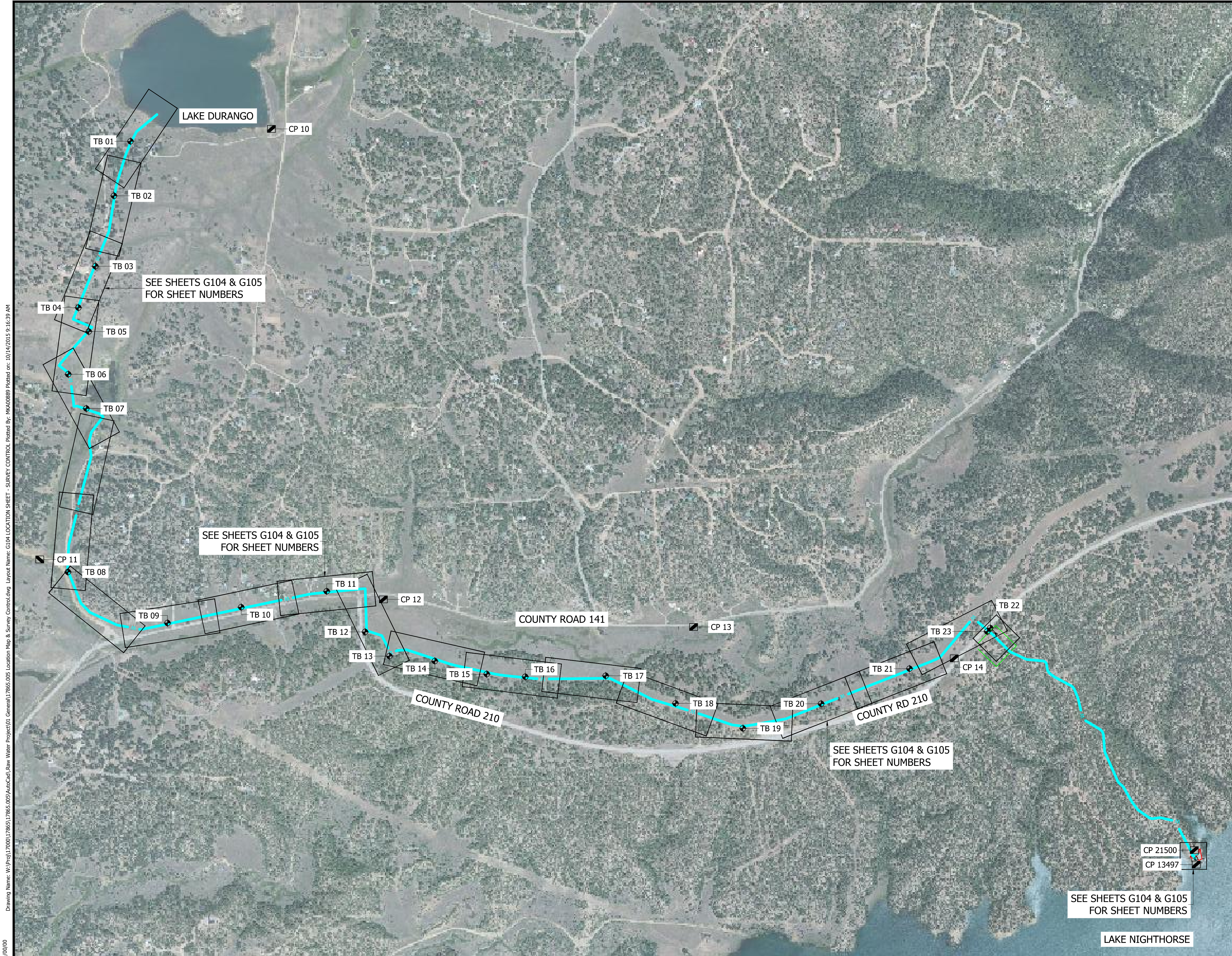
DIVISION
DISCIPLINE
DESIGNATOR

SEQUENTIAL
NUMBER

DRAWING
NUMBER

TOTAL SHEET
NUMBER

00/00/00
Last edit on:
Drawing Name: W:\Proj\17000\17865\005\AutoCad\Raw Water Project\01 General\17865.005 Location Map & Survey Control.dwg Layout Name: G104 LOCATION SHEET - SURVEY CONTROL Plotted on: 10/14/2015 9:16:39 AM



SURVEY CONTROL
SCALE: 1"=600'



GENERAL NOTES

- ALL COORDINATES SHOWN ARE IN STATE PLANE

SURVEY CONTROL

- CP 10
ELEV:7332.28
N:1223667.21
E:2281807.58
- CP 11
ELEV:7233.84
N:1218311.35
E:2278927.15
- CP 12
ELEV:7166.58
N:1217814.50
E:2283199.91
- CP 13
ELEV:7113.61
N:1217471.05
E:2287057.07
- CP 14
ELEV:7170.93
N:1217081.27
E:2290298.37
- CP 13497
ELEV:6888.34
N:1214514.94
E:2293307.02
- CP 21500
ELEV:6925.48
N:1214695.58
E:2293283.02

LEGEND

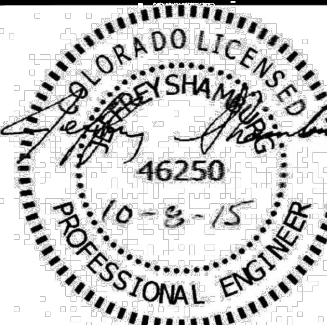
- CP 201 CONTROL POINT
- BH01 BORE HOLE or DRILL HOLE

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SURVEY CONTROL

RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO



DESIGNED BY:	MKA
DRAWN BY:	MKA
APPROVED BY:	JAS
DESIGN PROJ:	17865.005
CONST PROJ:	----
SCALE:	AS NOTED
DATE:	OCT 2015
DRAWING NO:	G103
SHEET NO:	4 of 114

Last edit on:



TB 23

TB 22

BOOSTER SITE
SEE SHEET C153

CP 14

INTAKE SITE
SEE SHEET C150

CP 21500

CP 13497

INTAKE TO BOOSTER STATION



SCALE: 1"=200'

SHEET LOCATION MAP
INTAKE TO BOOSTER STATION

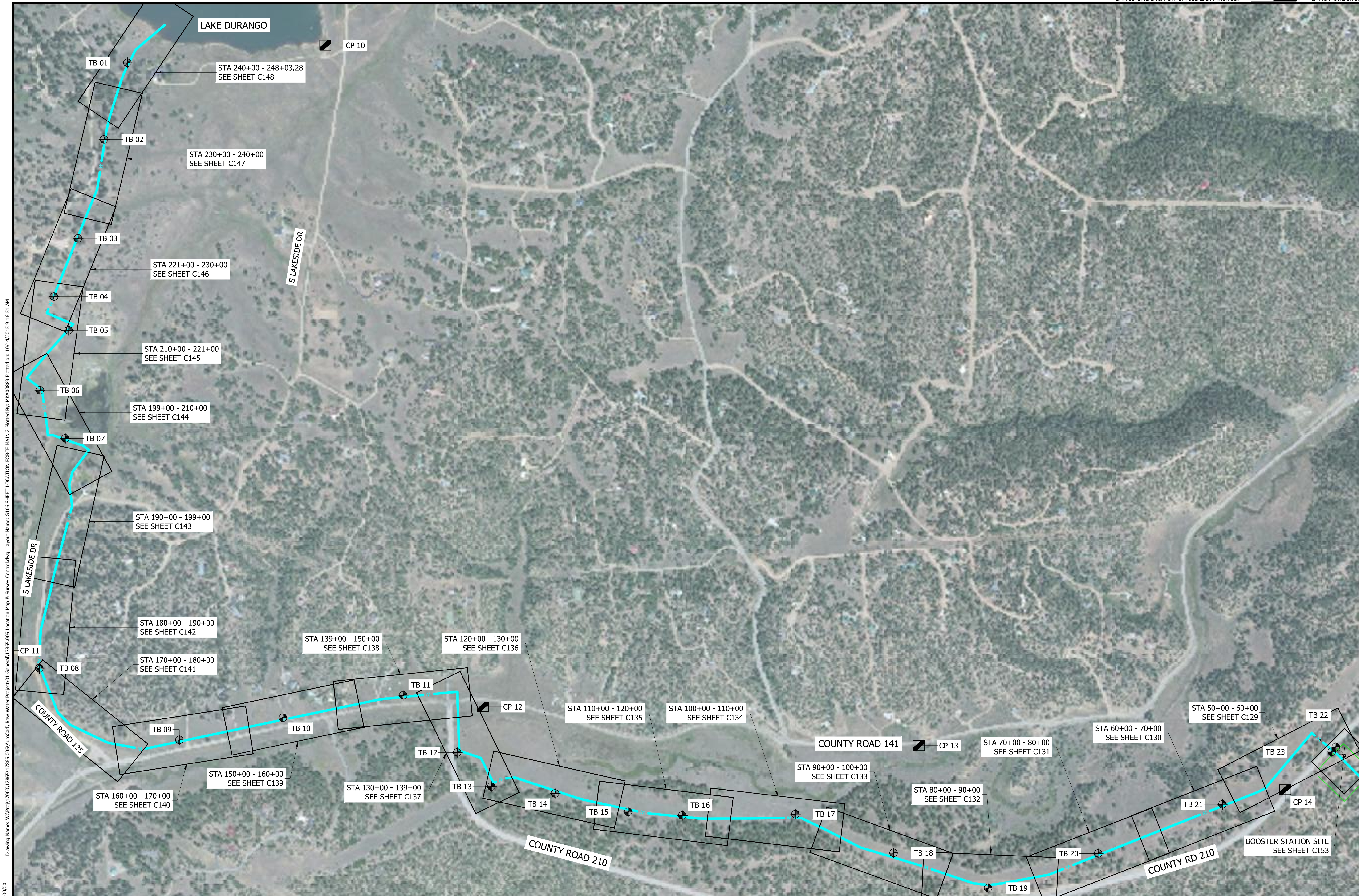
**RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO**

BARTLETT & WEST

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SHEET LOCATION MAP
BOOSTER STATION TO LAKE DURANGO

RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO



DESIGNED BY:	MKA
DRAWN BY:	MKA
APPROVED BY:	JAS
DESIGN PROJ:	17865.005
CONST PROJ:	----
SCALE:	AS NOTED
DATE:	OCT 2015

DRAWING NO: **G105**

SHEET NO:

GENERAL NOTES

1. THE CONTRACTOR SHALL THOROUGHLY REVIEW AND BECOME FAMILIAR WITH THE SPECIFICATIONS AND SPECIAL CONDITIONS OF THE CONTRACT DOCUMENTS PRIOR TO BEGINNING CONSTRUCTION OF THIS PROJECT.
2. THE CONTRACTOR MUST BE FAMILIAR WITH THE PROPOSED PROJECTS EXISTING CONDITIONS. THIS INCLUDES, BUT IS NOT LIMITED TO DIFFICULT CONSTRUCTION AROUND EXISTING TREES AND UTILITIES, CONNECTING TO EXISTING FACILITIES AND SMALL VERTICAL GRADE ADJUSTMENTS NECESSARY TO AVOID CONSTRUCTION CONFLICTS. THE CONTRACTOR MUST ADJUST PRICING TO ACCOUNT FOR THESE DIFFICULT CONSTRUCTION SITUATIONS. NO COMPENSATION SHALL BE GIVEN FOR EXISTING SURFACE CONDITIONS THAT MAY CAUSE DIFFICULT FIELD CONSTRUCTION MODIFICATIONS. SOILS ARE EXPANSIVE. CONTRACTOR SHALL EXPECT EXCAVATION TO INCLUDE INDIVIDUAL ROCKS OF VARYING SIZE. CONTRACTOR SHALL ALSO EXPECT GROUNDWATER IN THE EXCAVATION.
3. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE FOLLOWING:

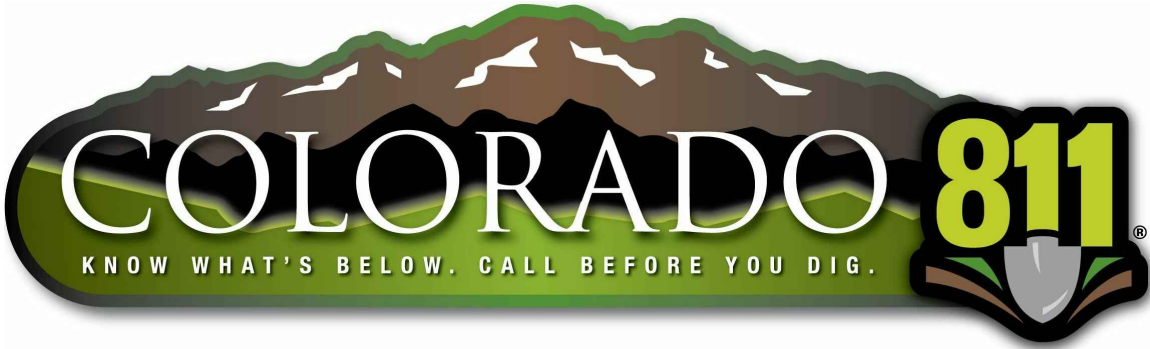
A) ALL LICENSES AND PERMITS REQUIRED FOR CONSTRUCTION.

B) THE NOTIFICATION OF THE PROPER AUTHORITIES PRIOR TO CONSTRUCTION.
4. IT WILL BE THE RESPONSIBILITY OF THE CONTRACTOR TO ASSURE THAT ACCESS TO ALL PROPERTIES BE PROVIDED DURING CONSTRUCTION OF THE PROJECT.
5. CONSTRUCTION STAKING SHALL BE PROVIDED BY THE CONTRACTOR.
6. THE OWNER WILL PREPARE A PRECONSTRUCTION NOTIFICATION (PCN) FOR THE PROJECT AND WILL UTILIZE USACE NATIONWIDE PERMIT 12 (UTILITY LINE ACTIVITIES) TO PERMIT THE CONSTRUCTION ACTIVITIES. AS PART OF THE PCN SUBMITTAL, WETLAND DELINEATIONS OF ALL DRAINAGE CROSSINGS, CULTURAL RESOURCES SURVEYS (CLASS III), A BIOLOGICAL EVALUATION AND A STORM WATER MANAGEMENT PLAN (SWMP) WILL BE SUBMITTED TO THE USACE. THE PROJECT CONSTRUCTION ACTIVITIES WILL COMPLY WITH ALL OF THE DISTRICT AND REGIONAL CONDITIONS FOR THE PERMIT. LA PLATA COUNTY DOES NOT HAVE ANY SPECIFIC WETLAND DEVELOPMENT REGULATIONS.
7. CONTRACTOR SHALL NOTIFY ALL LAND OWNERS AND TENANTS AT LEAST TWO (2) WEEKS PRIOR TO ANY CONSTRUCTION ACTIVITIES WHICH WOULD TAKE PLACE ADJACENT TO THEIR PROPERTY. CONTRACTOR SHALL NOTIFY LAND OWNERS AND TENANTS A MINIMUM OF 48 HOURS IN ADVANCE OF ALL WORK PERTAINING TO ENTRANCES, YARD GRADING, SOD AND LANDSCAPE, AND TREE REMOVAL. ALL WORK AND MATERIAL ASSOCIATED WITH PROVIDING TEMPORARY ACCESS SHALL BE SUBSIDIARY.
8. CONTACT AFFECTED OWNER(S) A MINIMUM OF 24 HOURS PRIOR TO HALTING OF UTILITY SERVICES. UNDER NO CIRCUMSTANCE SHALL ANY UTILITY SERVICE BE DISCONTINUED FOR MORE THAN ONE (1) 12-HOUR PERIOD.
9. ALL ROAD CONSTRUCTION SHALL BE IN CONFORMANCE WITH LA PLATA COUNTY'S ROAD AND BRIDGE DESIGN STANDARDS AND CONSTRUCTION SPECIFICATIONS, LATEST EDITION.
10. THE CONTRACTOR IS RESPONSIBLE FOR THE PROTECTION OF ALL PROPERTY CORNERS AND SECTION CORNERS. ANY PROPERTY CORNERS AND/OR SECTION CORNERS DISTURBED OR DAMAGED BY CONSTRUCTION ACTIVITIES SHALL BE RESET BY A REGISTERED LAND SURVEYOR LICENSED IN THE STATE OF COLORADO, AT THE CONTRACTOR'S EXPENSE.
11. ALL WORK SHALL BE CONFINED WITHIN THE EASEMENTS, RIGHT OF WAY AND/OR CONSTRUCTION LIMITS AS DIRECTED BY THE ENGINEER. ALL GRADING LIMITS SHOWN ARE APPROXIMATE AND MAY BE EXTENDED OR REDUCED AT THE DIRECTION OF THE ENGINEER. EASEMENTS ARE 50' WIDE.
12. CONTRACTOR SHALL USE DUE CARE IN PLACING CONSTRUCTION TOOLS, EQUIPMENT, EXCAVATED MATERIALS, AND PIPELINE MATERIALS AND SUPPLIES, SO AS TO CAUSE THE LEAST POSSIBLE DAMAGE TO EXISTING TREES AND THE LEAST POSSIBLE DISTURBANCE TO ADJACENT PROPERTY OWNERS.
13. THE CONTRACTOR SHALL AT NO TIME LEAVE EQUIPMENT, MATERIALS, OR DEBRIS IN LOCATIONS THAT COULD OBSTRUCT INTERSECTION SIGHT DISTANCE, OBSTRUCT ANY EXISTING CAPACITY OF THE SEWER SYSTEM, OR CAUSE FLOODING OR SEDIMENT RUNOFF TO RESIDENCES.
14. MATERIAL SHALL NOT BE STOCKPILED OVER EXISTING UTILITIES FOR ANY REASON.
15. PIPELINE STATIONING IS ALONG THE CENTER LINE OF THE PROPOSED PIPELINE.
16. THE CONTRACTOR IS RESPONSIBLE FOR THE PROVISION OF ALL MATERIAL, TOOLS, EQUIPMENT AND LABOR NECESSARY TO CONTROL EROSION, SILTATION, AND SEDIMENT DISCHARGES INTO PAVED AREAS, ADJACENT PROPERTIES, DOWNSTREAM SYSTEMS, OR RECEIVING CHANNELS. THIS SHALL BE REQUIRED DURING ALL PHASES OF CONSTRUCTION AND UNTIL SUITABLE GROUND COVER IS ESTABLISHED FOR ALL DISTURBED AREAS. IF ANY METHOD OF CONTROL FAILS, THE CONTRACTOR SHALL BE RESPONSIBLE FOR REMOVING ANY DEBRIS, SILT, OR MUD & RESTORING THE AREA TO ORIGINAL OR BETTER CONDITION. THE CONTRACTOR SHALL NOTIFY THE OWNER IMMEDIATELY, SO THAT THE OWNER CAN REVIEW THE CONTRACTOR'S PROPOSED METHOD OF REPAIR.
17. ALL LABOR, MATERIALS AND EQUIPMENT NECESSARY TO MAKE CONNECTIONS TO EXISTING OR PROPOSED PIPE, STRUCTURES, OR CULVERTS SHALL NOT BE PAID FOR DIRECTLY. ALL CONNECTIONS SHALL BE SUBSIDIARY TO OTHER ITEMS OF THE CONTRACT UNLESS OTHERWISE NOTED.
18. LABOR, TOOLS, MATERIALS AND EQUIPMENT REQUIRED FOR TEMPORARY SHORING, SLOPE PROTECTION AND CONNECTIONS TO MAINTAIN POSITIVE DRAINAGE DURING CONSTRUCTION SHALL BE SUBSIDIARY TO OTHER ITEMS OF PAY.
19. ANY MATERIAL BURIED OR STOCKPILED BEYOND APPROVED CONSTRUCTION LIMITS WOULD REQUIRE ADDITIONAL ARCHEOLOGICAL INVESTIGATIONS UNLESS BURIED IN A PREVIOUSLY APPROVED BORROW LOCATION.
20. ALL EXISTING STRUCTURES WITHIN THE CONSTRUCTION LIMITS SHALL BE LEFT IN PLACE UNLESS OTHERWISE NOTED IN THE PLANS. THIS WORK SHALL BE SUBSIDIARY TO OTHER BID ITEMS.
21. ANY ABANDONED WATER LINES SHALL BE PLUGGED. THIS WORK SHALL BE CONSIDERED SUBSIDIARY.
22. ALL TRAFFIC CONTROL SHALL BE IN CONFORMANCE WITH THE CURRENT MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES (MUTCD).
23. CONTRACTOR SHALL NOTIFY POLICE, FIRE, AND SHERIFF DEPARTMENTS, AND SCHOOL BUS COMPANIES PRIOR TO CLOSING ANY STREET. STREET CLOSINGS REQUIRE THE APPROVAL OF THE LOCAL AUTHORITY.
24. EXISTING PUBLIC STREET SIGNS REMOVED BY THE CONTRACTOR FOR CONSTRUCTION PURPOSES SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO SALVAGE AND STORE ALL SIGNS TO BE REUSED IN A STOCKPILE WITHIN THE RIGHT-OF-WAY. THIS WORK SHALL BE SUBSIDIARY TO OTHER BID ITEMS.
25. ALL PUBLIC STREET SIDEWALK RAMPS CONSTRUCTED WILL BE REQUIRED TO COMPLY WITH THE AMERICANS WITH DISABILITIES ACT (ADA) AND SIDEWALK DETAILS.
26. HIKE/BIKE TRAIL, CURB & GUTTER, SIDEWALKS AND OTHER AREAS NOT IDENTIFIED IN THE PLANS AS BEING REMOVED, BUT DAMAGED BY THE CONTRACTOR SHALL BE RESTORED AT THE CONTRACTORS EXPENSE TO A CONDITION EQUAL TO OR BETTER THAN EXISTING BEFORE DAMAGE OCCURRED.
27. THE INFORMATION SHOWN IN THESE PLANS CONCERNING THE TYPE AND LOCATION OF UNDERGROUND UTILITIES IS NOT GUARANTEED TO BE ACCURATE OR ALL INCLUSIVE. THE CONTRACTOR IS RESPONSIBLE FOR CONTACTING ALL UTILITY COMPANIES FOR FIELD LOCATION OF ALL UNDERGROUND UTILITY LINES PRIOR TO ANY EXCAVATION AND FOR MAKING HIS OWN VERIFICATION AS TO THE TYPE AND LOCATION OF UNDERGROUND UTILITIES AS MAY BE NECESSARY TO AVOID DAMAGE THERETO. THE CONTRACTOR SHALL POTHOLE AND SURVEY ALL UTILITY CROSSINGS PRIOR TO CONSTRUCTION OF ANY SUBSURFACE ELEMENT OF THE PROJECT. THIS SURVEY INFORMATION SHALL BE FORWARDED TO THE PROJECT ENGINEER FOR REVIEW. THE CONTRACTOR SHALL NOT BEGIN CONSTRUCTION ON ANY SUBSURFACE ELEMENT ON THE PROJECT WITHOUT THE APPROVAL OF THE PROJECT ENGINEER. DAMAGE TO ANY UTILITIES OR STRUCTURES DURING EXCAVATION AND CONSTRUCTION SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR. THE UTILITY NOTIFICATION CENTER OF COLORADO NUMBER IS 1-800-922-1987. THE CONTRACTOR MUST NOTIFY ALL UTILITIES 48 HOURS PRIOR TO ANY EXCAVATION. UTILITY COORDINATION, POTHOLING/SURVEYING SHALL BE SUBSIDIARY TO OTHER BID ITEMS.
28. PRIVATE UTILITY SERVICE LINES, POLES, VALVE BOXES, METERS, ETC. MUST BE ADJUSTED AS NECESSARY, BY EACH RESPECTIVE UTILITY OWNER, PRIOR TO CONSTRUCTION, UNLESS THE PLANS SPECIFICALLY CALL FOR THEIR ADJUSTMENT BY THE CONTRACTOR. THE CONTRACTOR WILL BE REQUIRED TO WORK AROUND EXISTING UTILITIES WITHIN THE RIGHT-OF-WAY WHICH DO NOT CONFLICT WITH PROPOSED CONSTRUCTION. THE CONTRACTOR WILL BE RESPONSIBLE FOR ALL WATER AND SANITARY RELOCATIONS AND ADJUSTMENTS AND SHALL CONTACT THE APPROPRIATE UTILITY COMPANY 10 WORKING DAYS PRIOR TO COMPLETING THE IMPROVEMENTS TO COORDINATE INSPECTIONS.
29. IF SPRINKLER SYSTEMS ARE ENCOUNTERED AND CONFLICT WITH CONSTRUCTION, THEN THE CONTRACTOR SHALL REMOVE SECTIONS OF THE SPRINKLER SYSTEMS NECESSARY FOR CONSTRUCTION. THE DISTURBED PORTION OF THE SPRINKLER SYSTEM SHALL BE CAPPED SO THE REMAINDER OF THE SYSTEM MAY BE OPERATED DURING CONSTRUCTION. DISTURBED PORTIONS OF THE SPRINKLER SYSTEMS SHALL BE REPAIRED TO EXISTING OR BETTER CONDITION AFTER CONSTRUCTION HAS BEEN COMPLETED AND PRIOR TO SODDING. REASONABLE ATTEMPTS HAVE BEEN MADE TO SHOW TRACTS WITH EXISTING SPRINKLER SYSTEMS ON THE PLANS, HOWEVER, NO GUARANTEE IS MADE THAT ALL SPRINKLER SYSTEMS ARE SHOWN. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO LOCATE AND PROTECT THESE FACILITIES, OR RECONSTRUCT TO ORIGINAL OR BETTER CONDITION PRIOR TO SODDING.
30. FOUNDATION ELEVATIONS OF EXISTING STRUCTURES ADJACENT TO THE WORK ARE NOT KNOWN AND SHALL BE VERIFIED BY THE CONTRACTOR. THE CONTRACTOR SHALL FURNISH, INSTALL, MONITOR & MAINTAIN EXCAVATION SUPPORT & PROTECTION SYSTEMS ADJACENT TO EXISTING STRUCTURES, PAVEMENTS, & UTILITIES WHICH MAY BE DAMAGED BY EXCAVATION WORK. PROVIDE PROFESSIONAL ENGINEERING SERVICES FOR THE ANALYSIS & DESIGN OF SHORING, UNDERPINNING, TIEBACKS OR OTHER SUPPORT & PROTECTIONS SYSTEMS USED. THIS WORK SHALL BE SUBSIDIARY TO ALL OTHER ITEMS OF WORK.
31. NEW AND EXISTING MANHOLE COVERS SHALL BE ADJUSTED TO THE SAME ELEVATIONS AND SLOPE AS ADJACENT SURFACES.
32. THE CONTRACTOR SHALL PROVIDE AND MAINTAIN ADEQUATE DEWATERING EQUIPMENT TO REMOVE AND DISPOSE OF ALL SURFACE AND GROUNDWATER ENTERING EXCAVATIONS, TRENCHES OR OTHER PARTS OF THE WORK. EACH EXCAVATION SHALL BE KEPT DRY DURING SUBGRADE PREPARATION AND CONTINUALLY THEREAFTER UNTIL THE STRUCTURE TO BE BUILT IS COMPLETED TO THE EXTENT THAT NO DAMAGE WILL RESULT. THIS ITEM SHALL BE CONSIDERED SUBSIDIARY TO OTHER BID ITEMS.
33. CONTRACTOR SHALL SUBMIT A PLAN TO BYPASS FLOW THROUGH CONSTRUCTION AREA AND WILL BE RESPONSIBLE FOR ANY DAMAGE TO PROPERTY RESULTING FROM STORM WATER FLOWS.

34. A FULL DEPTH SAW CUT OF THE EXISTING TOTAL PAVEMENT THICKNESS SHALL BE PROVIDED AT LOCATIONS WHERE PROPOSED CONSTRUCTION ABUTS AN EXISTING SURFACE COURSE OR PAVEMENT FOR WHICH PARTIAL REMOVAL OF THAT SURFACE OR PAVEMENT IS REQUIRED. REMOVAL LIMITS SHOWN WITHIN (3) FEET OF EXISTING JOINTS SHALL EXTEND TO THE EXISTING JOINT. SUCH SAW CUTS WILL NOT BE PAID FOR DIRECTLY AND THIS COST SHALL BE CONSIDERED AS SUBSIDIARY TO THE REMOVAL OF THE SURFACE OR PAVEMENT.
35. THE CONTRACTOR IS RESPONSIBLE FOR MAINTAINING, AND IF NECESSARY REMOVING AND RESTORING, ALL EXISTING DRIVEWAY MARKERS, YARD LIGHTS, ETC WITHIN CONSTRUCTION LIMITS. THIS WORK SHALL BE SUBSIDIARY TO OTHER BID ITEMS.
36. SMALL DRAIN LINES SUCH AS ROOF DRAINS AND UNDERDRAINS THAT ARE UNCOVERED, DAMAGED OR LOCATED DURING CONSTRUCTION, OR THAT ARE INDICATED ON THE PLANS, SHALL BE CONNECTED BY THE CONTRACTOR TO NEAREST STORM DRAINAGE PIPE OR STRUCTURE. CONTRACTOR TO PROPOSE MATERIALS, GRADE, LOCATION, ETC., WHICH ARE SUBJECT TO APPROVAL OF ENGINEER.
37. CONTRACTOR IS RESPONSIBLE FOR PROTECTING AND ADJUSTING OR REBUILDING ALL EXISTING MANHOLES, CATCH BASINS, UTILITY VALVES, AND METER PITS WITHIN CONSTRUCTION LIMITS TO THE FINAL GRADE AS REQUIRED. THIS WORK SHALL BE CONSIDERED SUBSIDIARY TO OTHER BID ITEMS UNLESS NOTED OTHERWISE.
38. THE CONTRACTOR SHALL BE RESPONSIBLE FOR SUPPORTING AND PROTECTING ALL EXPOSED UTILITIES IN OPEN TRENCHES AND UTILITY POLES NEEDING BRACING.
39. CONTRACTOR IS RESPONSIBLE TO PROVIDE THRUST BLOCKS, ANCHORS, RESTRAINTS, AND ADJUSTABLE SUPPORTS AS REQUIRED OR DIRECTED BY ENGINEER.
40. ANY UNATTENDED EXCAVATION PITS OR TRENCHES SHALL BE PROTECTED WITH ORANGE CONSTRUCTION FENCE. WORK SHALL BE SUBSIDIARY.
41. ANY POLES TO BE BRACED FOR CONSTRUCTION SHALL BE COORDINATED WITH LPEA OR THE OWNER OF THAT POLE. CONTRACTOR SHALL NOTIFY LPEA ONE WEEK PRIOR TO EXCAVATION ADJACENT TO THEIR POLES.
42. WHILE THE SEWER AND WATER SYSTEMS HAVE BEEN DESIGNED TO CLEAR MAJOR UTILITIES, UNKNOWN CONFLICTS MAY EXIST, AND THE ENGINEER RESERVES THE RIGHT TO ADJUST SEWER PIPE ELEVATIONS AS REQUIRED TO CLEAR CONFLICTS. WHERE THESE ADJUSTMENTS RESULT IN FLOWLINE ELEVATION BEING RAISED OR LOWERED 1' MAXIMUM, THERE SHALL BE NO ADDITIONAL PAYMENT MADE FOR TRENCHING OR STRUCTURE CONSTRUCTION MODIFICATION.
43. FLOORS, WALLS AND DOORS SHOWN IN THE PROCESS DRAWINGS ARE FOR REFERENCE ONLY. REFER TO STRUCTURAL FOR SPECIFIC LOCATIONS.
44. DIMENSIONS AND ELEVATIONS ARE FOR BIDDING PURPOSES. CONTRACTOR IS RESPONSIBLE FOR FIELD VERIFICATIONS OF DIMENSIONS AND ELEVATIONS PRIOR TO CONSTRUCTION.
45. NOT ALL PIPE SUPPORTS, HANGERS, TAPS, AND EQUIPMENT ARE SHOWN ON THE DRAWINGS. CONTRACTOR SHALL COORDINATE LOCATION AND MODIFY IN ACCORDANCE WITH SPECIFICATIONS AND DETAILS.
46. PIPE, FITTINGS, VALVES, EQUIPMENT, ETC. TAGS & LABELS ARE PROVIDED AS A COURTESY FOR THE CONTRACTOR. IT IS NOT THE INTENT OF THESE CALL OUTS, LABELS, AND TAGS TO BE OF MATERIAL LIST. CONTRACTOR SHALL BE RESPONSIBLE FOR ALL ITEMS REQUIRED TO COMPLETE THE WORK REGARDLESS IF THEY ARE EITHER CALLED OUT OR SHOWN IN THE DRAWINGS.
47. CONTRACTOR TO COORDINATE PIPE SUPPORT LAYOUT, SPACING AND TYPE TO MINIMIZE INTERFERENCES.
48. ALL SUBGRADE UNDER PROPOSED PAVEMENT WILL RECEIVE TYPE 'A' COMPACTION. THIS SUBGRADE COMPACTION WILL BE FOR THE AGGREGATE/ROAD BASE.
49. AFTER INSTALLATION OF PROPOSED WORK, CONTRACTOR SHALL PROVIDE POSITIVE DRAINAGE FOR ALL TRENCHES AND CONSTRUCT FILL SLOPES AT 4:1 OR FLATTER AROUND MANHOLES AND STRUCTURES.
50. ROCK EXCAVATION INCLUDES SUITABLE REPLACEMENT MATERIAL (FOR ALL ROCK REMOVED) FROM OFF SITE. BORROW MATERIAL WILL NOT BE PAID FOR SEPARATELY BUT SHALL BE SUBSIDIARY TO OTHER ITEMS IN THE CONTRACT. THE CONTRACTOR SHALL BE RESPONSIBLE FOR HANDLING ALL TYPES OF MATERIALS ENCOUNTERED.
51. THE CONTRACTOR SHALL DISPOSE OF ANY ROCK EXCAVATED FROM SEWER TRENCHES & STRUCTURES OFFSITE. TRENCH WIDTH USED IN COMPUTING ROCK EXCAVATION SHALL BE THE OUTSIDE DIAMETER OF PIPE PLUS 12" EACH SIDE. ROCK REMOVAL FOR STRUCTURES SHALL BE SUBSIDIARY TO THAT BID ITEM.
52. FOR ANY EXCAVATION & BACKFILL BEYOND THE LIMITS SHOWN ON THE CROSS SECTION, THE CONTRACTOR SHALL BACKFILL THOSE AREAS TO SLOPES EQUAL TO OR LESS THAN THE EXISTING SLOPES AS SHOWN ON THE CROSS SECTIONS. THIS WORK SHALL BE CONSIDERED SUBSIDIARY TO OTHER BID ITEMS.
53. EXCEPT AS NOTED, THE CONTRACTOR SHALL BACKFILL THE TRENCH UP TO THE EXISTING SURFACE, PROVIDING A SMOOTH SURFACE. IN THIS MANNER, THE CONTRACTOR CAN ASPHALT OR CONCRETE PAVE LARGE SECTIONS OF TRENCH AT ONE TIME WHILE STILL PROVIDING A USABLE SURFACE.
54. TRENCH AND BACKFILL QUANTITIES CALCULATED TO EXISTING GROUND. ALL DISTURBED AREAS SHALL BE GRADED TO DRAIN FREE WITHOUT PONDING.
55. EXCAVATION SHOWN TO BE WASTED SHALL BE WASTED ON SITES PROVIDED BY THE CONTRACTOR. THESE SITES SHALL BE APPROVED BY THE ENGINEER AS TO SUITABILITY, APPEARANCE, AND SITE LOCATION. LOCATIONS THAT IN THE OPINION OF THE ENGINEER WILL LEAVE AN UNSIGHTLY APPEARANCE WILL NOT BE APPROVED.
56. ALL DISPOSAL SITES MUST BE APPROVED BY THE GOVERNMENTAL AGENCY(S) HAVING JURISDICTION. MATERIAL EITHER STOCKPILED OR DISPOSED OF IN A FLOOD PLAIN WOULD REQUIRE THE APPROPRIATE PERMIT. ANY MATERIAL DUMPED IN WATERS OF THE UNITED STATES OR WETLANDS IS SUBJECT TO U.S. CORPS OF ENGINEERS PERMITTING REGULATIONS.
57. THE CONTRACTOR SHALL REPAIR OR REPLACE ANY EXISTING LANDSCAPING, OF ANY KIND, THAT WAS REMOVED OR DAMAGED DURING CONSTRUCTION. THE CONTRACTOR SHALL GUARANTEE SAID LANDSCAPING FOR ONE (1) YEAR AFTER THE FINAL ACCEPTANCE OF THE PROJECT.
58. THE CONTRACTOR SHALL SEED ALL DISTURBED AREAS UNLESS NOTIFIED OTHERWISE ON THE PLANS.
59. ALL TREES, HEDGE ROWS, SHELTER BELTS AND WOOD SHRUBS NOT SHOWN TO BE REMOVED AND LOCATED BETWEEN THE CONSTRUCTION LIMITS AND THE RIGHT-OF-WAY LINE OR EASEMENT LINE SHALL BE SPARED UNLESS DIRECTED BY THE ENGINEER TO BE REMOVED. ADDITIONAL CARE TO SPARE ALL TREES AS POSSIBLE SHALL BE GIVEN WHEN WORKING AROUND TREES ADJACENT TO THE CONSTRUCTION LIMITS. REMOVAL OF ALL TREES LESS THAN 12" & SHRUBS SHALL BE SUBSIDIARY TO CLEARING AND GRUBBING.

UTILITY LOCATIONS SHOWN ON PLANS ARE APPROXIMATE AND SHOULD BE VERIFIED IN THE FIELD AT THE TIME OF CONSTRUCTION.

FOR FIELD LOCATIONS OF UNDERGROUND UTILITIES CALL 1-800-424-5555 OR 811. STATE LAW REQUIRES TWO DAYS ADVANCE NOTICE.



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CHAIRMAN, BOARD OF DIRECTORS

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- WATER: LAKE DURANGO WATER AUTHORITY
970.247.4062
- GAS: ATMOS ENERGY
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- HIGH PRESSURE GAS: NORTHWEST PIPELINE
1.800.972.7733
- PHONE: CENTURY LINK
970.259.8755
- NATURAL GAS: ENTERPRISE GAS
713.381.6500

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GENERAL NOTES & UTILITY CONTACTS

RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO

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DESIGNED BY: MKA

DRAWN BY: MKA

APPROVED BY: JAS

DESIGN PROJ: 17865.005

CONST PROJ: ----













































































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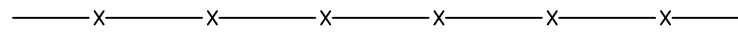








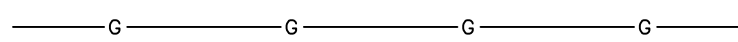
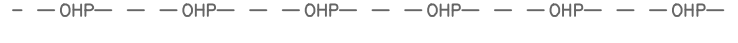


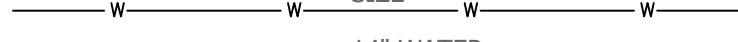


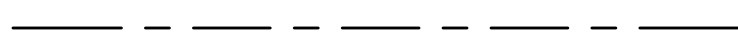
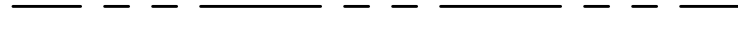

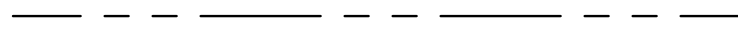

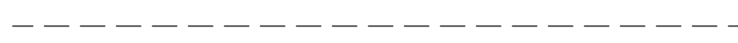


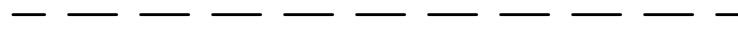







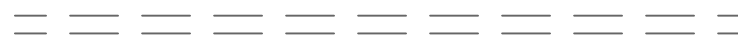


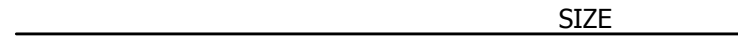
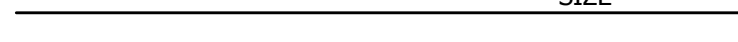
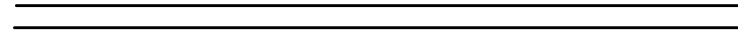












DATE: OCT 2015

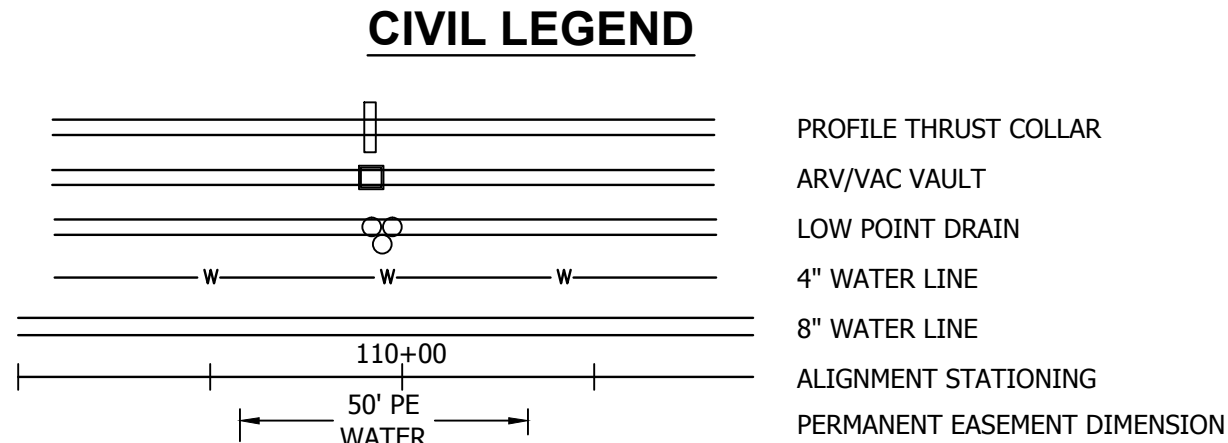
DRAWING NO: G106

SHEET NO: 7 of 114

Drawing Name: W:\Proj\17000\17865\AutoCad_Raw Water Project\02 Civil\17865.005 Civil General Sheet.dwg Layout Name: C100 CIVIL SYMBOLS ABBREVIATIONS & NOTES Plotted on: 10/12/2015 10:19:59 AM Last edit on: 06/09/00

SURVEY SYMBOL			
	BILLBOARD		ROOF DRAIN
	BORE HOLE or DRILL HOLE		CURB INLET
	LANDSCAPE BOULDER		SANITARY MANHOLE
	WELL		CLEANOUT
	FLAG POLE		YARD HYDRANT
	SATELLITE DISH		WATER SPRINKLER
	POST		WATER MANHOLE
	MAIL BOX		WATER METER
	TWO POLE SIGN		WATER VALVE
	ONE POLE SIGN		FIRE HYDRANT
	PARKING METER		LIGHT
	STOP SIGN		FLOOD LIGHT
	GAS REGULATOR		LUMINARY (STREET LIGHT)
	GAS RISER		MANHOLE COVER -Shows eccentric manholes
	GAS TEST STATION		MISCELLANEOUS TOPO ITEM
	GAS METER		FINISH FLOOR
	GAS VALVE		MIN. OPENING ELEV.
	UTILITY POLE		STUMP
	GUY POLE		SHRUB
	GUY ANCHOR		DECIDUOUS TREE
	TELEPHONE PEDESTAL		EVERGREEN SHRUB
	TELEPHONE MANHOLE		EVERGREEN TREE
	CABLE TV PEDESTAL		TE TEMPORARY UTILITY EASEMENT
	ELECTRIC MANHOLE		PE PERMANENT UTILITY EASEMENT
	ELECTRIC METER	SURVEY MONUMENTATION	
	TRANSFORMER/ELECTRIC PAD		BM BENCHMARK
	AIR CONDITIONER		TBM TEMPORARY BENCHMARK
	HAND HOLE		R/W MARKER
	TRAFFIC SIGNAL		FOUND SURVEY MONUMENT
	TRAFFIC SIGNAL BOX		SET SURVEY MONUMENT
	SIGNAL MANHOLE		SET SURVEY MONUMENT IN CONCRETE
	STORM MANHOLE		◎ CALCULATED SURVEY POINT
	AREA INLET		✚ CHISELED CROSS FOUND
	22-1/2° FITTING		✚ CHISELED CROSS SET
	45° FITTING		✕ TO BE REMOVED
	90° FITTING		REMOVE, AND/OR REPLACE
	TEE FITTING		
	REDUCING FITTING		
	WYE FITTING		
	CAP FITTING		
	BLOW-OFF		

CIVIL LINETYPE LEGEND	
	FENCE WIRE
	FENCE CHAIN LINK
	FENCE WOOD
	FENCE STONE
	GUARDRAIL
	BACK OF CURB
	GUTTER
	ASPHALT
	UNDER GROUND TELEPHONE
	OVERHEAD TELEPHONE
	UNDER GROUND TELEVISION
	OVERHEAD CABLE TELEVISION
	FIBER OPTICS
	GAS LINE
	OVERHEAD ELECTRIC
	UNDER GROUND ELECTRIC
	SANITARY SEWER
	FORCE MAIN (SANITARY)
	WATER LINE
	WATER MAINS > 12" (TO SCALE)
	FIRE PROTECTION LINE
	STORM SEWER
	CENTERLINE
	R/W LINE
	LOT LINE
	PROPERTY LINE
	SECTION LINE
	BOUNDARY LINE
	5' CONTOUR
	1' CONTOUR
	SETBACK LINE
	COMMUNICATION LINE
	EASEMENT TEMPORARY CONSTRUCTION
	EASEMENT PERMANENT
	TIMBER LINE
	PAVEMENT EDGE
	BREAK LINE - EDGE OF GRAVEL
	RESTRICTED ACCESS
	RESTRICTED ACCESS LT
	RESTRICTED ACCESS RT
	TRACKS
	REINF CONC BOX - RCB (TO SCALE)
	CMP < 8"
	CMP > 8" (TO SCALE)
	RCP < 8"
	RCP > 8" (TO SCALE)
	NEW GAS LINE
	NEW SEWER LINE
	NEW WATER LINE
	NEW WATER LINE > 12" (TO SCALE)



GENERAL NOTES

- CONTRACTOR IS RESPONSIBLE FOR THE SWMP AND PERMIT AND IMPLEMENTING ALL BMPS AND SPILL CONTROL & CONTAINMENT PLAN.
- SEE SPECIFICATIONS FOR BMPS SPECIFIC TO WETLAND CROSSINGS.
- ANY VEGETATION REMOVAL THAT WOULD OCCUR DURING THE BREEDING BIRD SEASON (APRIL 1 - AUGUST 15) SHALL REQUIRE BIOLOGICAL NEST CLEARANCE SURVEYS NO MORE THAN 10 DAYS PRIOR TO ANY SUCH ACTIVITIES.
- SUBSIDIARY WORK TO INCLUDE BUT NOT BE LIMITED TO THE FOLLOWING REMOVAL AND REPLACEMENT OF MAILBOXES, SIGNS, POST, DRAINAGE PIPES, LIGHTS, POLES, FENCE, FENCE POST, GATES, STORM SEWERS, TRAILS, SIDEWALKS, UTILITIES, SERVICES AND APPURTENANCES.
- ADDITIONAL REQUIREMENTS THROUGH WETLANDS INCLUDING TRENCH PLUGS SHALL BE SUBSIDIARY TO PIPELINE INSTALLATION.
- PAY ITEMS ARE LIMITED TO ITEMS LISTED ON THE BID TAB AND UNDER MEASUREMENT FOR PAYMENT.

BARTLETT & WEST

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**CIVIL SYMBOLS, ABBREVIATIONS
& NOTES**

**RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO**



DESIGNED BY:	MKA
DRAWN BY:	MKA
APPROVED BY:	JAS
DESIGN PROJ:	17865.005
CONST PROJ:	----
SCALE:	AS NOTED
DATE:	OCT 2015
DRAWING NO:	C100
SHEET NO:	8 of 114

GENERAL NOTES:

1. ANY EROSION AND SEDIMENT CONTROL MEASURES INTENDED TO CONTROL EROSION OF AN EARTH DISTURBANCE OPERATION SHALL BE INSTALLED BEFORE ANY EARTH DISTURBANCE OPERATIONS TAKE PLACE.
2. THE CONTRACTOR SHALL VERIFY THAT ALL EROSION AND SEDIMENT CONTROL MEASURES ARE IN WORKING CONDITION PRIOR TO ANY FORECASTED RAINFALL. THE CONTRACTOR SHALL INSPECT THE LAND DISTURBANCE SITE AFTER EACH SIGNIFICANT RAINFALL EVENT WITHIN A 24-HOUR PERIOD. ALL NECESSARY REPAIRS SHALL BE MADE TO MAINTAIN THE INTEGRITY OF THE EROSION AND SEDIMENT CONTROL MEASURES. SEDIMENT SHALL BE REMOVED ONCE IT REACHES HALF OF THE INSTALLED HEIGHT OF MEASURE.
3. THE CONTRACTOR SHALL MAINTAIN ALL EROSION AND SEDIMENT CONTROL MEASURES DURING ALL PHASES OF CONSTRUCTION UNTIL OWNER ACCEPTS WORK AS COMPLETE. THE CONTRACTOR SHALL PROVIDE TEMPORARY SEEDING, BERMS, SILT FENCE, SEDIMENT TRAPS OR OTHER MEANS TO PREVENT SEDIMENT FROM REACHING STREAMS, PUBLIC RIGHT-OF-WAY OR ADJACENT PROPERTY.
4. SEDIMENT AND EROSION CONTROL MEASURES SHALL BE REMOVED ONCE 70 PERCENT OF THE PERMANENT COVER IS ESTABLISHED.
5. THE CONTRACTOR SHALL TEMPORARILY SEED AND MULCH ALL DISTURBED AREAS IF THERE HAS BEEN NO CONSTRUCTION ACTIVITY ON THEM FOR A PERIOD OF 14 CALENDAR DAYS. IF THE ENGINEER DETERMINES THAT A SITE HAS A POTENTIAL FOR EROSION, STABILIZATION OF SOIL MAY BE REQUIRED BY THE ENGINEER. TEMPORARY SEED MIXTURE SHALL BE APPROVED BY THE ENGINEER OR AS LISTED IN THE SPECIFICATIONS:
6. REPAIRS AND RESEEDING SHALL BE PERFORMED BY THE CONTRACTOR AT THE DIRECTION OF THE ENGINEER AT NO ADDITIONAL COST TO THE OWNER. IF VEGETATIVE MEASURES ARE NOT EFFECTIVE, NON-VEGETATIVE OPTION MAY BE REQUIRED.
7. LONGITUDINAL EROSION FENCING IS ONLY SHOWN ON THE PLAN & PROFILE SHEETS. SEE SHEET C104 FOR EROSION FENCING FOR SLOPE AREAS.

STORM WATER MANAGEMENT - EROSION AND SEDIMENT CONTROL:

- GENERAL
- THIS PLAN OUTLINES STORM WATER MANAGEMENT AND SEDIMENT AND EROSION CONTROL PRACTICES TO BE FOLLOWED BY THE CONTRACTOR DURING ALL PHASES OF CONSTRUCTION OF THE PROJECT. THE CONTRACTOR WILL BE RESPONSIBLE TO PREVENT SOIL OR SEDIMENT LOSS FROM THE CONSTRUCTION SITE. THE CONTRACTOR CANNOT LEAVE THE SITE UNTIL ALL PERMANENT EROSION CONTROL, SEDIMENT CONTROL AND STORM WATER MANAGEMENT PRACTICES ARE IN PLACE, INSPECTED, HAVE BEEN FOUND TO BE SATISFACTORY, AND ALL TEMPORARY PRACTICES HAVE BEEN PROPERLY REMOVED.
- STORM WATER MANAGEMENT
THIS PROJECT HAS BEEN DESIGNED TO PROVIDE POSITIVE POST-CONSTRUCTION CONTROL OF EXCESS STORM WATER GENERATED ON THE SITE. DURING THE COURSE OF CONSTRUCTION. THE CONTRACTOR SHALL INSTALL AND MAINTAIN STORM WATER MANAGEMENT STRUCTURES TO MAXIMIZE STORM WATER CONTROL.
 - EROSION AND SEDIMENT CONTROL
THIS PROJECT IS DESIGNED TO MINIMIZE OFF-SITE EFFECT OF SOIL EROSION AND RESULTING SEDIMENT LOSS THROUGH THE USE OF PROPER CONSTRUCTION TECHNIQUES, INCLUDING INSTALLING BOTH TEMPORARY AND PERMANENT MANAGEMENT PRACTICES. ALL SOIL DISTURBING ACTIVITIES PERFORMED BY THE CONTRACTOR SHALL BE ACCOMPLISHED IN SUCH A MANNER AS TO PREVENT THE LOSS OF SEDIMENT IN STORM WATER AND TRACKING OF SOIL FROM VEHICLE TRAFFIC FROM THE CONSTRUCTION SITE. TO ACCOMPLISH THIS, THE FOLLOWING SPECIFIC STEPS WILL BE TAKEN DURING CONSTRUCTION:
 - OVERALL PLAN AND CONTRACTOR RESPONSIBILITY
- THE CONTRACTOR SHALL BE FULLY RESPONSIBLE FOR ALL ASPECTS OF THIS WORK
 - THE CONTRACTOR SHALL KEEP A WRITTEN LOG OF WHEN CONSTRUCTION ACTIVITIES BEGIN, EROSION AND SEDIMENT CONTROLS ARE INSTALLED, INSPECTED AND REPAIRED. COPIES OF LOG SHALL BE FURNISHED TO THE ENGINEER.
 - THE ENGINEER AND CONTRACTOR SHALL MONITOR EROSION AND SEDIMENT CONTROL MEASURES THROUGHOUT THE PROJECT. THIS PLAN MAY BE UPDATED AS CONSTRUCTION PROGRESSES WITH APPROVAL OF ENGINEER.
 - TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES INSTALLED AS PART OF THIS PLAN SHALL NOT BE REMOVED FOLLOWING CONSTRUCTION UNTIL SLOPES ARE STABILIZED TO A NON-EROSIVE STATE WITH ESTABLISHED GRASS OR AS DIRECTED BY THE ENGINEER.
 - IMMEDIATELY AFTER MOBILIZATION AND PRIOR TO STARTING ANY SOIL DISTURBING ACTIVITIES, THE CONTRACTOR SHALL INSTALL THE PERIMETER EROSION AND SEDIMENT CONTROL MEASURES OF THE PERIMETER SILT FENCE, GRAVEL CONSTRUCTION ENTRANCE(S) AND TEMPORARY SEDIMENT BASIN(S). IT IS RECOGNIZED THAT SOME SITE CLEARING AND PREPARATION MAY BE REQUIRED TO PROPERLY INSTALL SUCH MEASURES.
 - THE RECOMMENDED SEQUENCE OF CONSTRUCTION ACTIVITIES AND OF THE INSTALLATION AND REMOVAL OF EROSION AND SEDIMENT CONTROL MEASURES IS AS FOLLOWS: PERIMETER CONTROL MEASURES (SILT FENCE, TEMPORARY SEDIMENT BASIN) INCLUDING AREAS DRAINING TO A DRAINAGE WAY SUCH AS A STREAM, GRAVEL CONSTRUCTION ENTRANCE(S), CONSTRUCTION OF SANITARY SEWERS, STORM SEWERS, STRAW OR HAY BALE INLET PROTECTION AND BALE DITCH CHECKS, STREETS, FINAL GRADING, SEEDING, FERTILIZING AND MULCHING ON ALL SLOPES AND DISTURBED AREAS, HOME CONSTRUCTION AND INDIVIDUAL SITE CONTROL MEASURES, REMOVAL OF TEMPORARY PRACTICES, REMOVAL OF PERIMETER CONTROLS AND SITE CLEANUP.
 - PERIMETER SILT FENCE, BALE DITCH CHECKS, CONSTRUCTION ENTRANCE(S) AND TEMPORARY SEDIMENT BASIN(S) SHALL BE CONSTRUCTED IN ACCORDANCE WITH DETAILS SHOWN HEREON. INSTALL SILT FENCE OR BALES WHERE REPRESENTED ON PLAN AS DITCH CHECKS AND SLOPE CONTROL, AROUND INLETS, ALONG ROADWAYS, AREAS DRAINING TO A DRAINAGE WAY SUCH AS A STREAM AND OTHER LOCATIONS AS NEEDED TO PREVENT SEDIMENT FROM LEAVING THE SITE. ACTUAL SPACING OF SILT FENCE AND BALES WILL FOLLOW INSTALLATION TABLE. MEASURES WILL BE KEPT IN PLACE UNTIL GRASS IS ESTABLISHED.
 - BALE OR REINFORCED SILT FENCE INLET PROTECTION AT EACH INLET AND BALE DITCH CHECKS SHALL BE INSTALLED AFTER COMPLETION OF INLETS AND DITCHES. PROTECTION SHALL REMAIN IN PLACE AT INLETS UNTIL PAVEMENT IS CONSTRUCTED AND IN DITCHES UNTIL PERMANENT GRASS STAND IS ESTABLISHED. ROCK BAGS SHALL BE INSTALLED AFTER CURB & GUTTER IS INSTALLED. IN ADDITION, HAY BALES OR SILT FENCE WILL BE PLACED ALONG STREETS, AS NEEDED, TO REDUCE SEDIMENT IN THE STREETS.
 - EROSION CONTROL PERIMETER FENCE, BALE PROTECTION BARRIERS AND TEMPORARY SEDIMENT BASIN(S) SHALL BE INSPECTED AND MAINTAINED BY THE CONTRACTOR NOT LESS THAN WEEKLY OR WITHIN 24 HOURS AFTER A RAINFALL EVENT OF 0.5 INCHES OR MORE. MAINTENANCE SHALL INCLUDE BUT NOT LIMITED TO SEDIMENT REMOVAL, SILT FENCE AND HAY BALE BARRIER REPAIR AND/OR REPLACEMENT.
 - CONSTRUCTION ENTRANCE(S) SHALL BE MAINTAINED BY THE CONTRACTOR IN A CONDITION THAT WILL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO PUBLIC RIGHT-OF-WAYS AND PAVED STREETS. THIS MAY INCLUDE PERIODIC TOP DRESSING WITH ADDITIONAL CRUSHED STONE AS CONDITIONS WARRANT. REPAIR OF ENTRANCE(S), CLEANING ON A DAILY BASIS OF RIGHT-OF-WAYS AND PAVED STREETS THAT HAVE BEEN SOILED BY CONSTRUCTION ACTIVITIES SHALL BE THE CONTRACTOR'S RESPONSIBILITY.
 - IF ADDITIONAL INGRESS AND EGRESS TO THE CONSTRUCTION SITE IS REQUIRED OVER ENTRANCE(S) SHOWN HEREON, CONTRACTOR SHALL COORDINATE WITH THE ENGINEER THE LOCATION AND CONSTRUCTION DETAILS OF THESE ADDITIONAL ENTRANCES. USAGE OF NON-STABILIZED ENTRANCES WILL NOT BE PERMITTED.
 - DURING ALL SOIL DISTURBING ACTIVITIES, THE CONTRACTOR SHALL TAKE APPROPRIATE STEPS USING ACCEPTED CONSTRUCTION METHODS TO MINIMIZE THE TIME OF EXPOSURE OF UNPROTECTED SOIL AND OTHER CONSTRUCTION MATERIALS TO RAINFALL.
 - NO GROUND SHALL BE LEFT OPEN FOR MORE THAN 14 DAYS OF NON-ACTIVITY WITHOUT BEING MULCHED AND/OR SEEDED.
 - SOIL STOCKPILED FOR MORE THAN 7 DAYS SHALL HAVE SILT FENCE OR BALES PLACED ON THE DOWNHILL SLOPE TO TRAP SEDIMENT.
 - WHENEVER SOIL, ROCK, VEGETATION OR OTHER MATERIALS ARE EXPORTED FOR PLACEMENT IN AREAS OFF OF THE CONSTRUCTION SITE COVERED IN THIS PLAN, THE CONTRACTOR IS RESPONSIBLE FOR DETERMINING THAT EPA STORM WATER PERMITTING REQUIREMENTS ARE MET. PRIOR TO THE REMOVAL OF ANY MATERIALS FROM THE SITE THE CONTRACTOR SHALL FURNISH THE ENGINEER WITH WRITTEN AGREEMENT, SIGNED BY EACH LANDOWNER WHO WILL RECEIVE EXPORTED MATERIALS, STATING THAT THEY ACCEPT THE MATERIAL AND THAT RECEIVING SITE IS PROPERLY PERMITTED, WHEN REQUIRED.

[illegible]

EROSION & SEDIMENT CONTROL NOTES

**RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO**

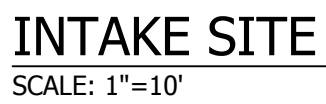


DESIGNED BY:	MKA
DRAWN BY:	MKA
APPROVED BY:	JAS
DESIGN PROJ:	17865.005
CONST PROJ:	----
SCALE:	AS NOTED
DATE:	OCT 2015

DRAWING NO:

SHEET NO: 9 of 114

Last edit on: 00/00/00

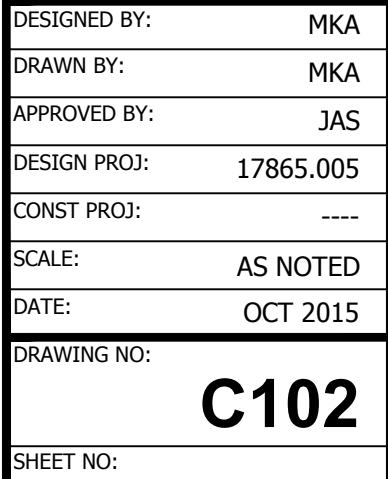


1. INSTALL EROSION FENCE AND OTHER BEST MANAGEMENT PRACTICES (BMP's) AT PLAN LOCATIONS AND OTHER AREAS AS REQUIRED TO CONTROL EROSION.

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**RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO**



Last edit on: 00/00/00



INSTALL EROSION FENCE

CONTROL

—INSTALL EROSION FENCE

BOOSTER STATION SITE

SCALE: 1"=20'



1. INSTALL EROSION FENCE AND OTHER BEST MANAGEMENT PRACTICES (BMP's) AT PLAN LOCATIONS AND OTHER AREAS AS REQUIRED TO CONTROL EROSION.

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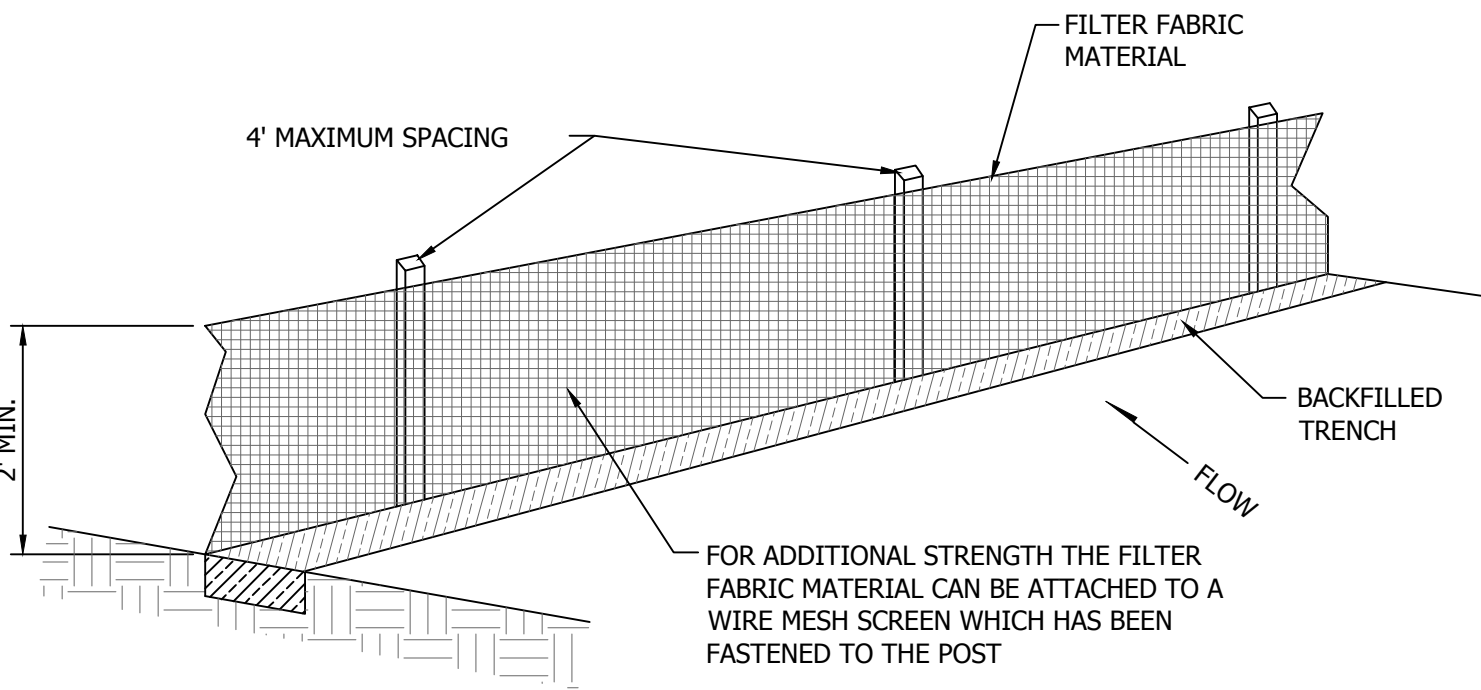
190 TALISMAN DR, UNIT D-1 PAGOSA SPRINGS, CO 81147
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**RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO**



DESIGNED BY:	MKA
DRAWN BY:	MKA
APPROVED BY:	JAS
DESIGN PROJ:	17865.005
CONST PROJ:	----
SCALE:	AS NOTED
DATE:	OCT 2015
DRAWING NO:	C103
SHEET NO:	

Drawing Name: W:\Proj\17000\17865\17865.005\AutoCad_Raw Water Project\02 Civil\17865.005 Erosion & Sediment Details.dwg Layout Name: C105 EROSION & SEDIMENT CONTROL DETAILS Plotted on: 10/12/2015 10:20:53 AM
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EROSION FENCE DETAIL
SCALE: NTS

1
C104

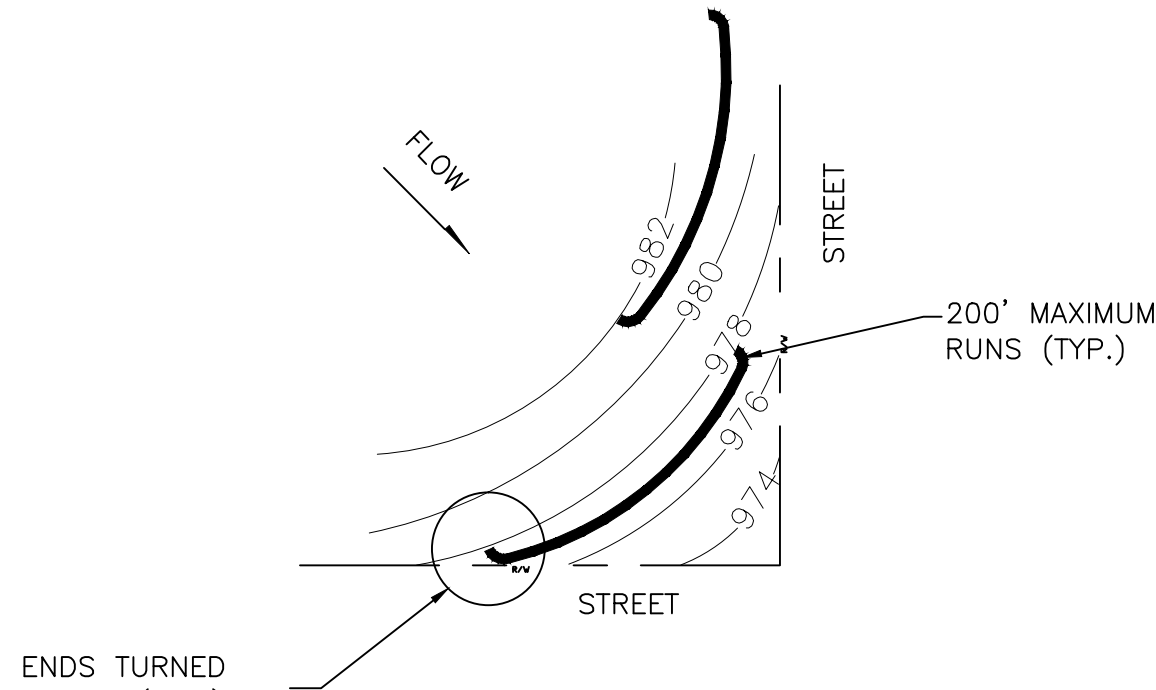


FIGURE A

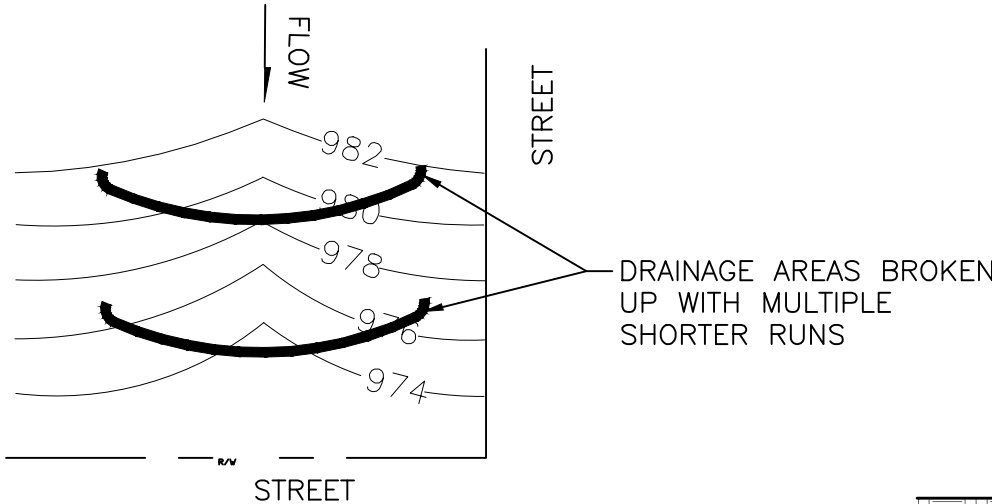


FIGURE B

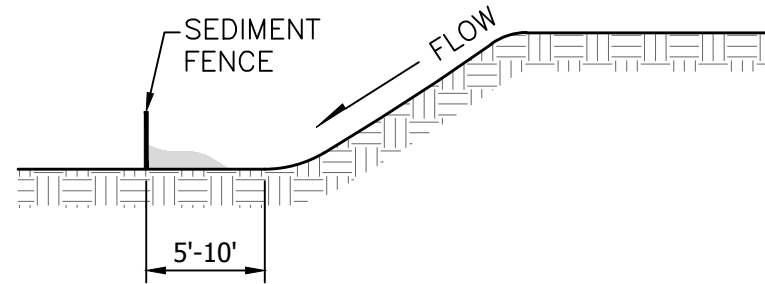
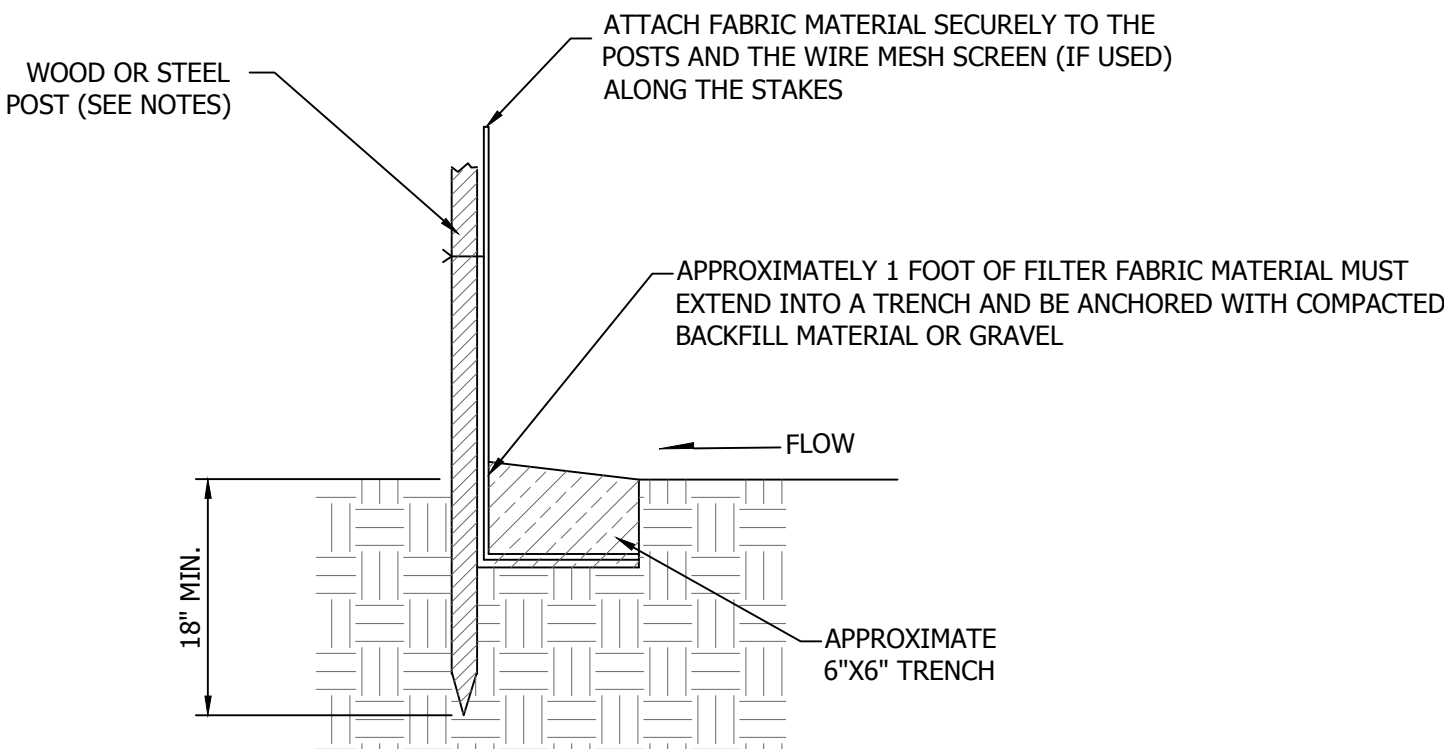


FIGURE C

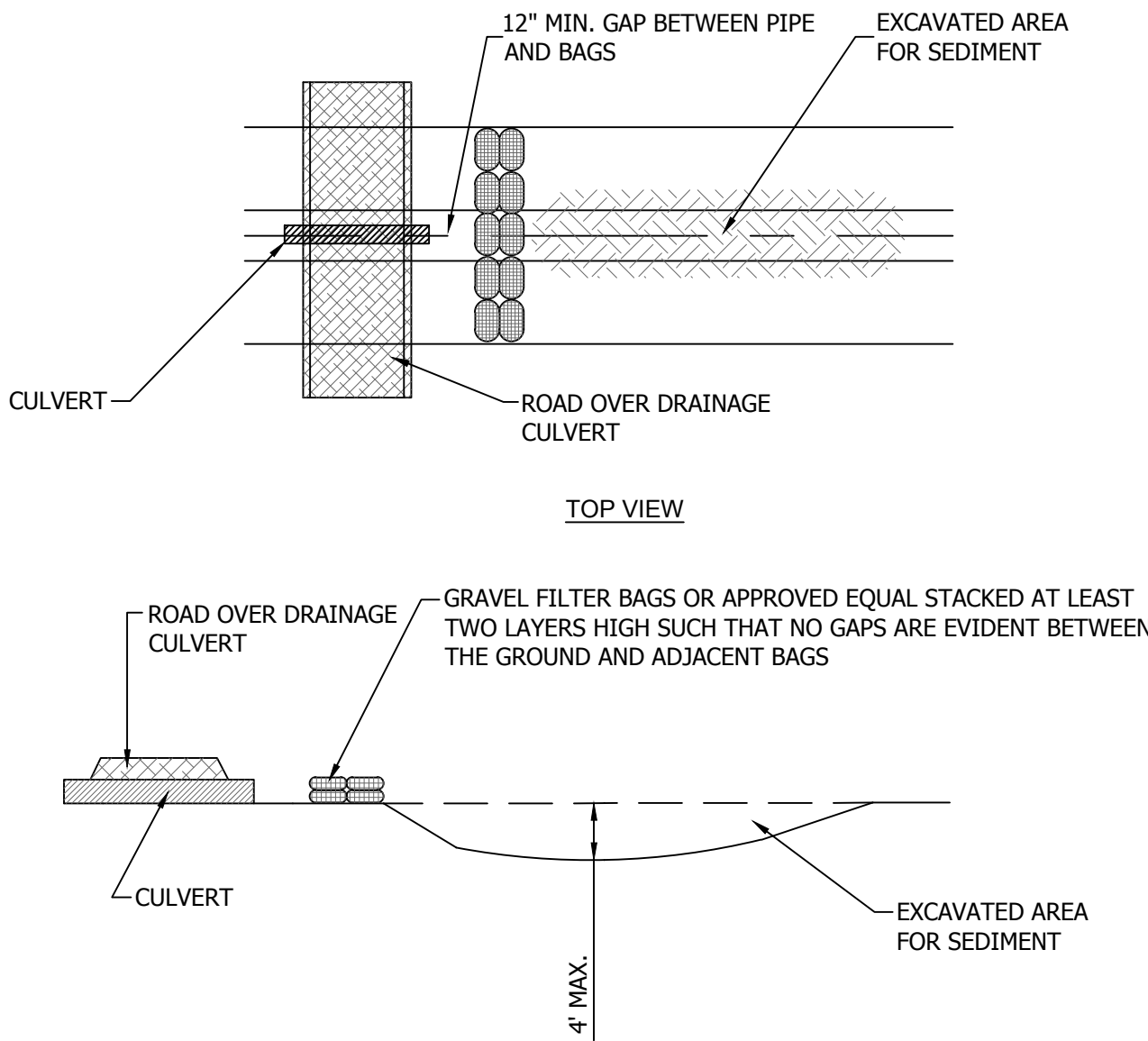
EROSION FENCE LAYOUT
SCALE: NTS

2
C104



EROSION FENCE SECTION
SCALE: NTS

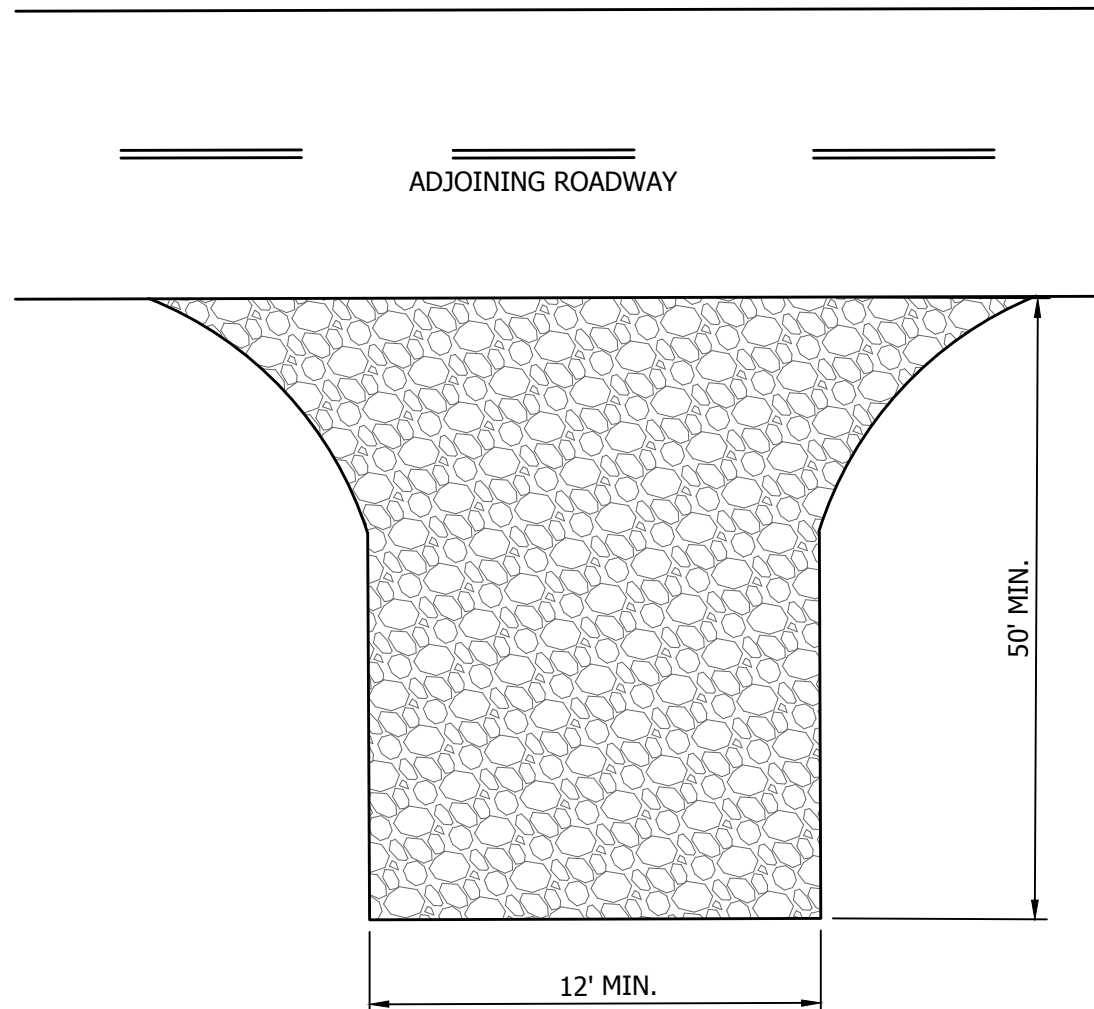
3
C104



- NOTES:
- GRAVEL FILTER BAGS SHALL BE 24 INCHES LONG, 12 INCHES WIDE AND 6 INCHES HIGH FILLED WITH COARSE AGGREGATE BETWEEN 1/2"-1" DIA.
 - WHEN SEDIMENT FILLS THE AREA BEHIND THE SILT FENCE TO 1/2 THE HEIGHT OF THE SILT FENCE, THE CONTRACTOR SHALL REMOVE THE SEDIMENT.
 - SIZE OF THE BASIN SHALL CONFORM TO DESIGN.

SEDIMENT TRAP
SCALE: NTS

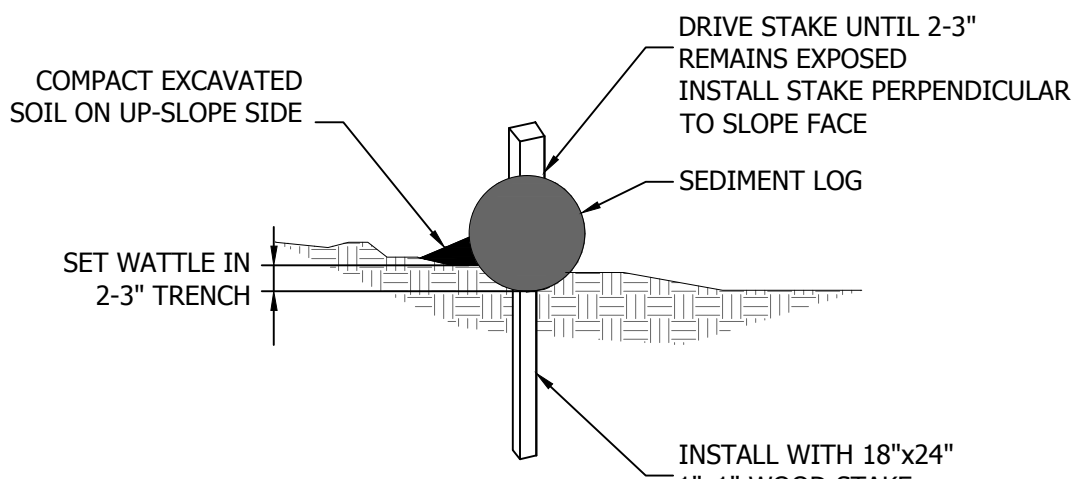
4
C104



- NOTES:
- GEOTEXTILE FABRIC MAY BE USED AS AN UNDERLINER IN WET CONDITIONS TO PROVIDE STABILITY.
 - TURNING RADIUS SUFFICIENT TO ACCOMMODATE LARGE TRUCKS IS TO BE PROVIDED.
 - MUST BE MAINTAINED IN A CONDITION WHICH WILL PREVENT TRACKING OR DIRECT FLOW OF SEDIMENT ON TO STREETS.
 - INSTALL AT ALL CONSTRUCTION ACCESS POINTS.

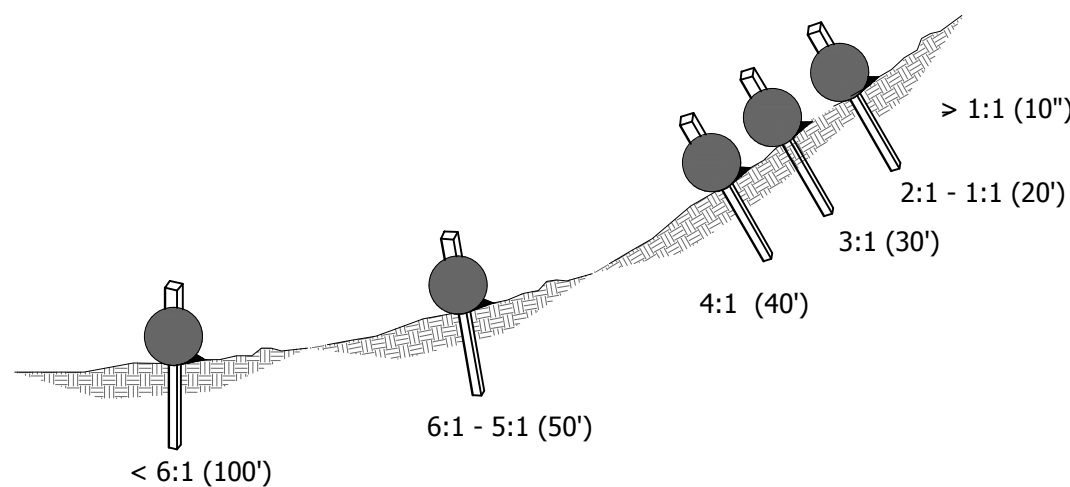
CONSTRUCTION ENTRANCE
SCALE: NTS

5
C104



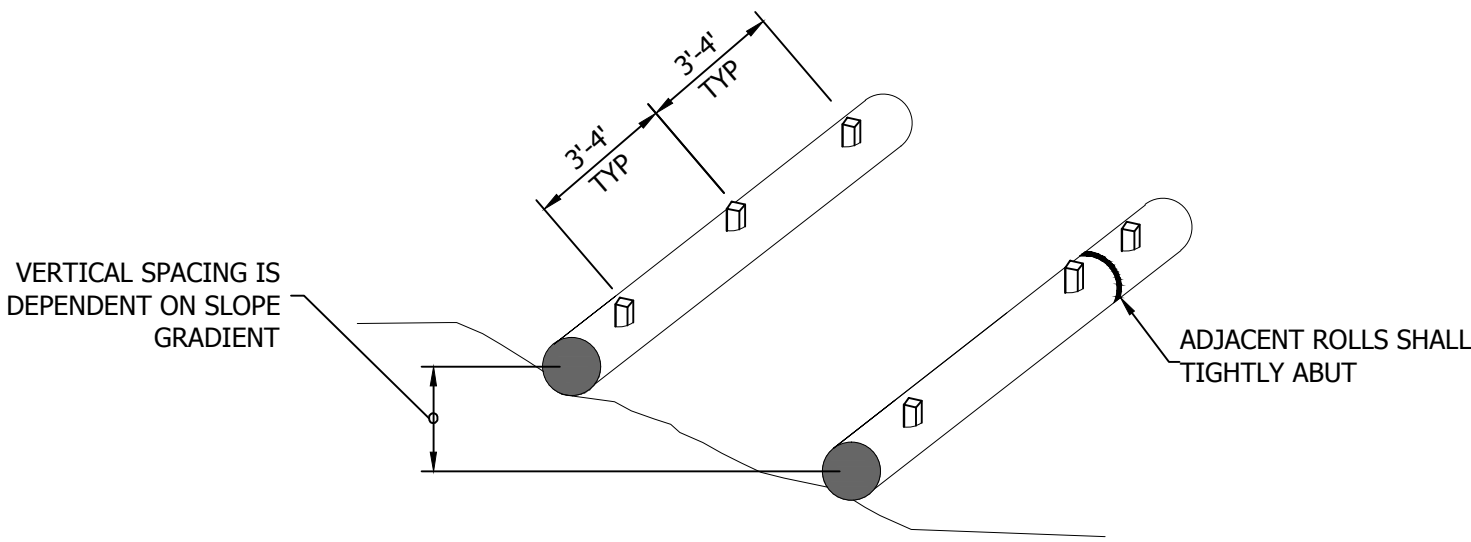
ENTRENCHMENT DETAIL
SCALE: NTS

6
C104



SILT FENCE/ SEDIMENT LOG
SCALE: NTS

7
C104



BIODEGRADABLE SEDIMENT/EROSION LOG INSTALLATION
SCALE: NTS

8
C104

GENERAL NOTES

- THE USE OF HAY/STRAW BALES OR BIODEGRADABLE SEDIMENT/EROSION LOGS IS THE CONTRACTORS OPTION. IF HAY BALES ARE USED PLACE TIGHTLY TOGETHER AND WOOD STAKED IN CENTER OF BALES WITH 2"x2"x4' (MIN) LENGTH STAKES. BALES SHOULD EMBEDDED INTO THE SOIL A MINIMUM OF 6".
- THE SEDIMENT FENCES SHALL BE PLACED ALONG CONTOUR LINES, WITH A SHORT SECTION TURNED UPGRADE AT EACH END OF THE BARRIER TO HOLD WATER AND SEDIMENT (SEE FIGURE A).
- AREAS THAT CONTAIN LARGER CONCENTRATIONS OF WATER SHALL LIMIT LENGTHS OF SILT FENCES TO NO LONGER THAN 200 FOOT LENGTHS (SEE FIGURE A).
- AREAS SHOULD BE BROKEN UP WITH INTERIOR SEDIMENT FENCE TO MINIMIZE WATER CONCENTRATIONS AND LONG SLOPES (SEE FIGURE B).
- SEDIMENT FENCES INSTALLED AT TOE OF SLOPES SHALL BE PLACED 5 FEET TO 10 FEET AWAY (DOWNSTREAM) TO CREATE SEDIMENT STORAGE (SEE FIGURE C).
- DEPTH OF WATER CONCENTRATIONS SHOULD NOT EXCEED 1.5 FEET AT ANY POINT ALONG THE FENCE.
- INSTALL AND MAINTAIN SEDIMENT/EROSION NPDES GUIDELINES.

EROSION CONTROL NOTES

- THE CONTRACTOR SHALL PROVIDE ALL MATERIALS, TOOLS, EQUIPMENT AND LABOR AS NECESSARY TO INSTALL AND MAINTAIN ADEQUATE EROSION CONTROL TO PREVENT SOIL FROM LEAVING THE PROJECT SITE. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO INSURE THAT THE METHODS UTILIZED COMPLY WITH THE REQUIREMENTS OF THE GOVERNMENTAL AGENCIES HAVING JURISDICTION OVER THE WORK.
- THE CONTRACTOR SHALL CONTROL THE GRADING OPERATION SO THAT THE SITE IS WELL DRAINED AT ALL TIMES AND SHALL SCHEDULE THE WORK TO MINIMIZE THE EROSION OF MATERIAL BY THE USE OF STAKED STRAW BALES AND OTHER ACCEPTABLE METHODS TO PROTECT THE ABUTTING PROPERTIES, STREETS, AND ALL UTILITIES.
- EROSION CONTROL DEVICES SHALL REMAIN IN PLACE FOR THE DURATION OF THE PROJECT.
- THE CONTRACTOR SHALL SEED/MULCH AND OR SOD ALL AREAS DISTURBED DURING THE CONSTRUCTION ACTIVITIES.

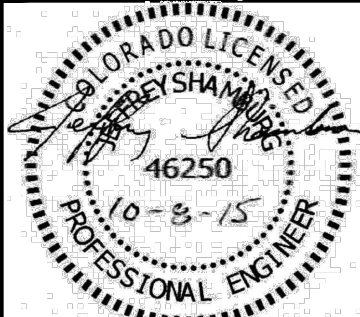
CONSTRUCTION NOTES

- WOOD/STEEL POSTS WHICH SUPPORT THE SILT FENCE SHALL BE INSTALLED ON A SLIGHT ANGLE TOWARD THE ANTICIPATED RUNOFF SOURCE.
- SILT FENCE SHALL BE TRENCHED IN WITH A SPADE OR MECHANICAL TRENCHER SO THAT THE DOWN SLOPING FACE OF THE TRENCH IS FLAT AND PERPENDICULAR TO THE LINE OF FLOW.
- THE TRENCH SHOULD BE A MINIMUM OF 6" DEEP AND 6" WIDE TO ALLOW FOR THE SILT FENCE TO BE LAID IN THE GROUND AND BACKFILLED.
- SILT FENCE SHOULD BE SECURELY FASTENED TO EACH WOOD/STEEL SUPPORT POST OR TO WOVEN WIRE WHICH IS IN TURN ATTACHED TO THE WOOD/STEEL POSTS.
- INSPECTION SHALL BE FREQUENT AND REPAIR OR REPLACEMENT SHALL BE MADE PROMPTLY AS NEEDED.
- SILT FENCE SHALL BE REMOVED WHEN IT HAS SERVED ITS USEFULNESS SO AS NOT TO BLOCK OR IMPEDE STORM FLOW OR DRAINAGE.
- SEDIMENT TRAPPED BY THIS PRACTICE SHALL BE UNIFORMLY DISTRIBUTED ON THE SOURCE AREA PRIOR TO TOP SOILING.
- THE EROSION CONTROL SHOWN SHALL BE SILT FENCE. ADDITIONAL EROSION CONTROL PROVIDED BY CONTRACTOR MAY BE STRAW BALE DIKE.

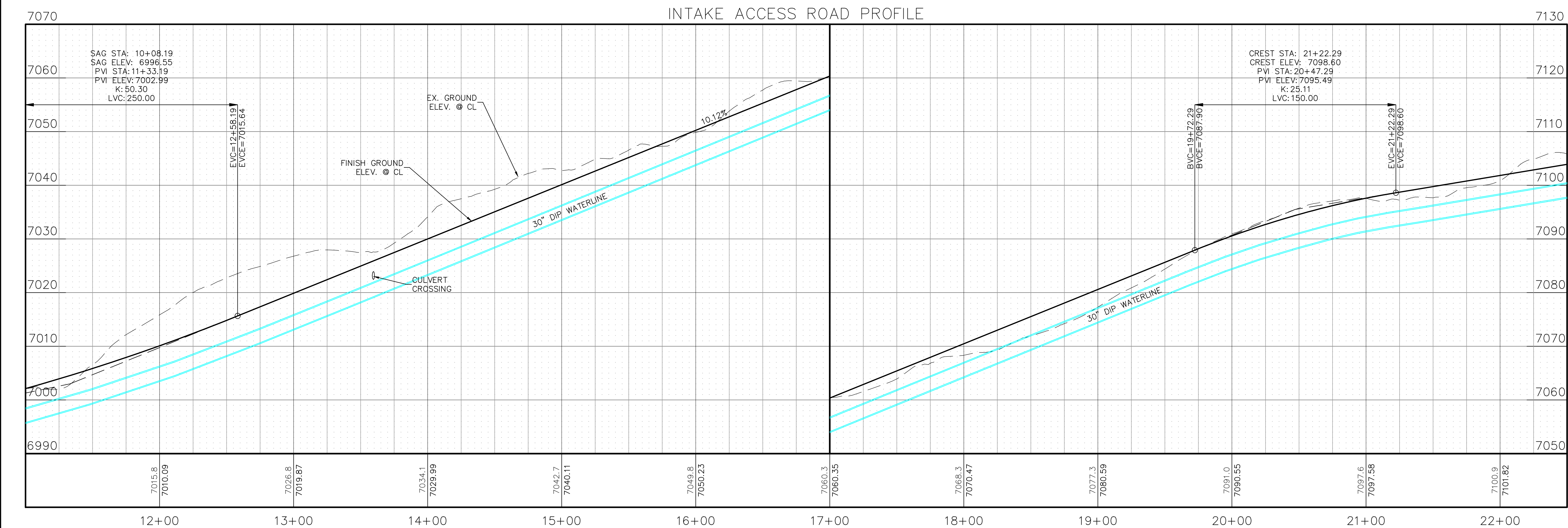
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EROSION & SEDIMENT CONTROL DETAILS

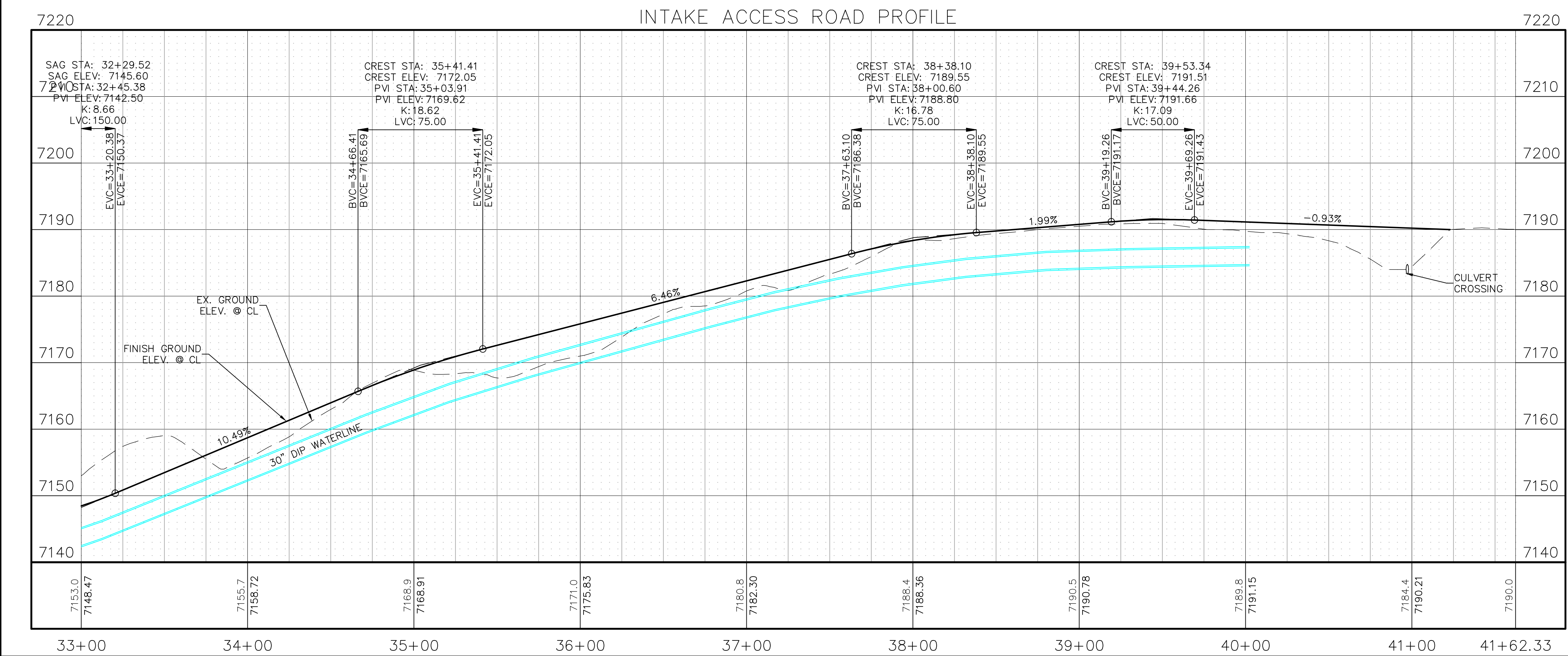
RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO



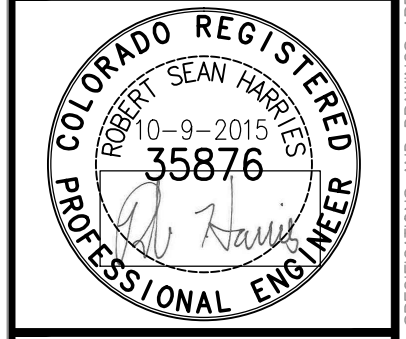
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DATE:	OCT 2015
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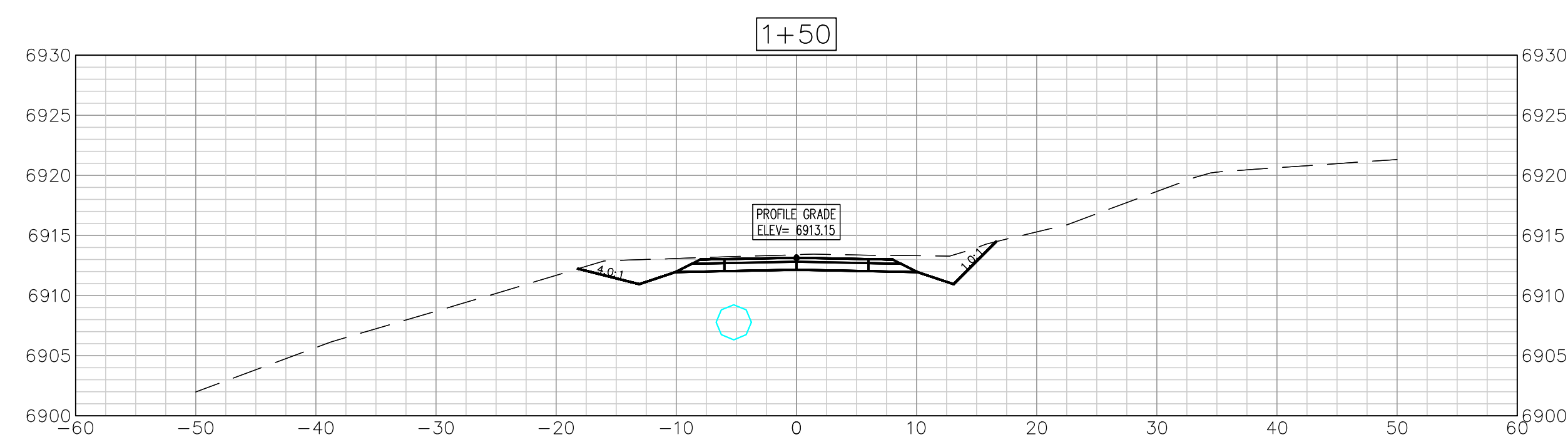
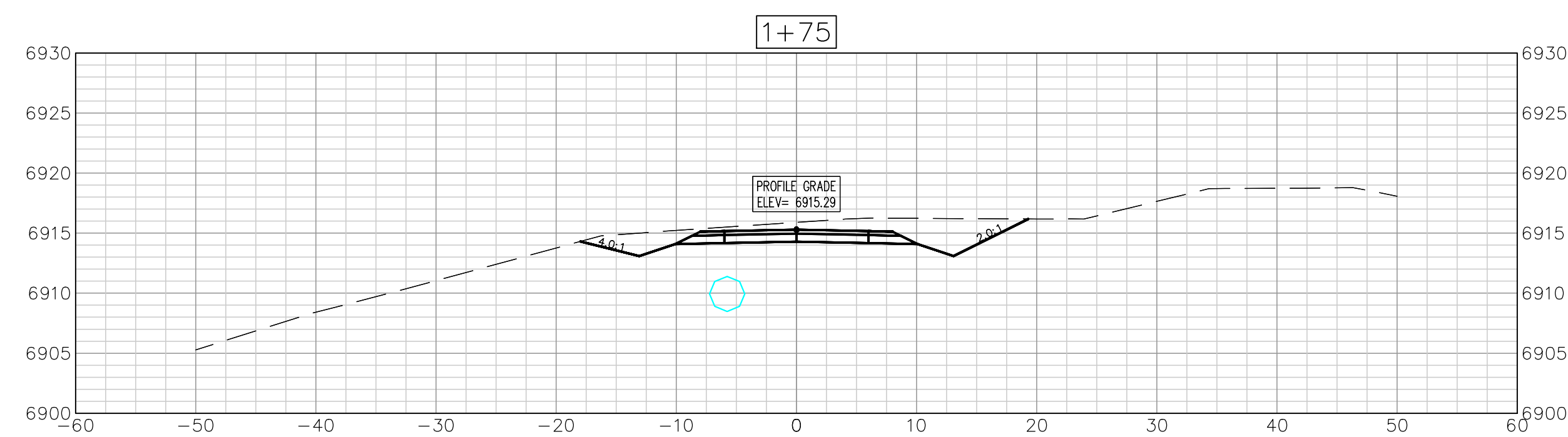
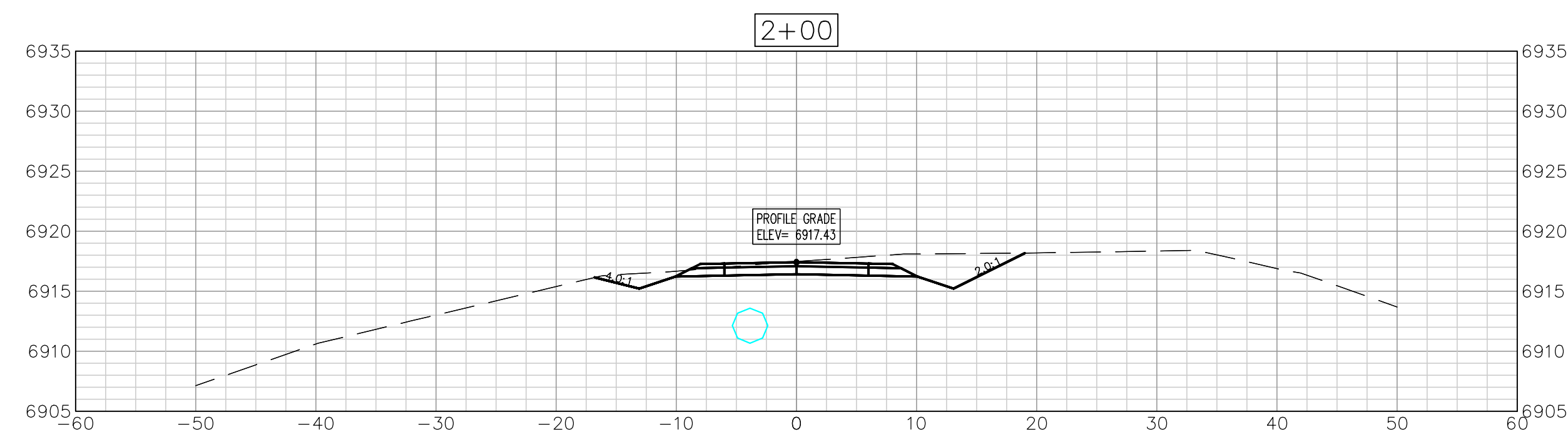
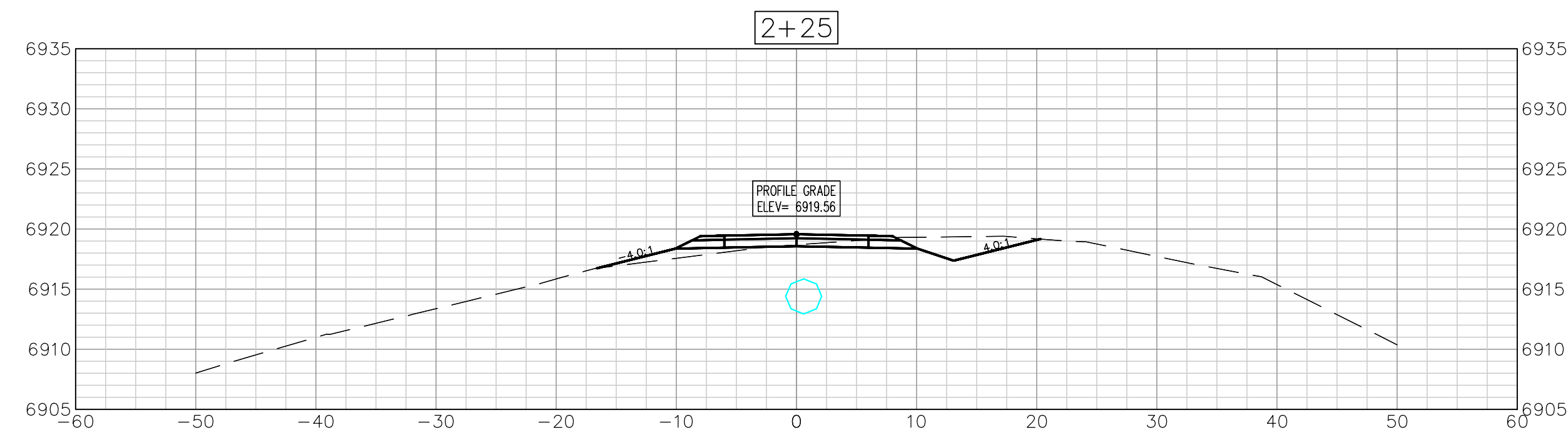
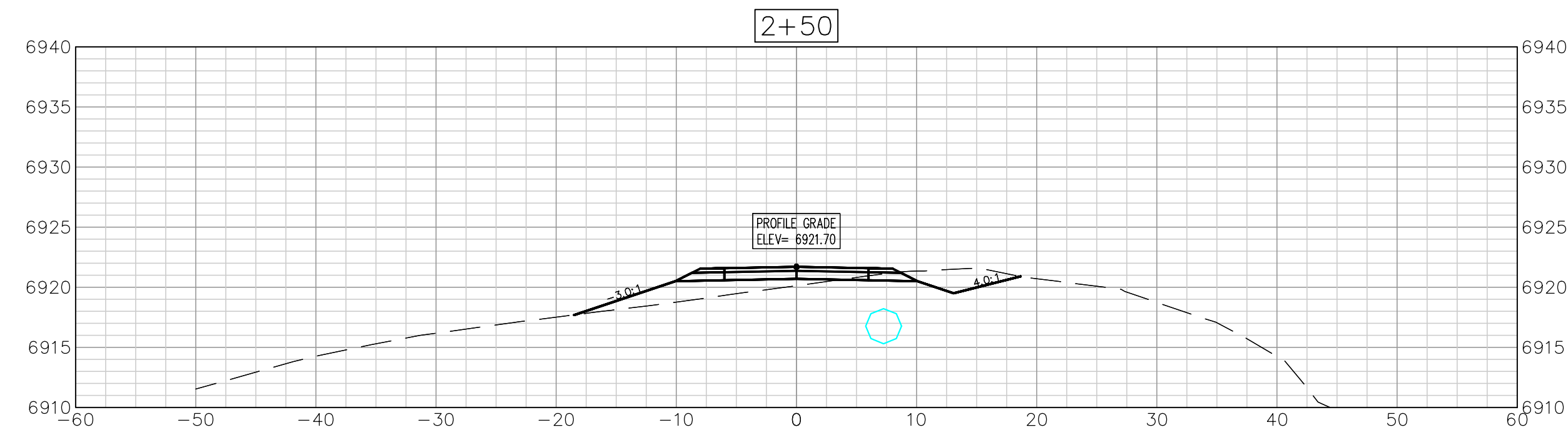
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APPROVED BY:	RSH		
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**INTAKE ACCESS ROADWAY
ROADWAY PLAN & PROFILE**



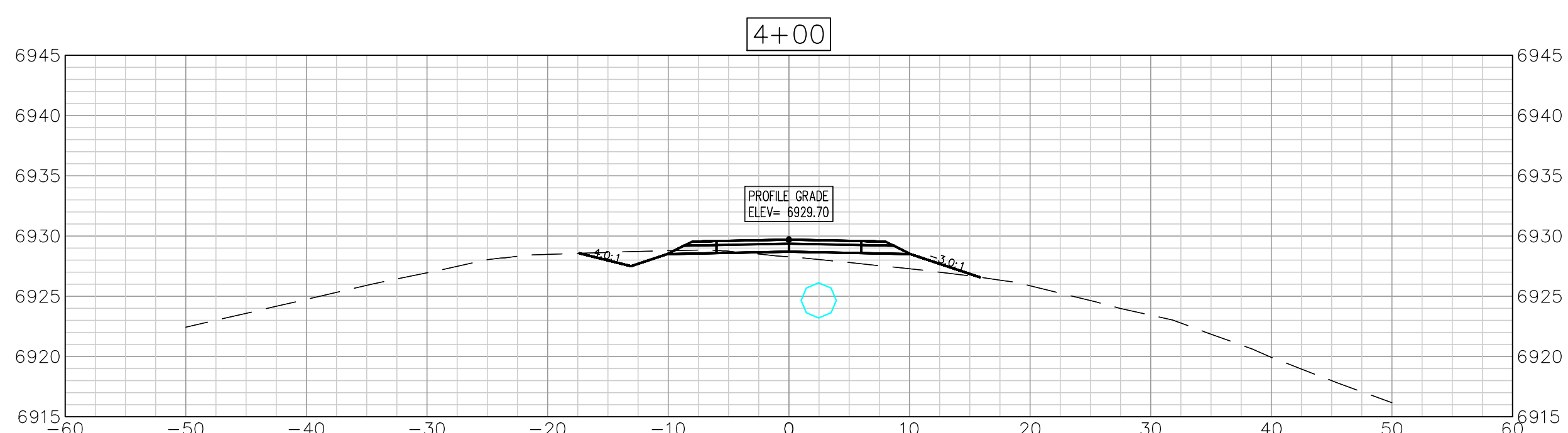
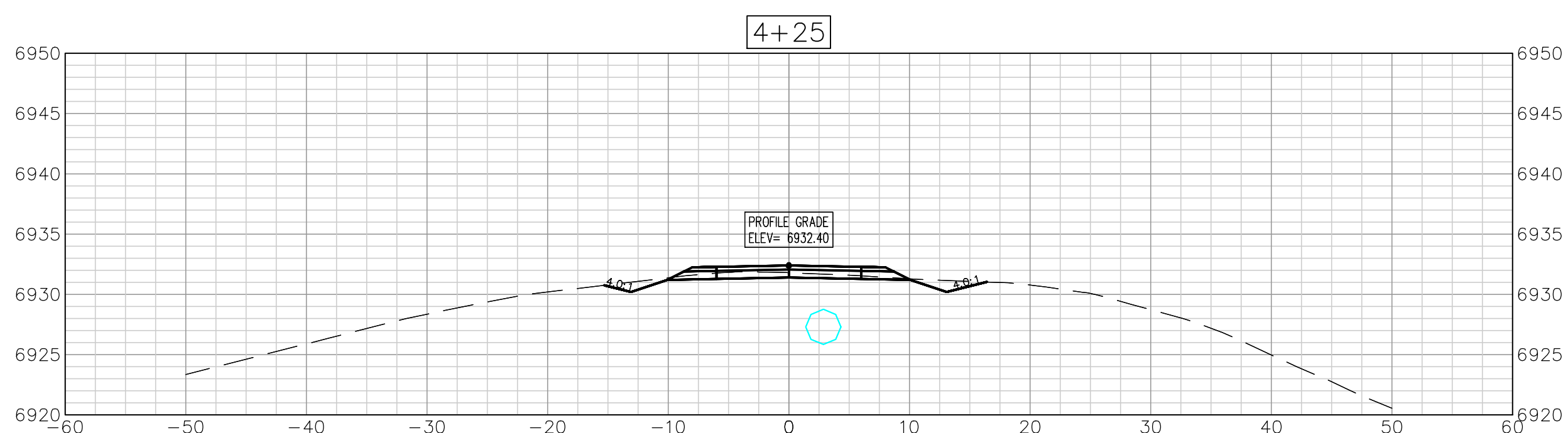
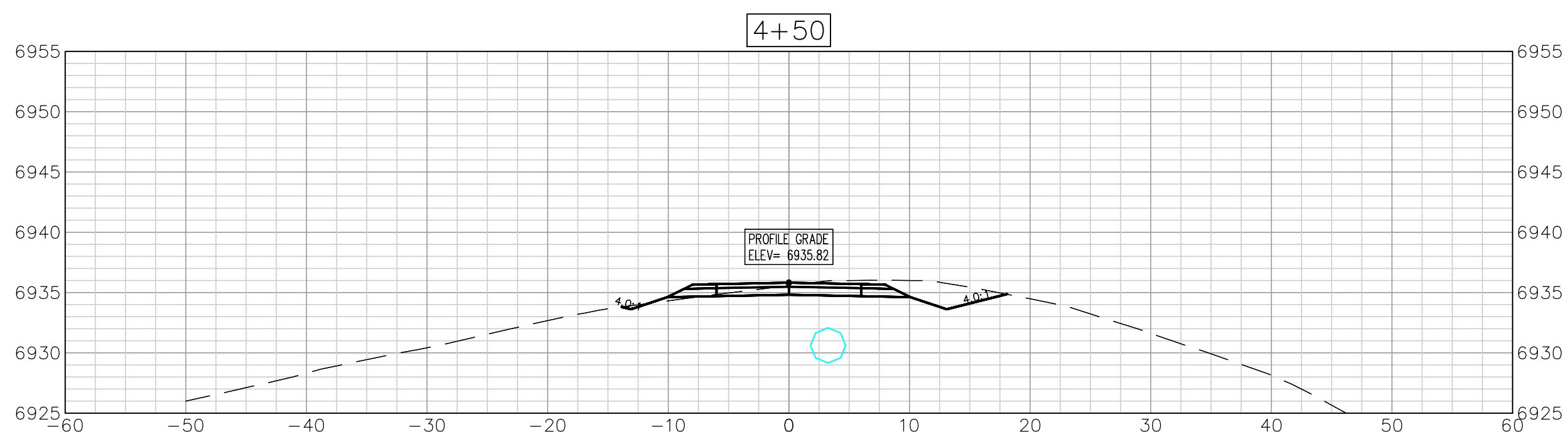
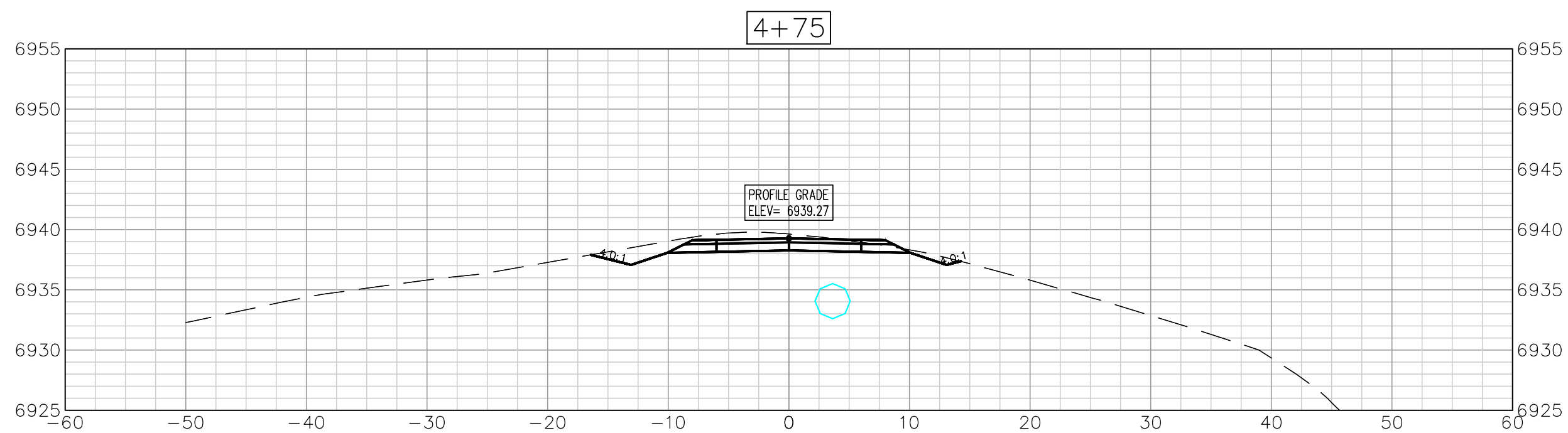
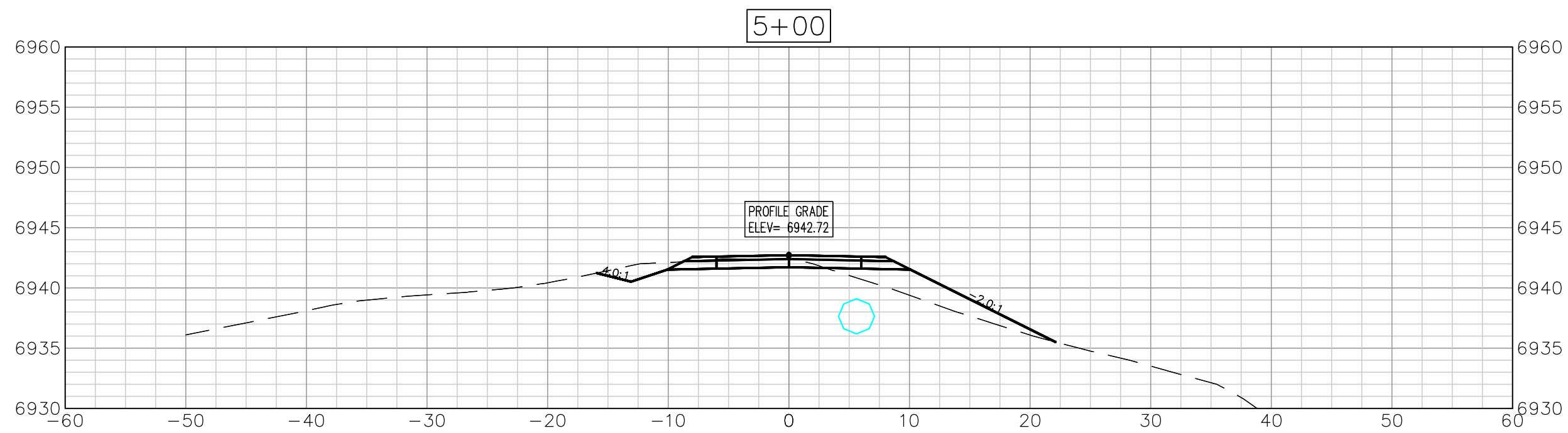
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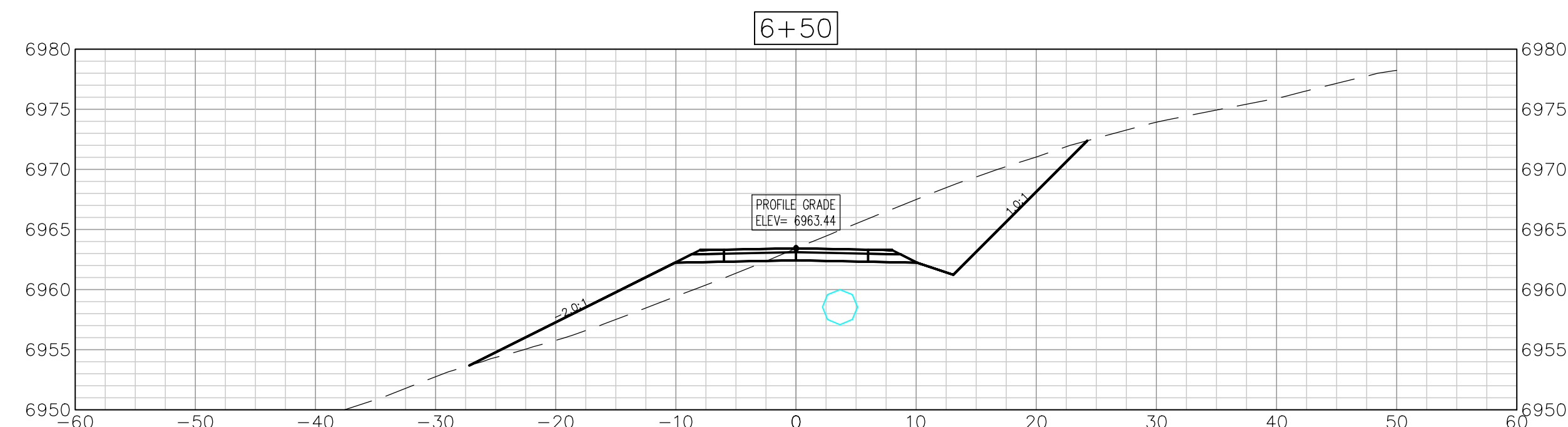
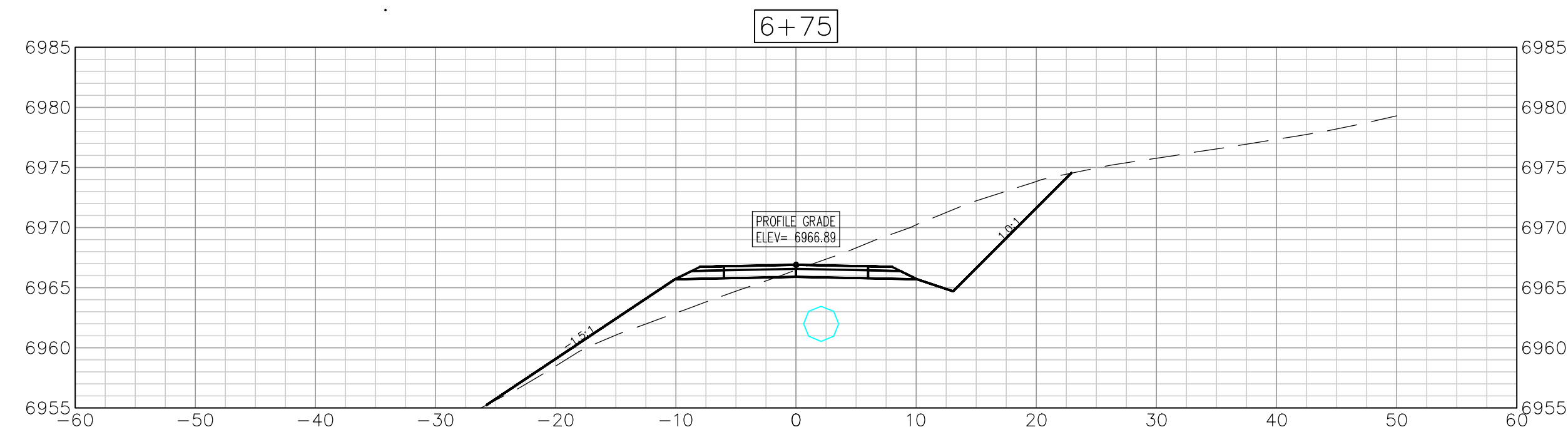
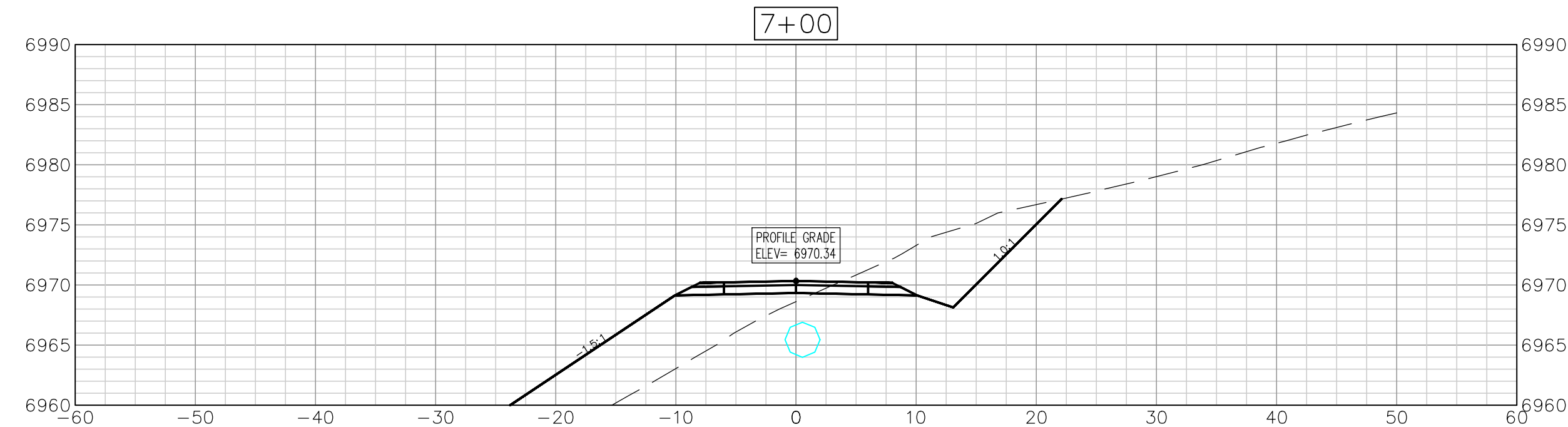
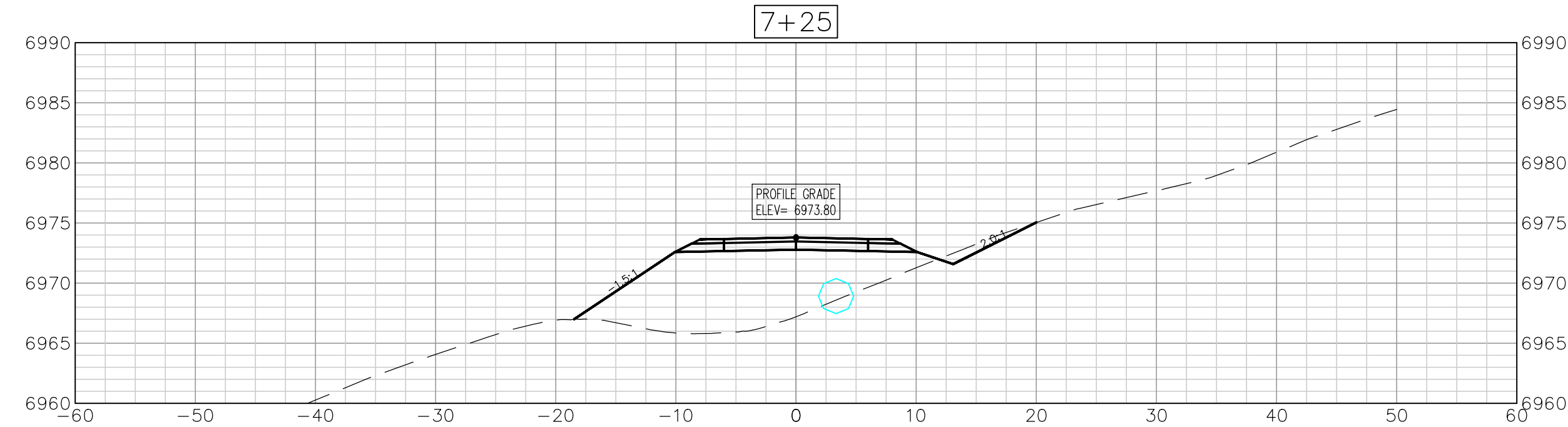
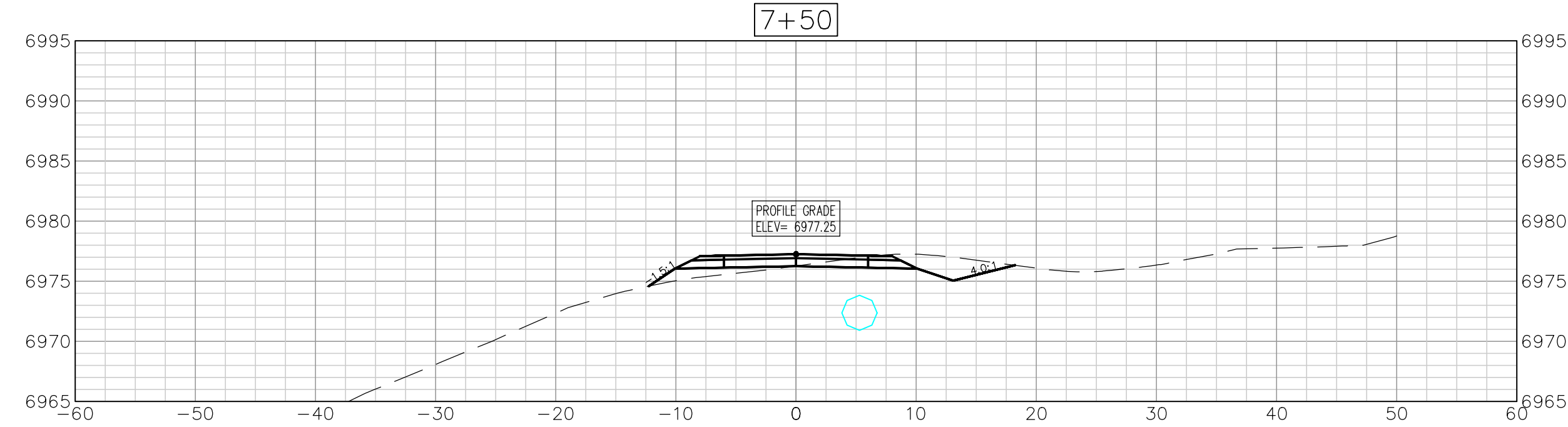
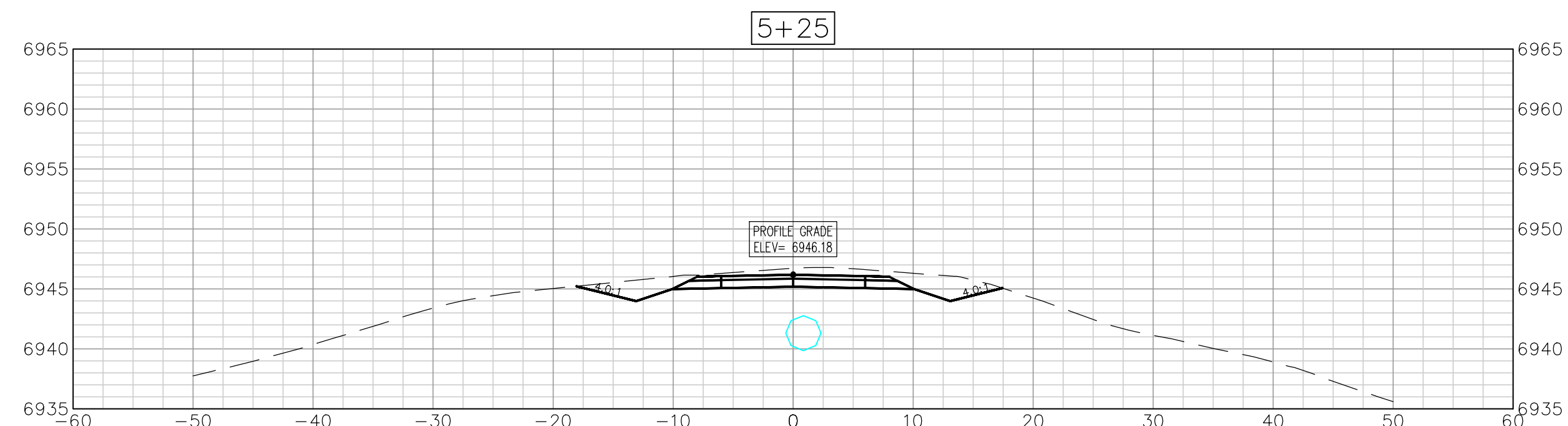
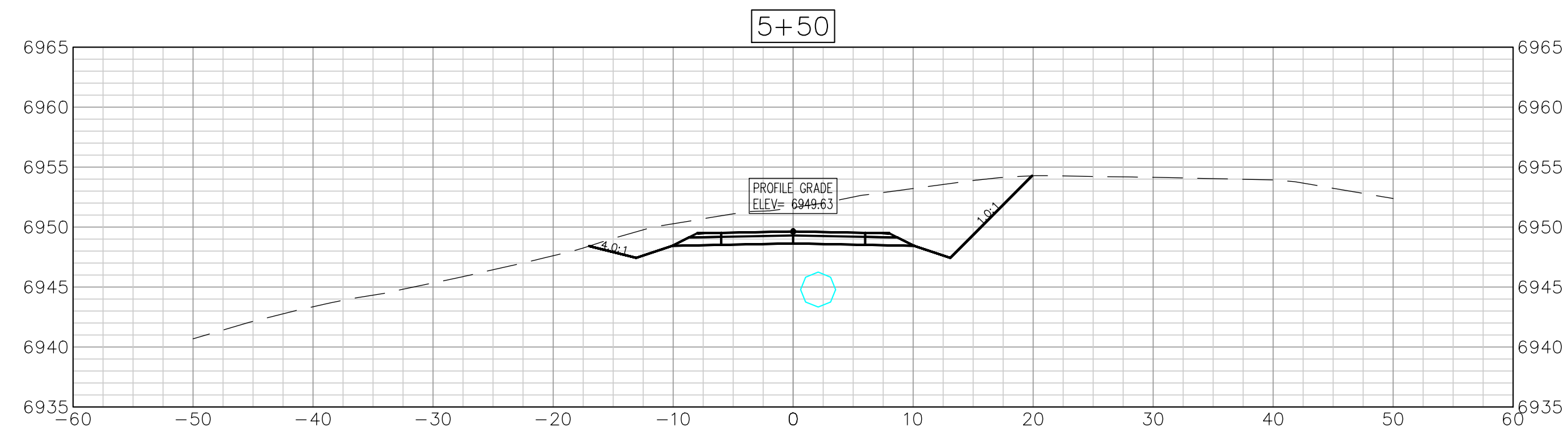
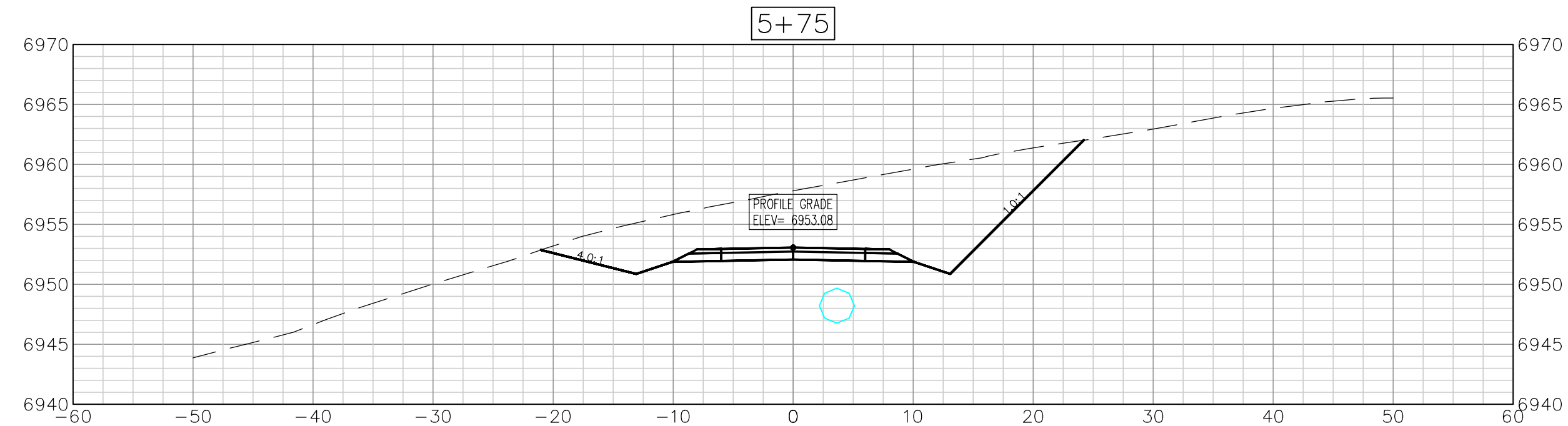
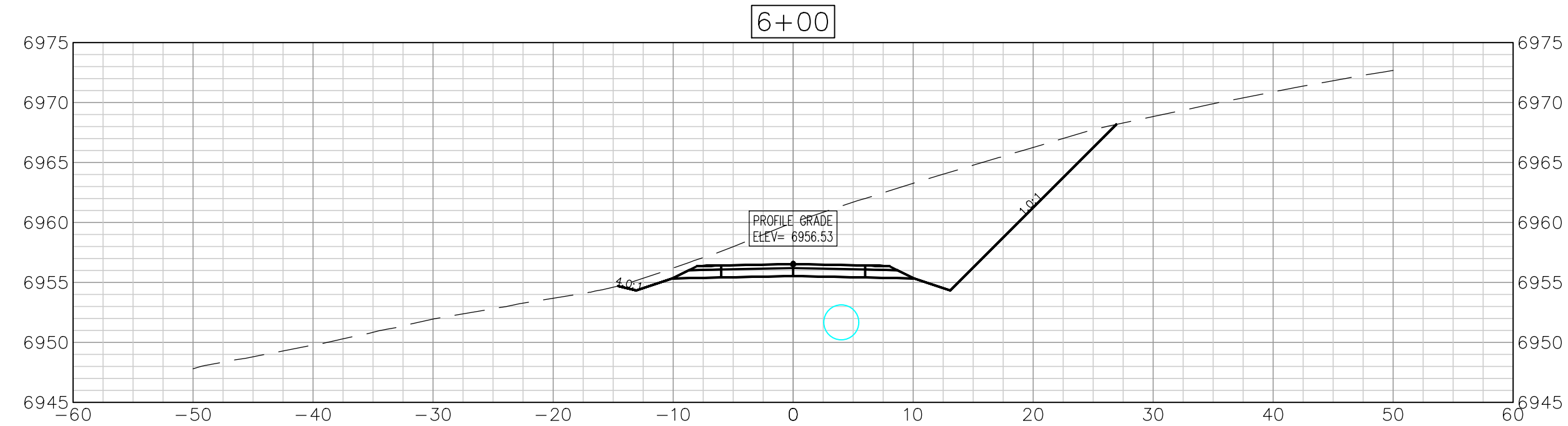
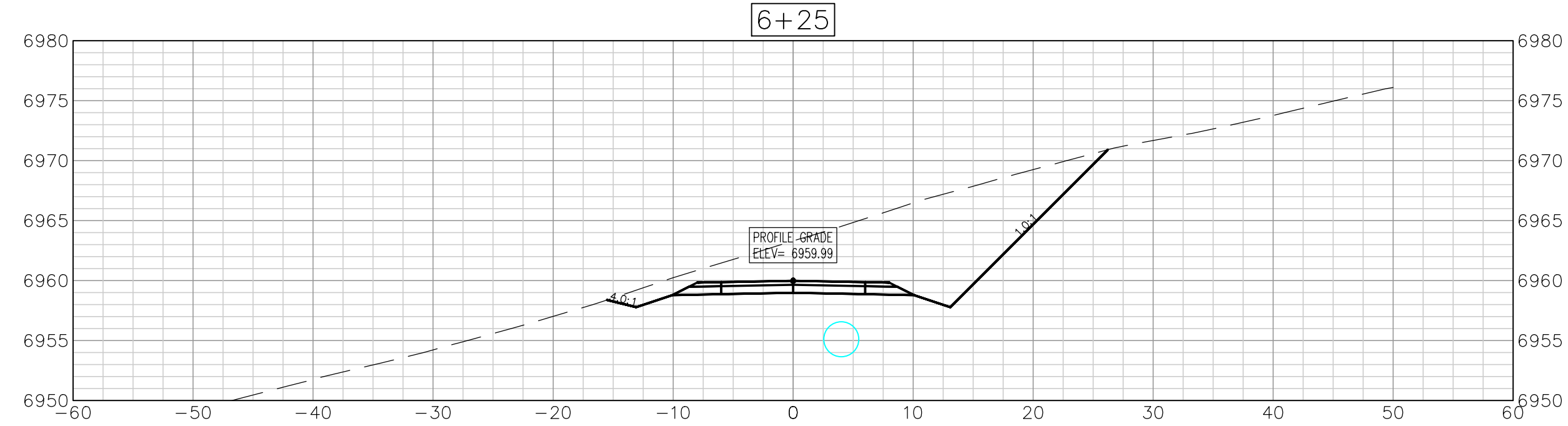
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RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO

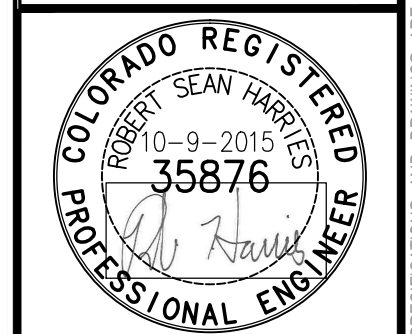


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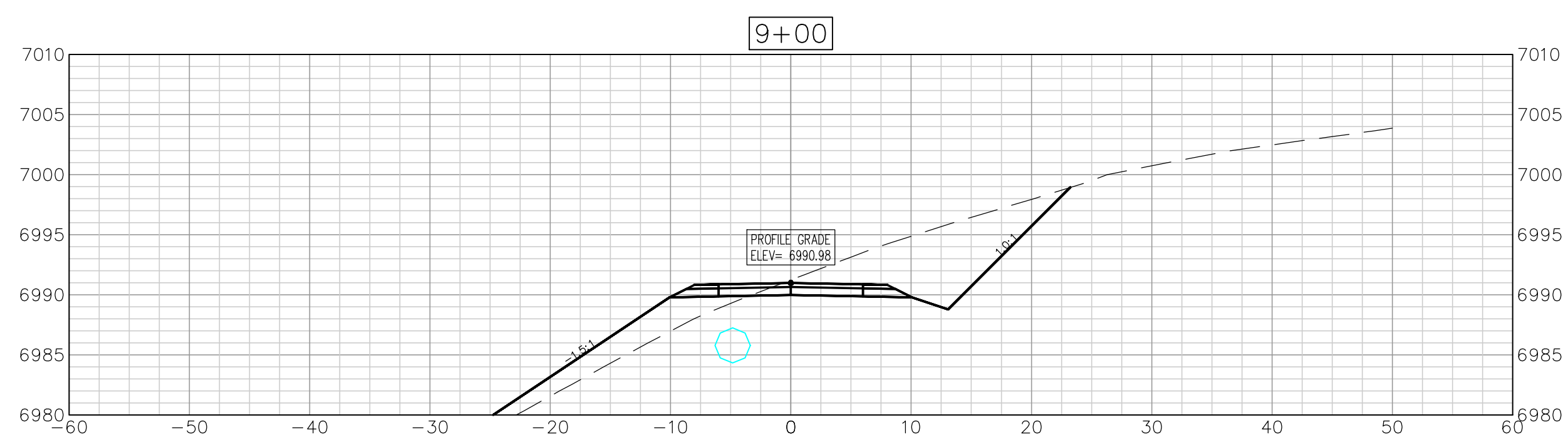
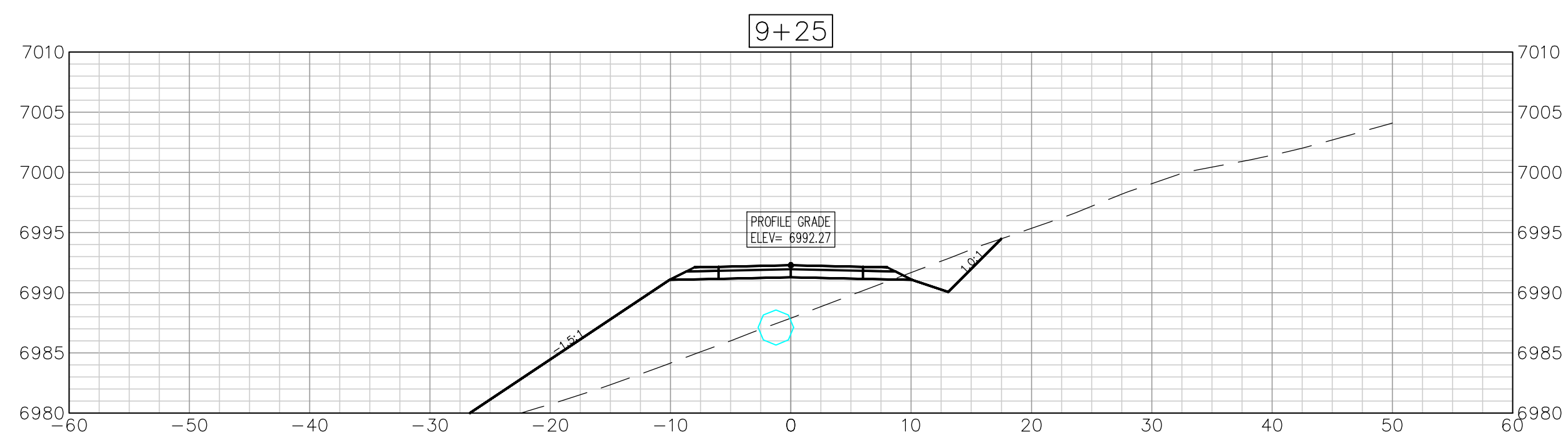
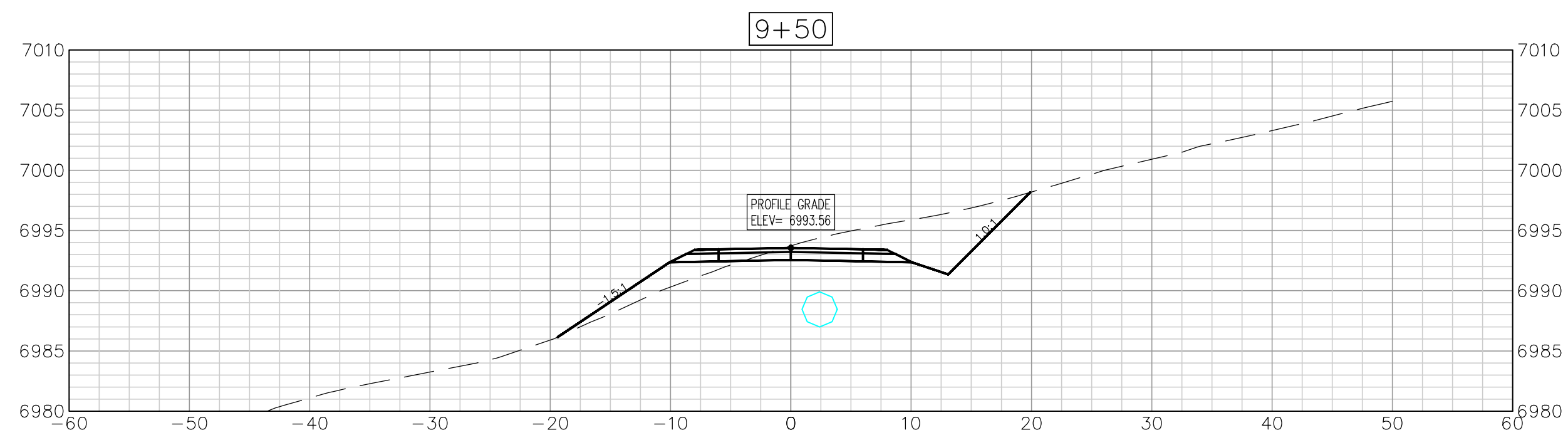
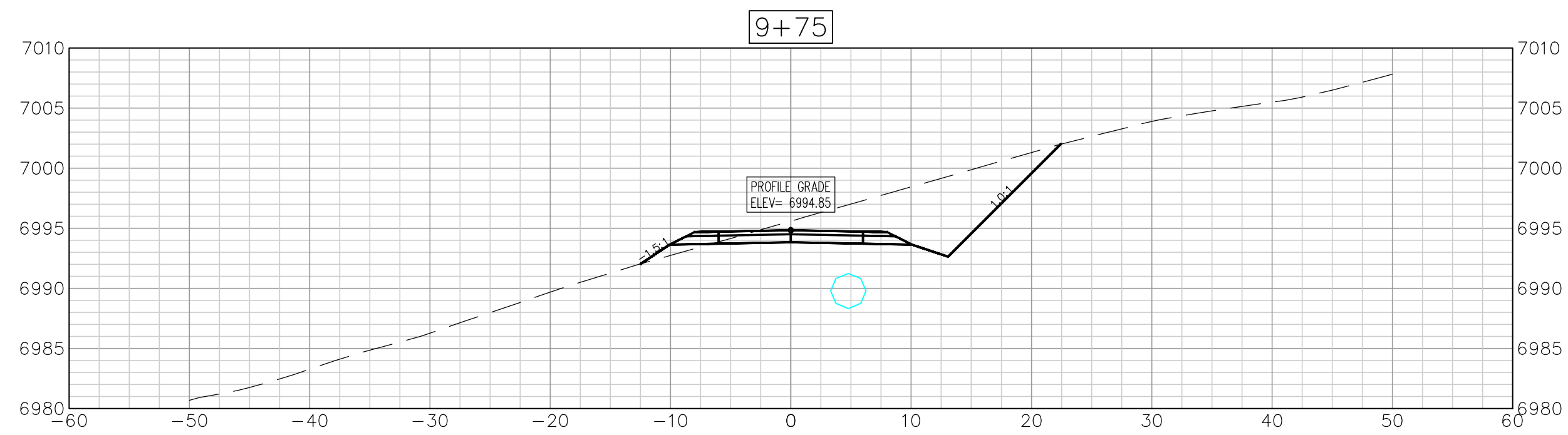
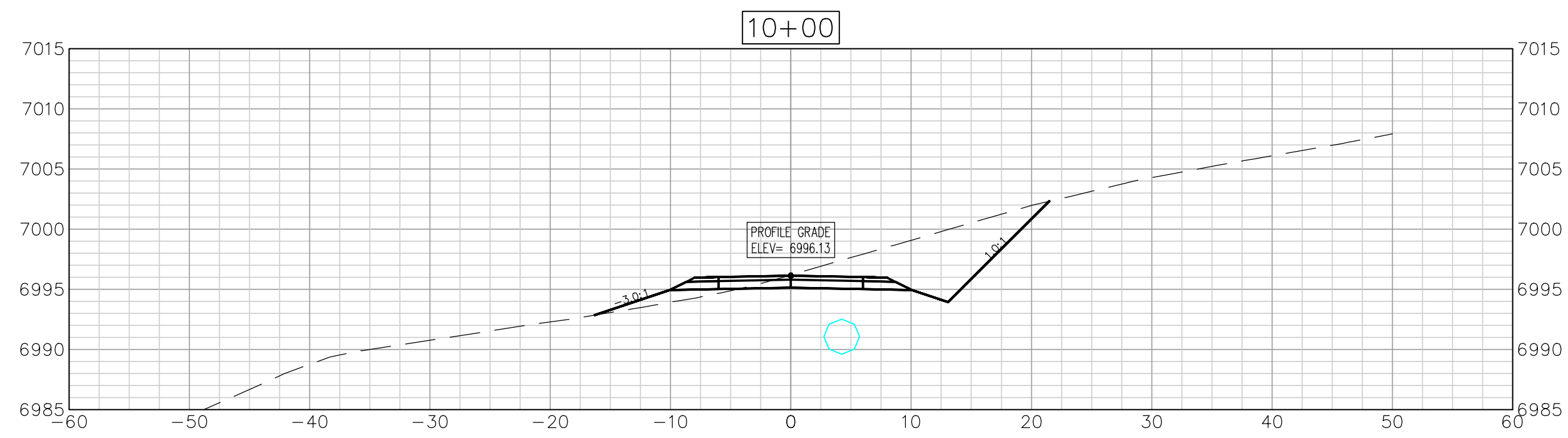
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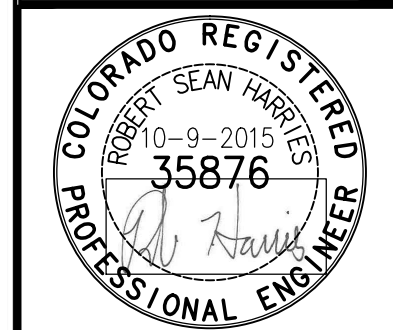
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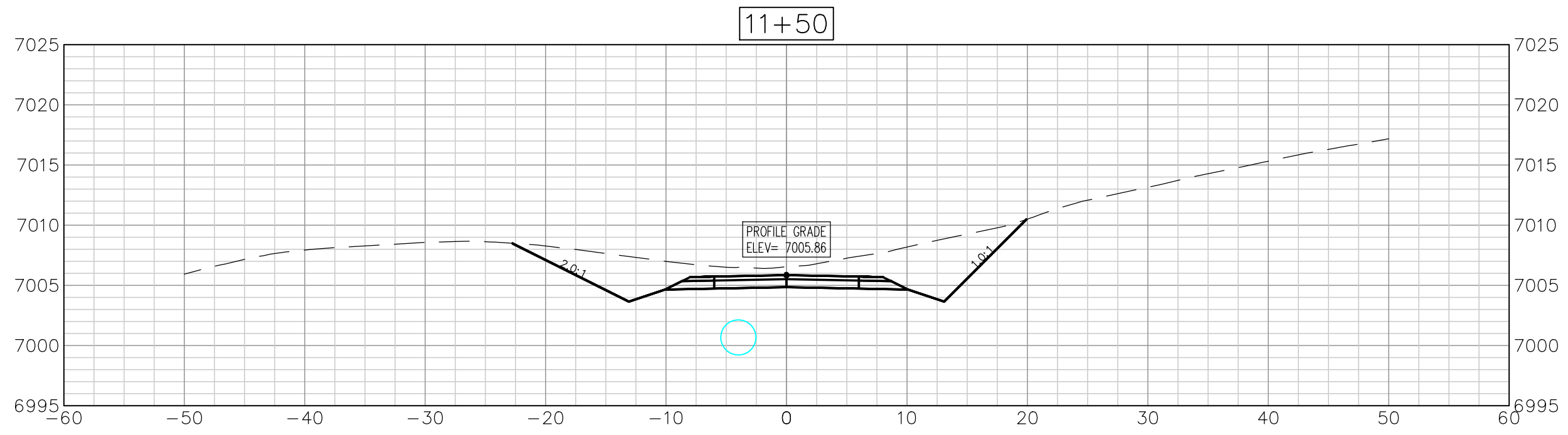
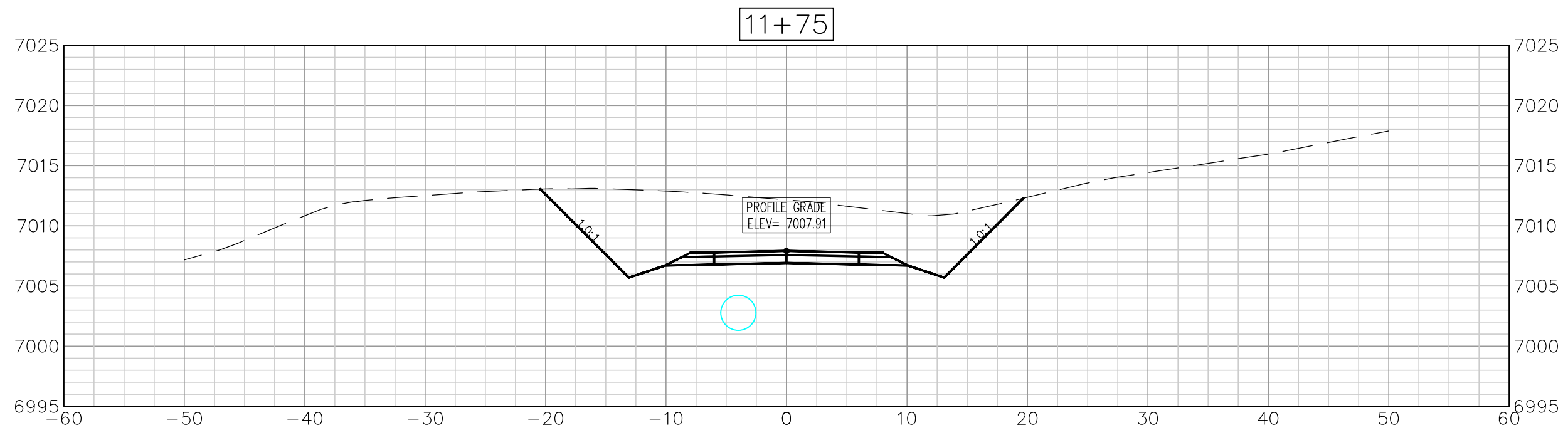
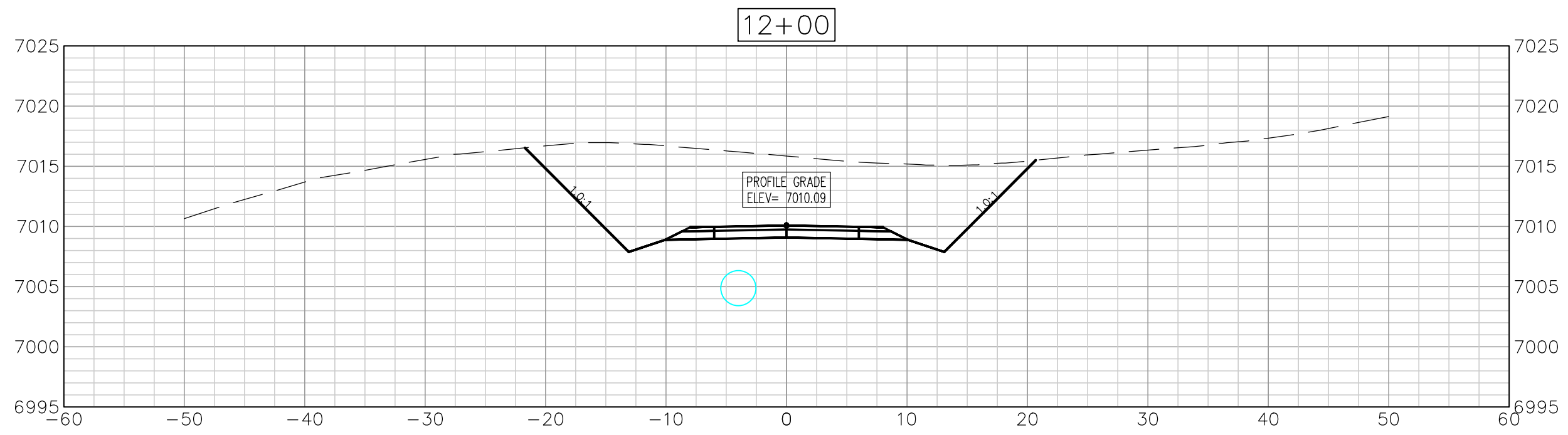
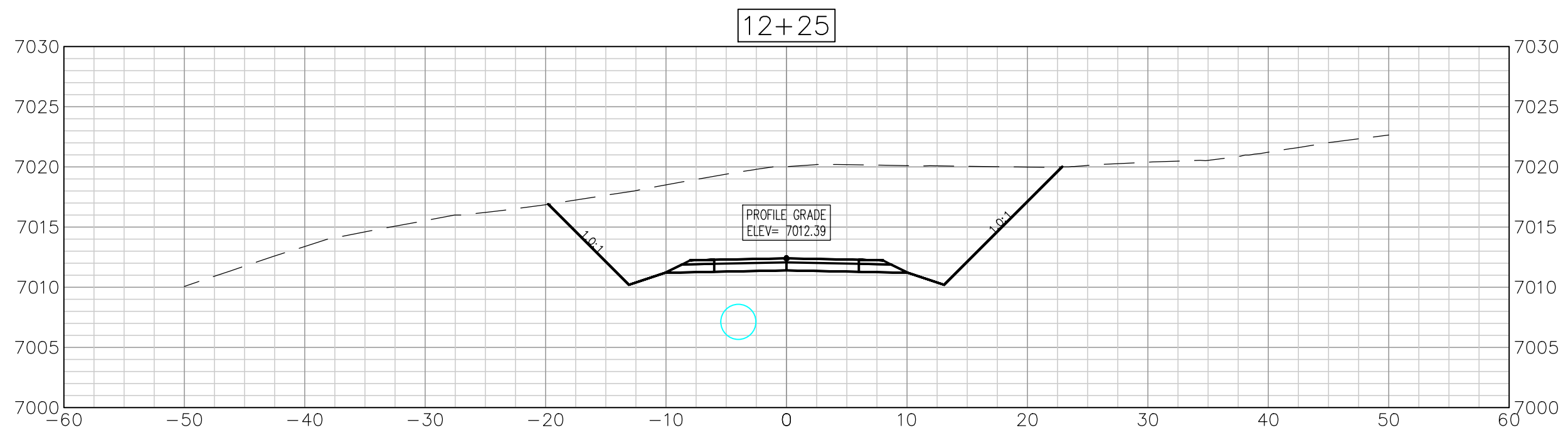
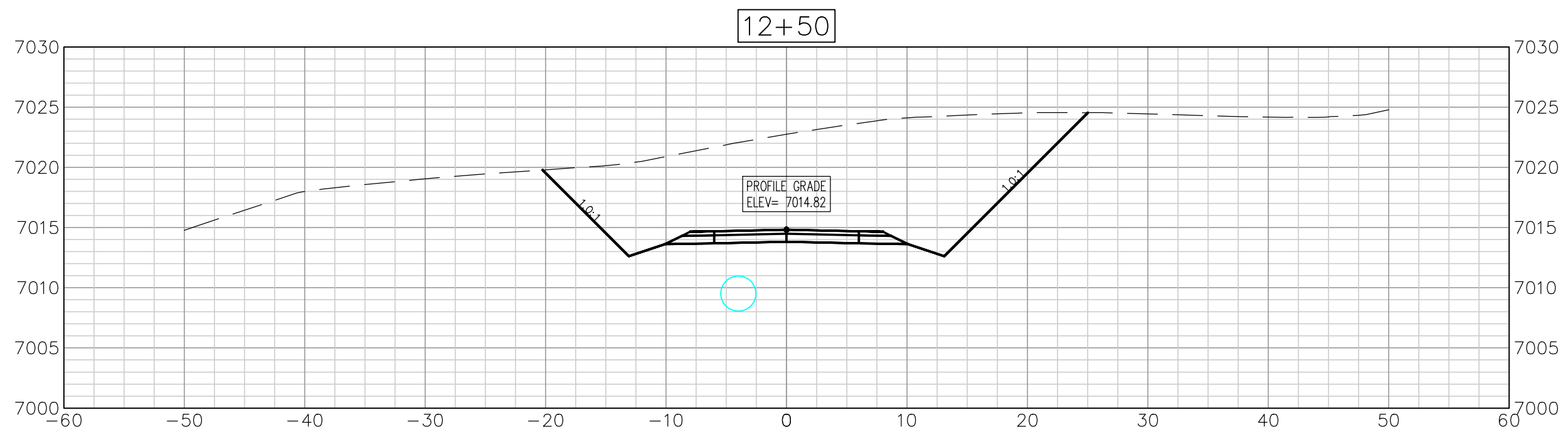
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RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO



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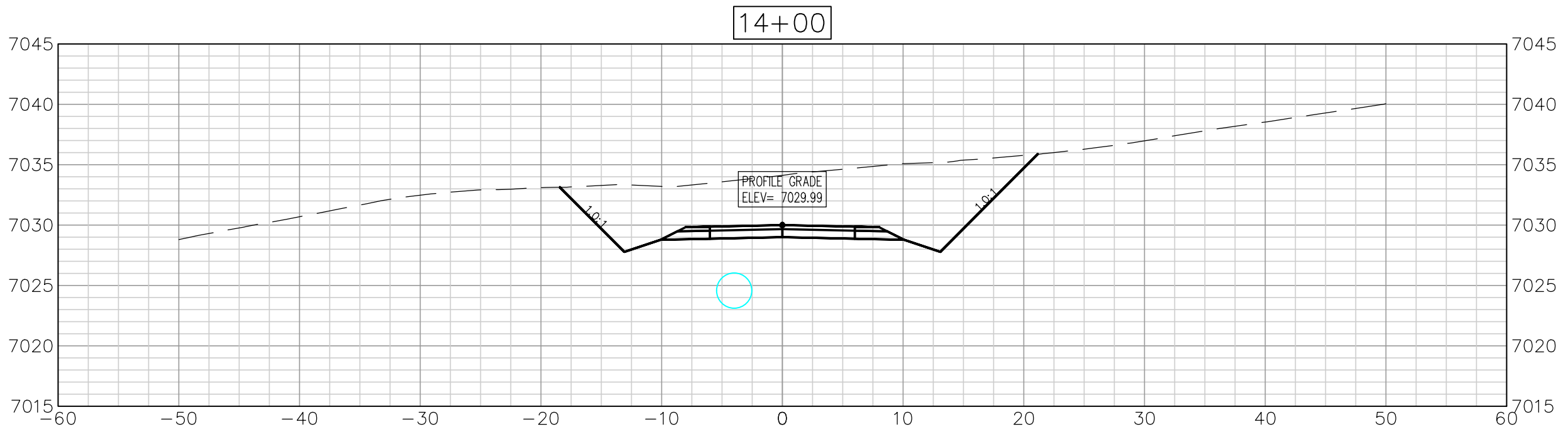
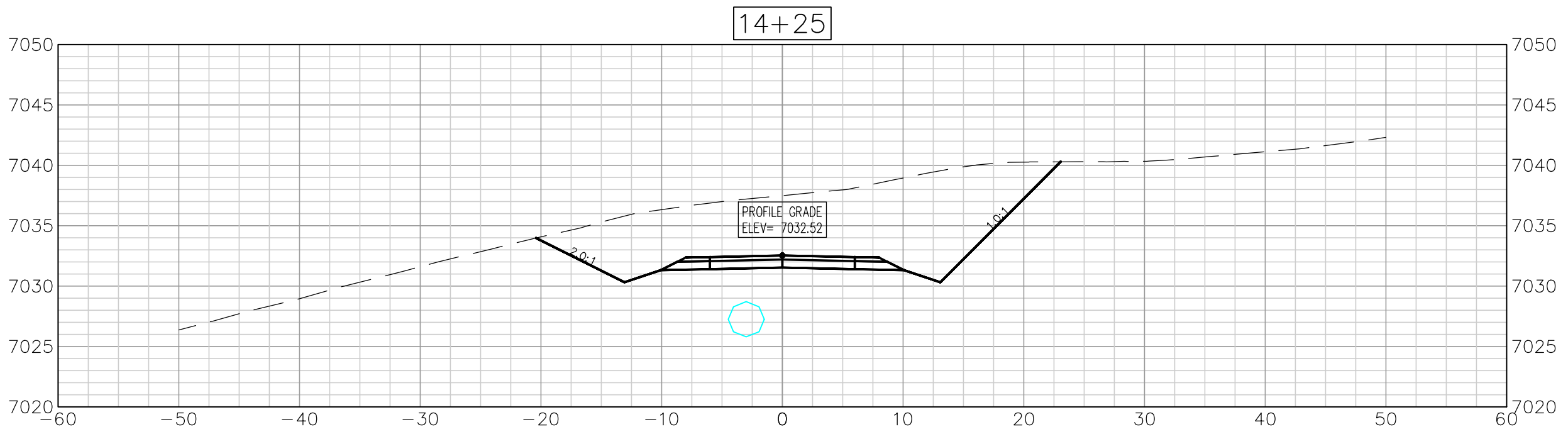
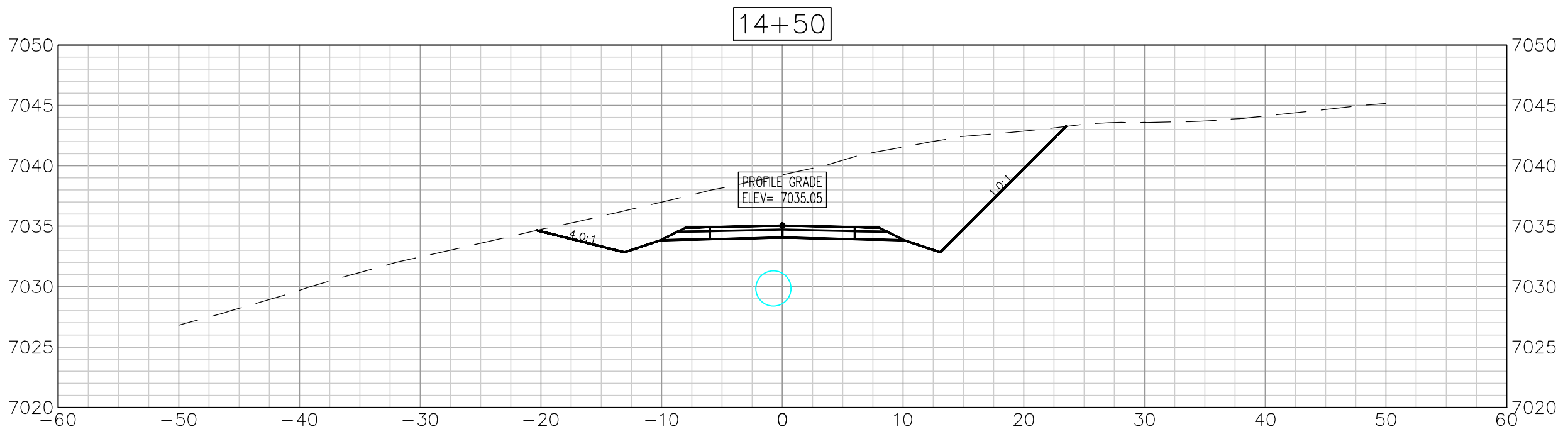
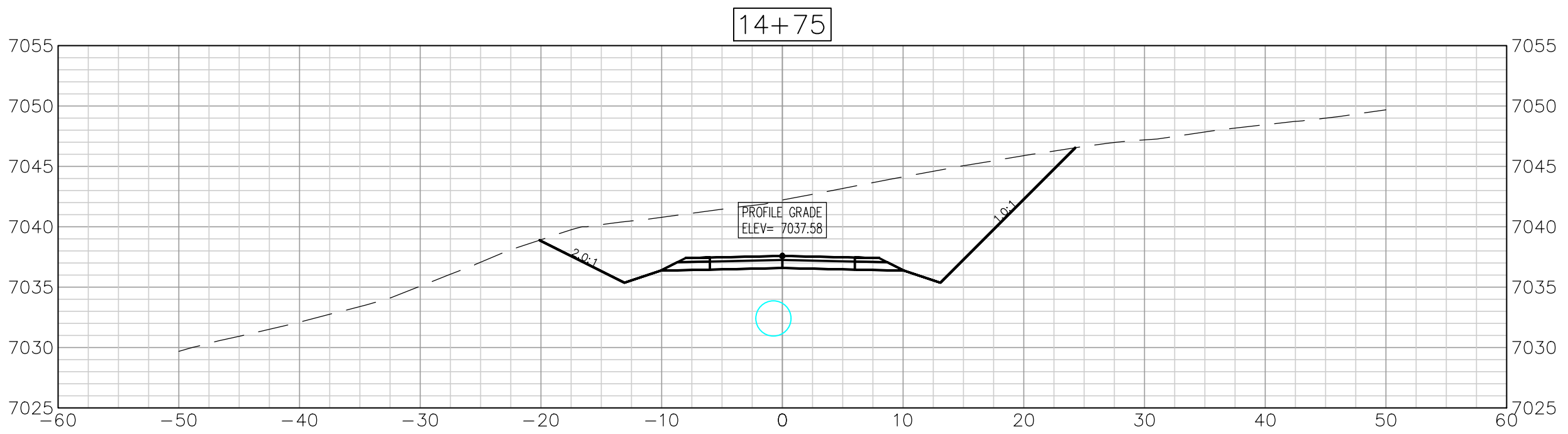
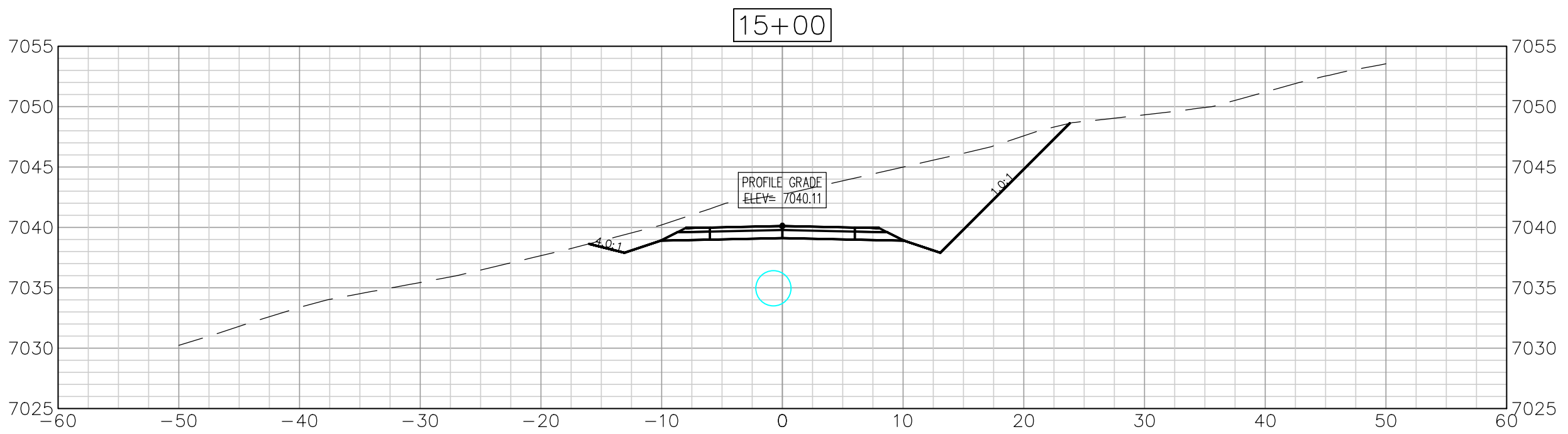
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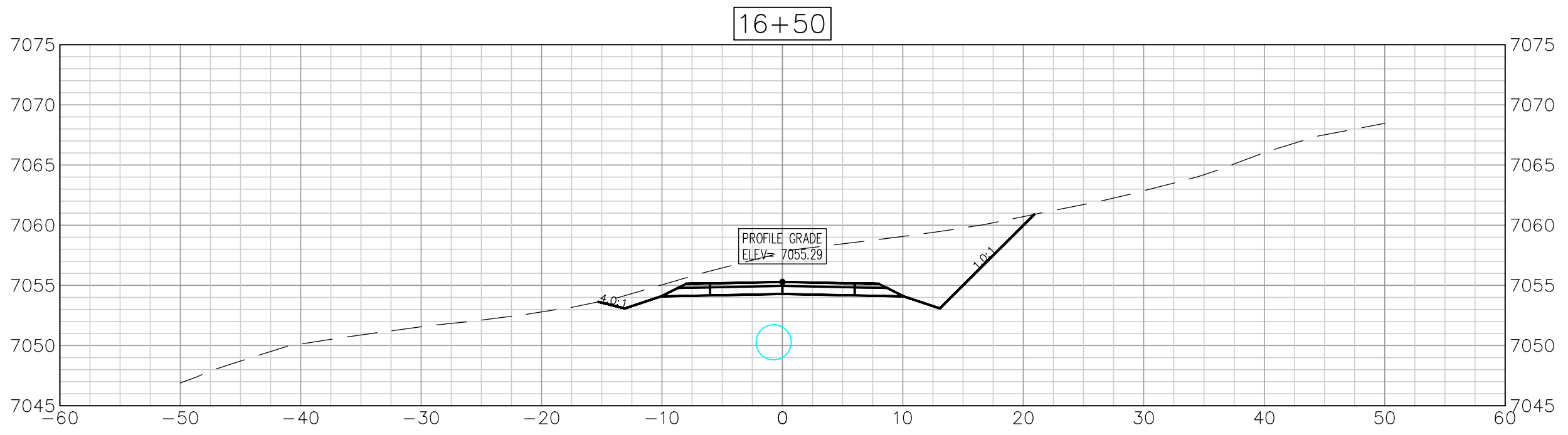
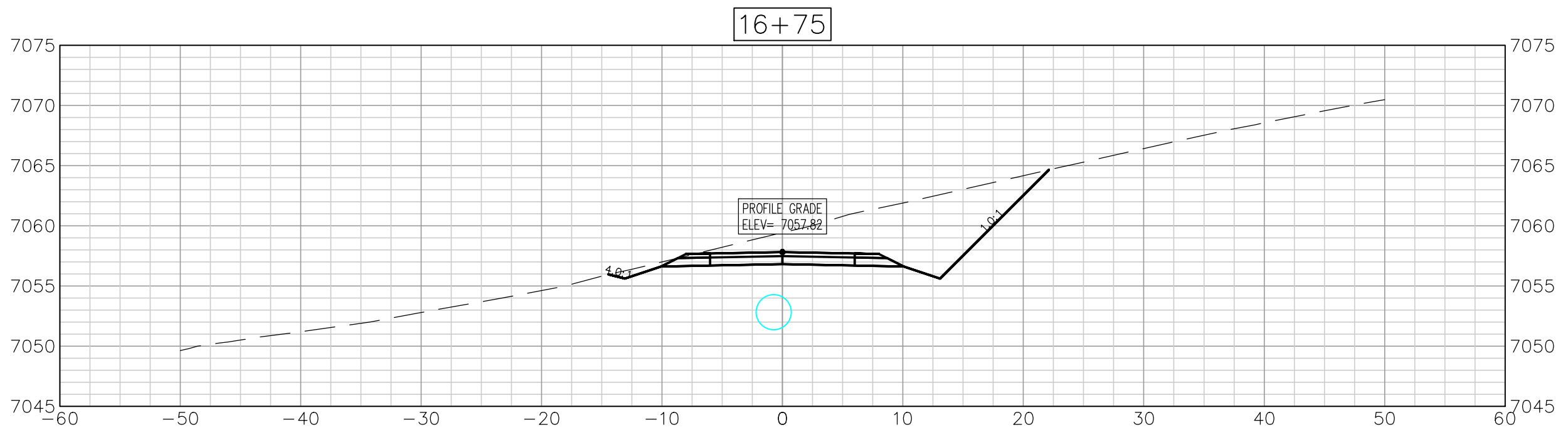
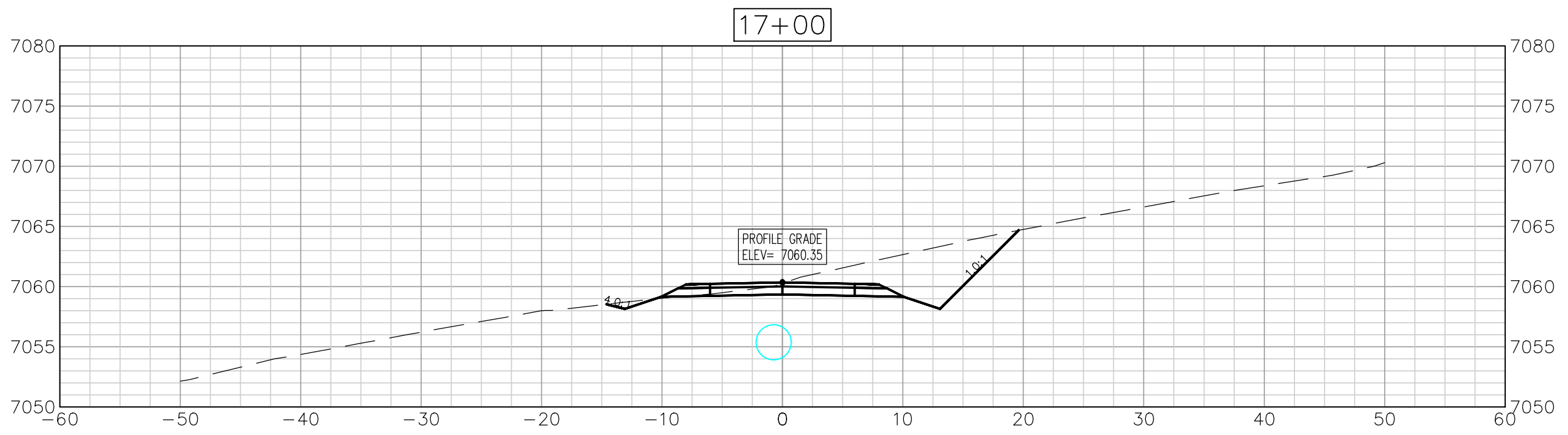
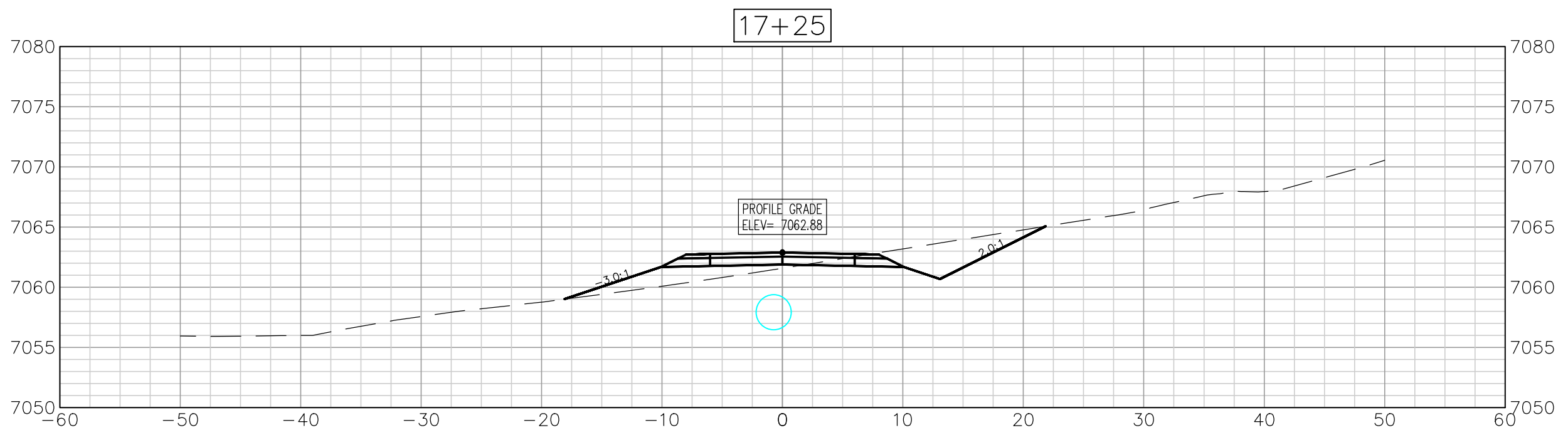
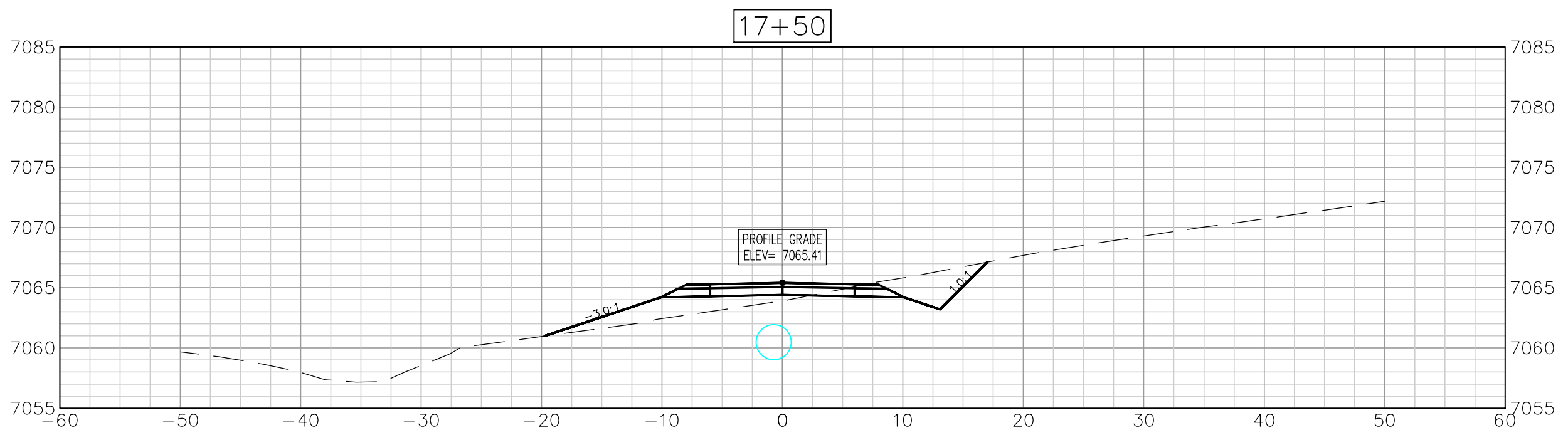
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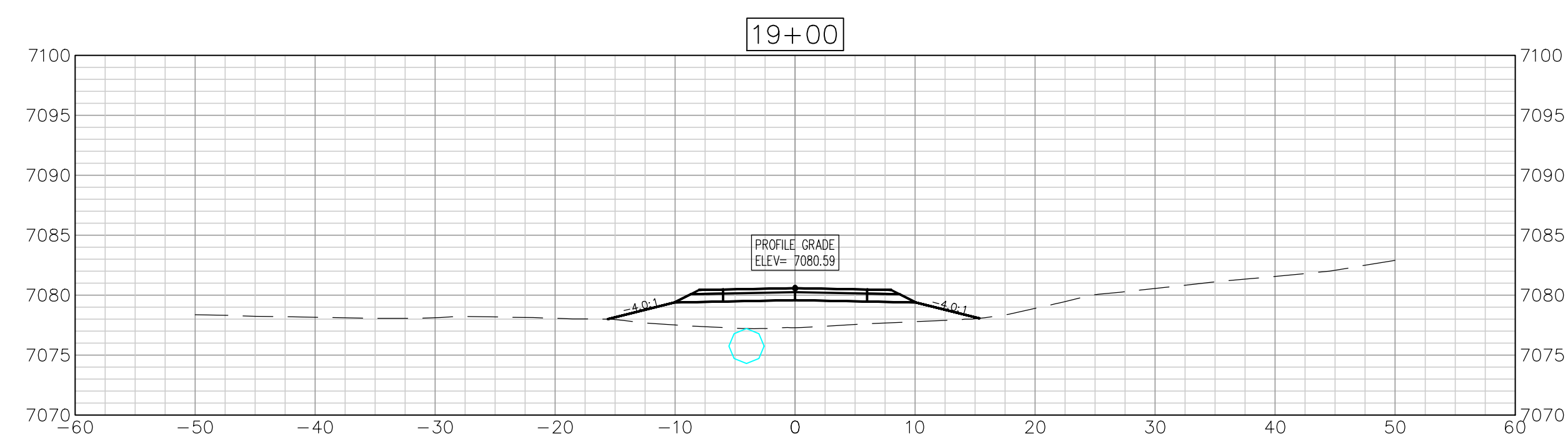
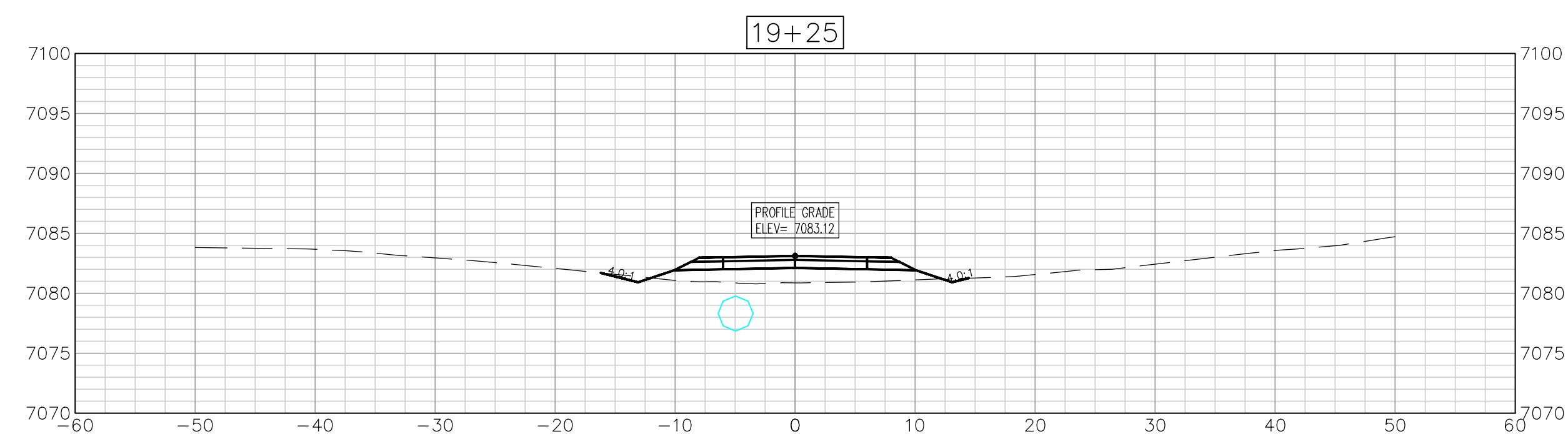
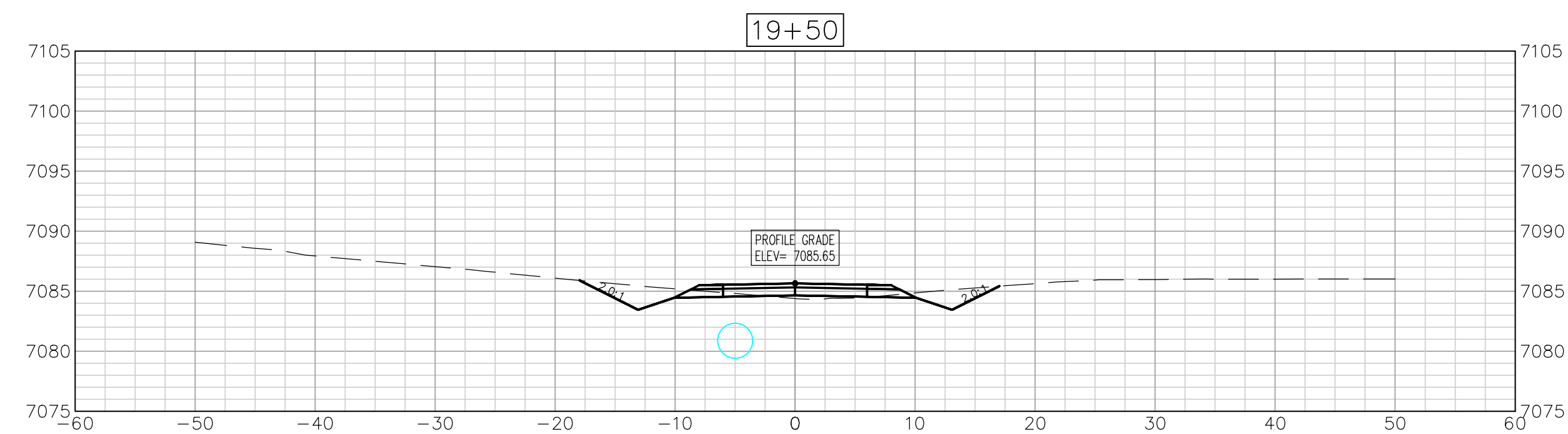
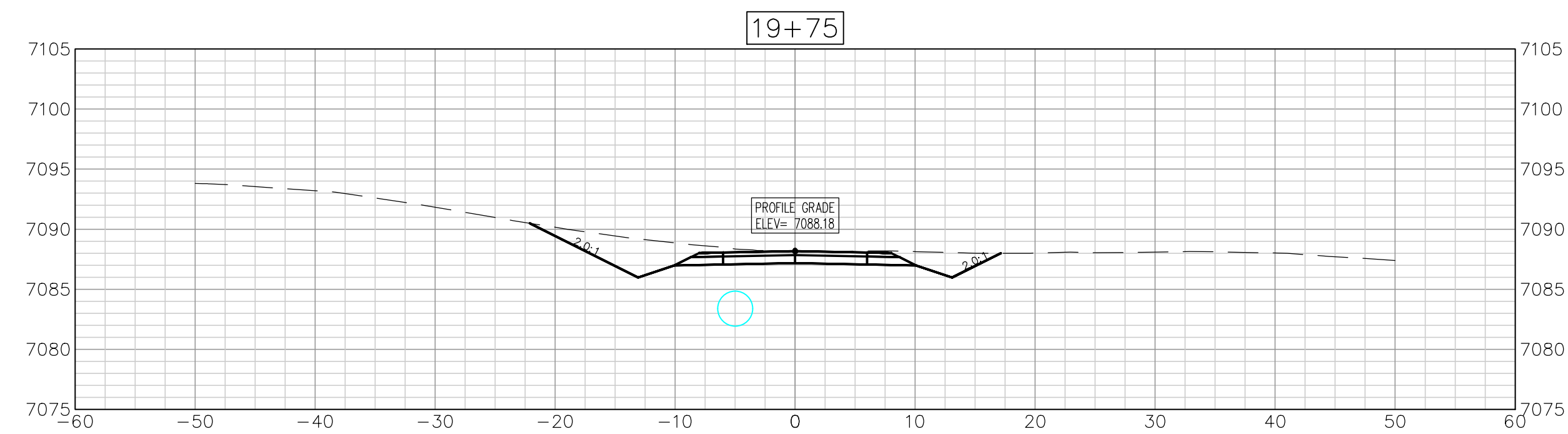
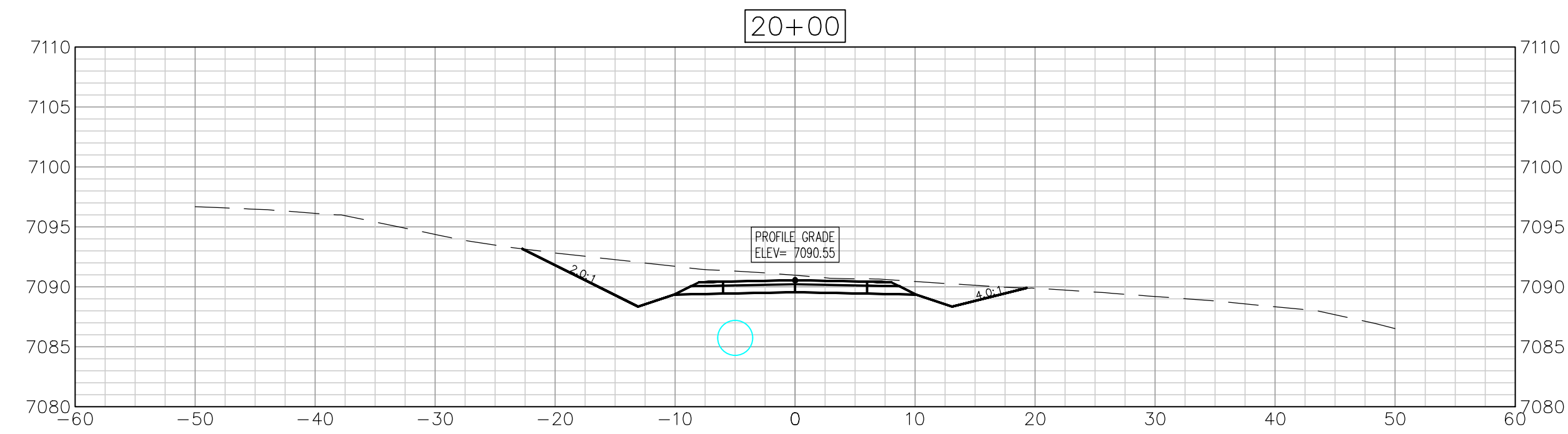
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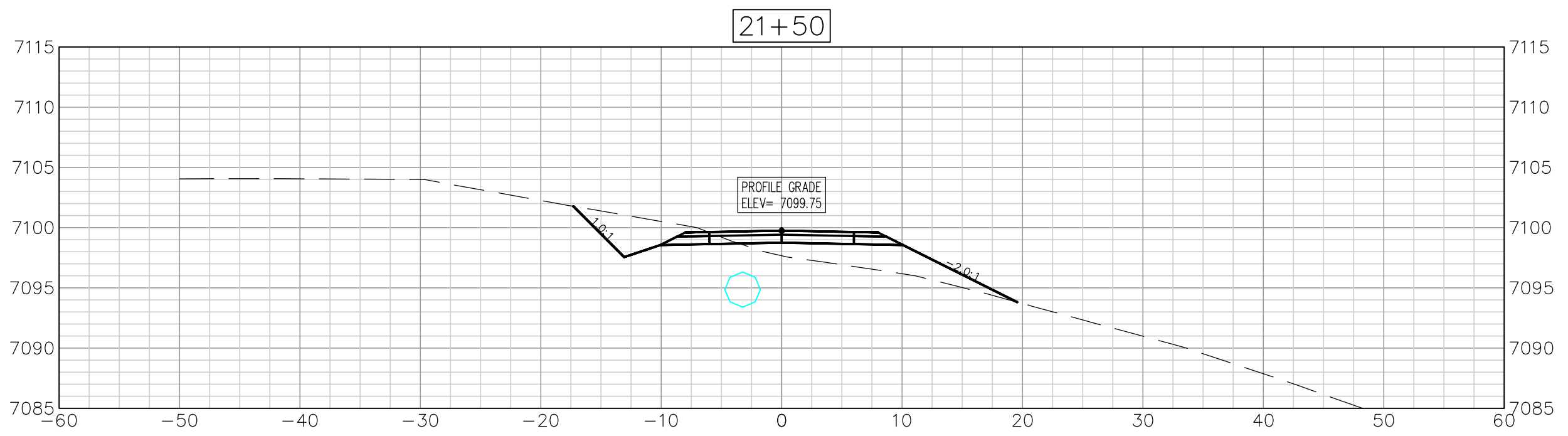
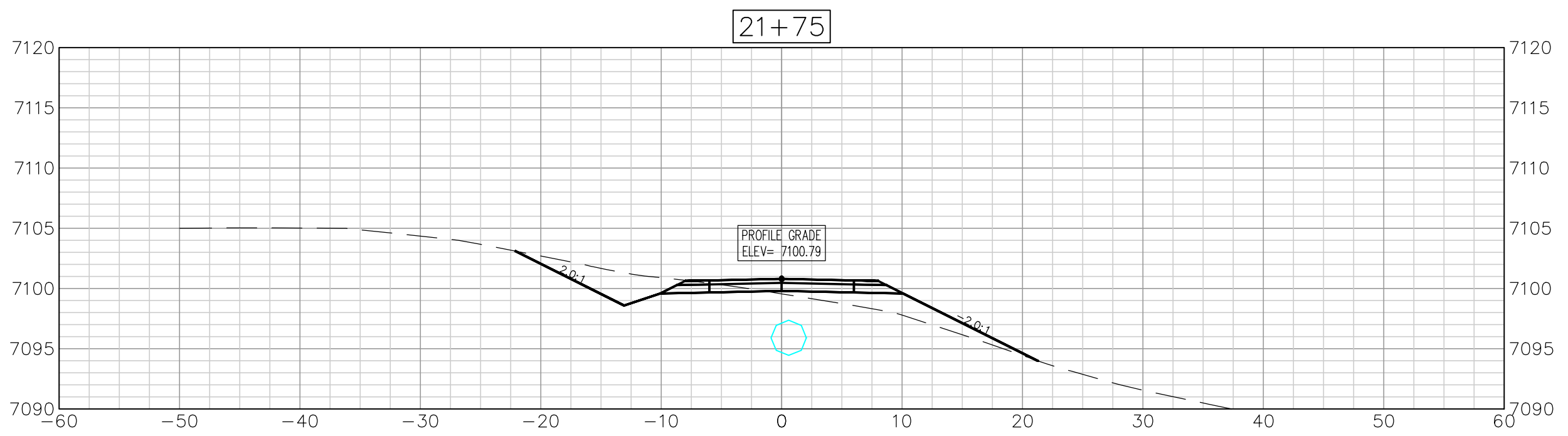
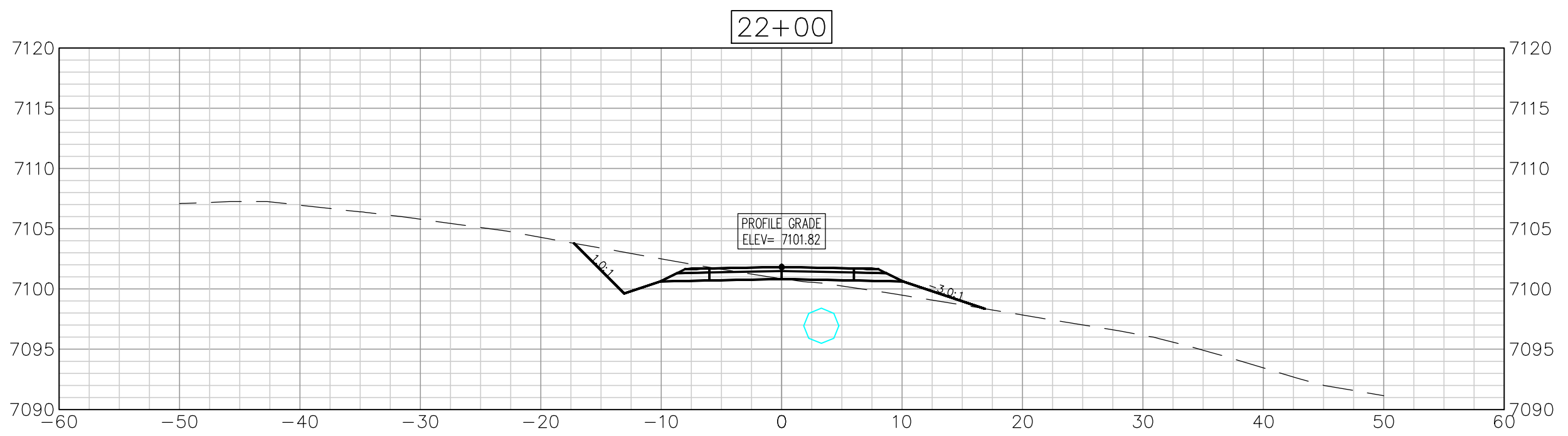
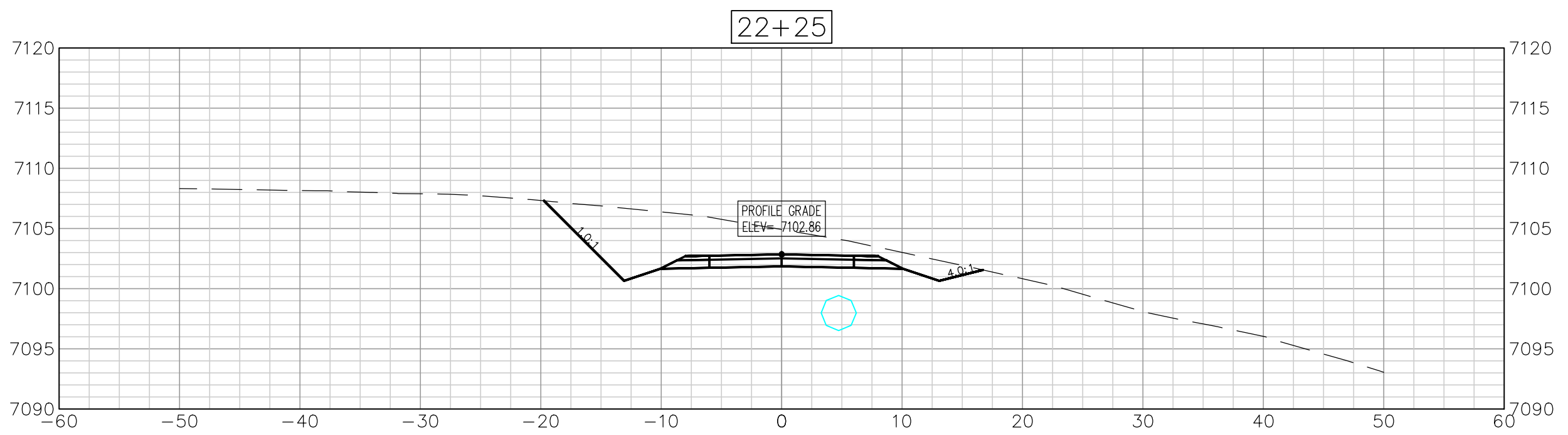
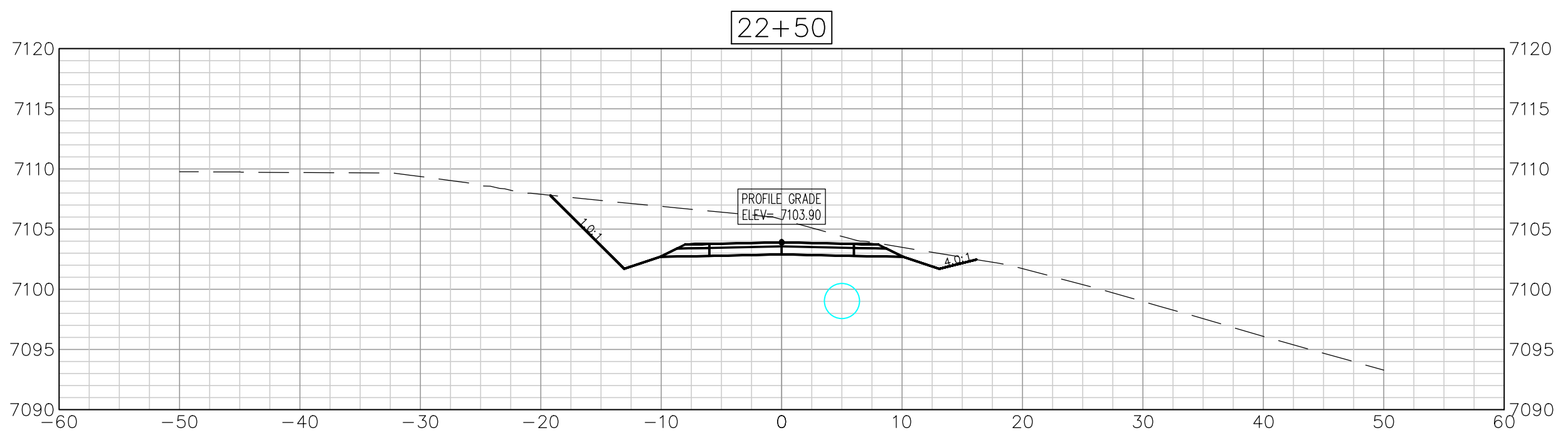
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**INTAKE ACCESS ROADWAY
ROADWAY SECTIONS**

RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO



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SHEET NO:	24 of 114

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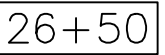
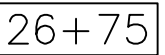
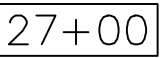
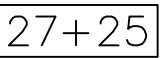
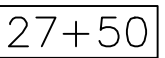
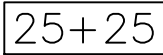
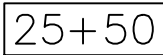
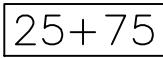
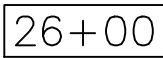
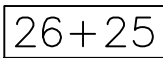
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DATE:	OCTOBER 9, 2015
DRAWING NO:	C118
SHEET NO:	26 of 114



#	DATE	DESCRIPTION	BY
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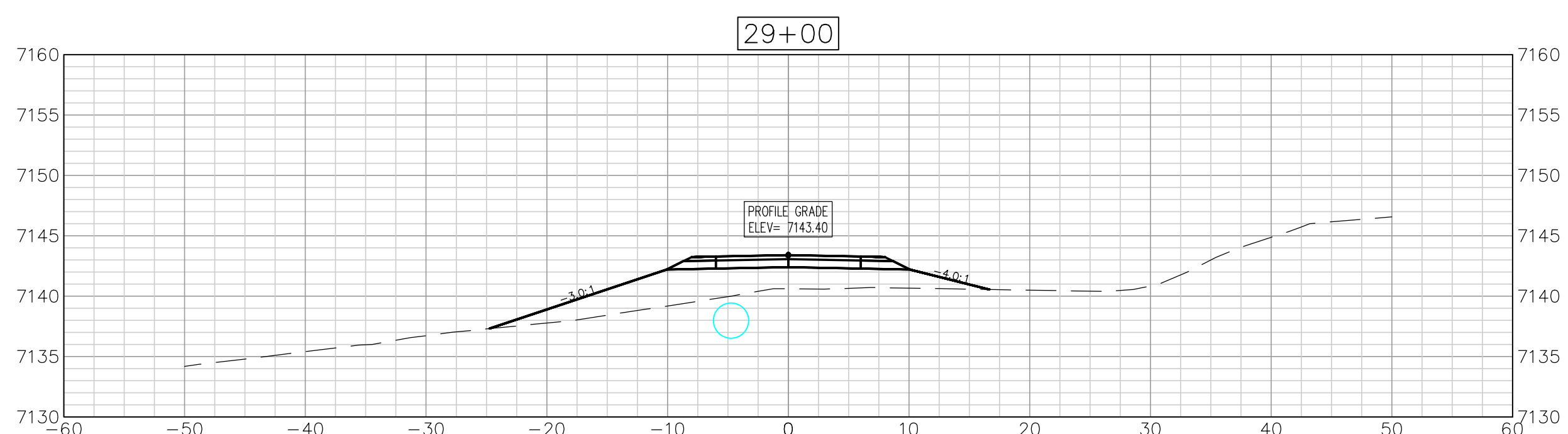
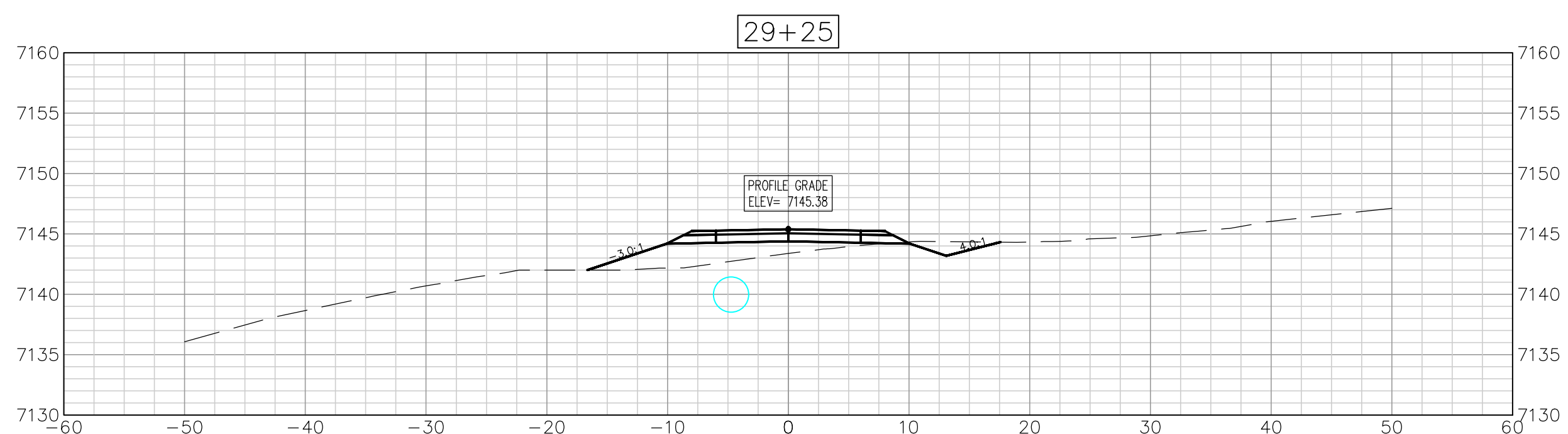
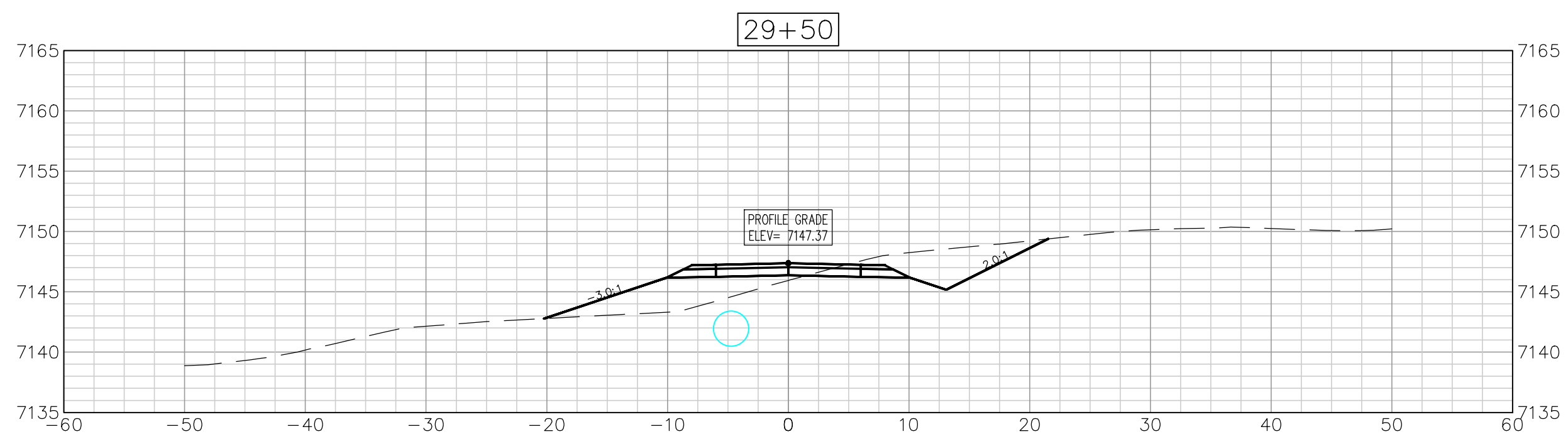
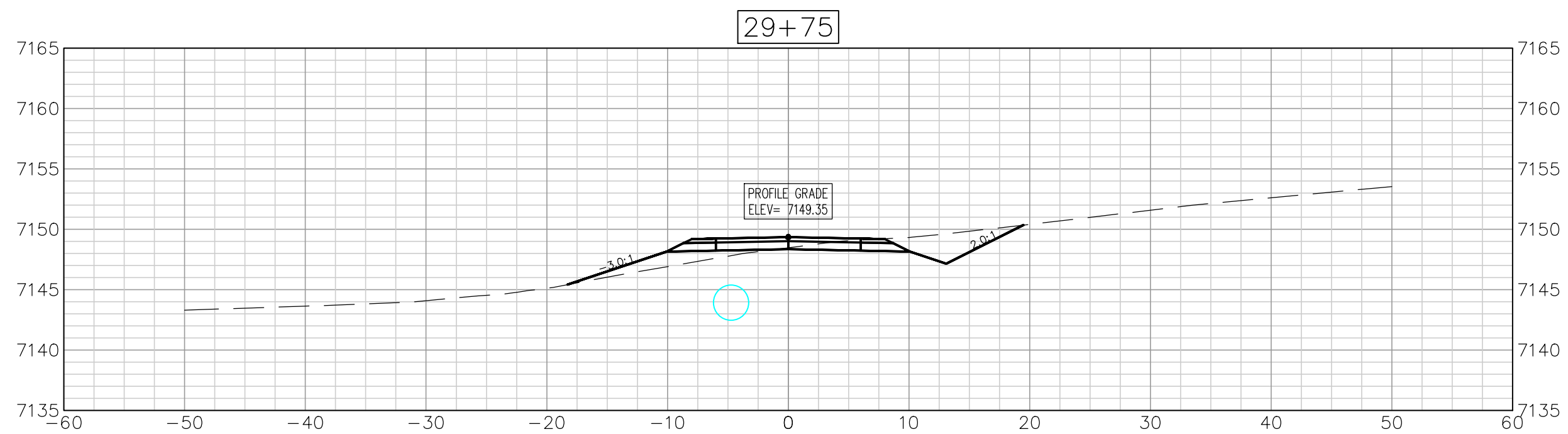
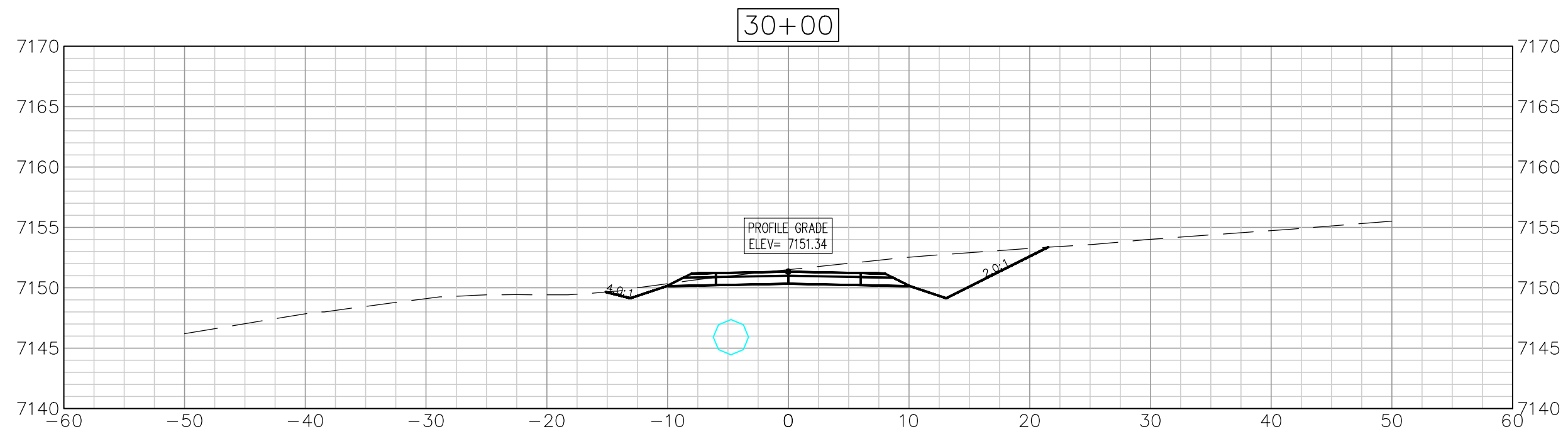
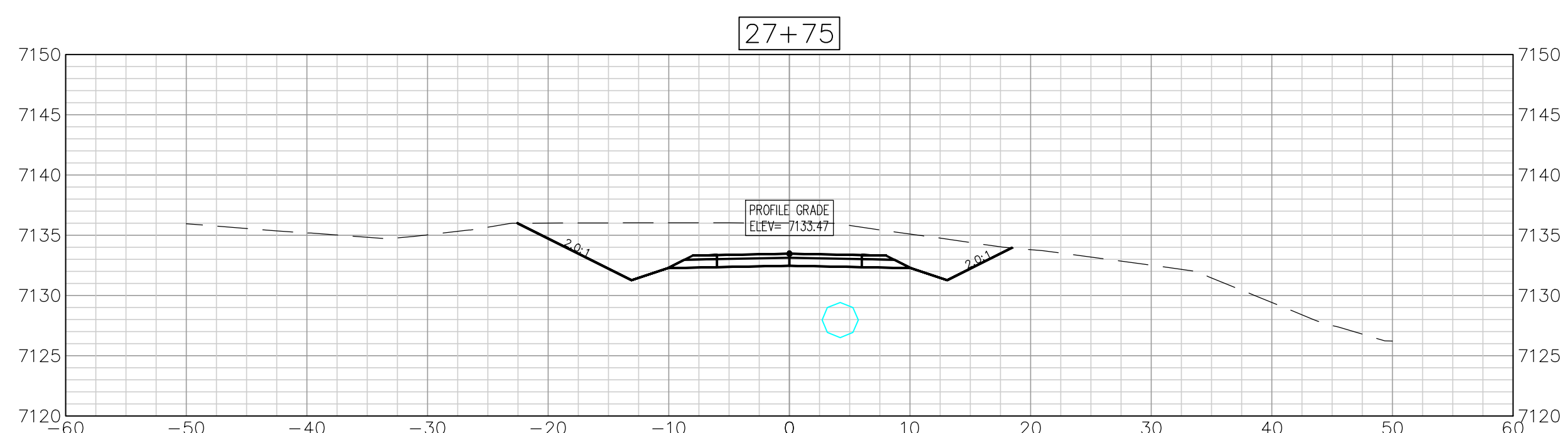
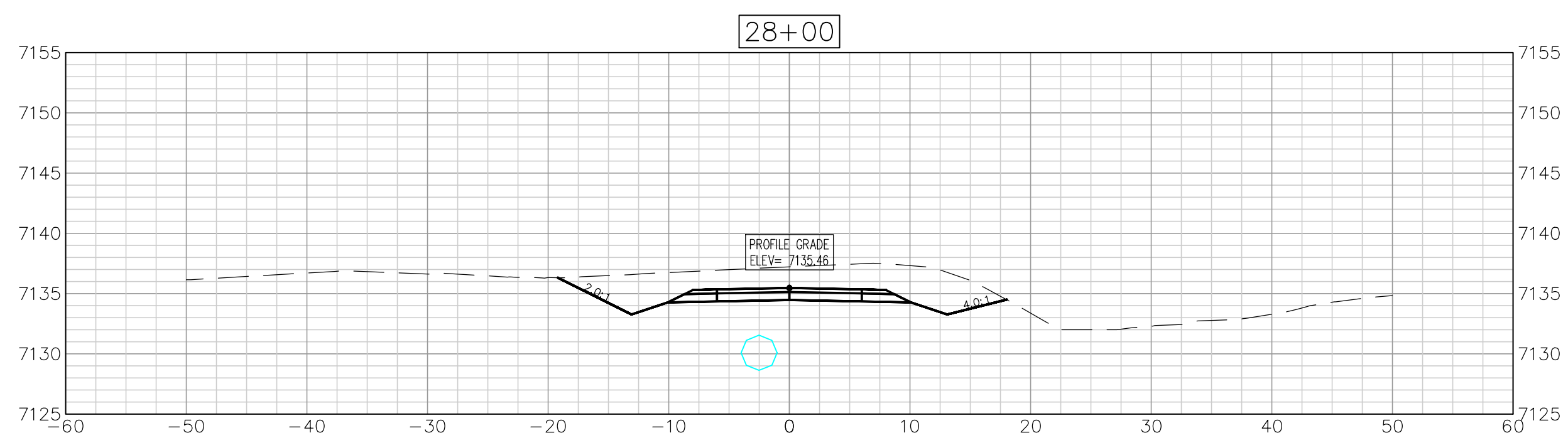
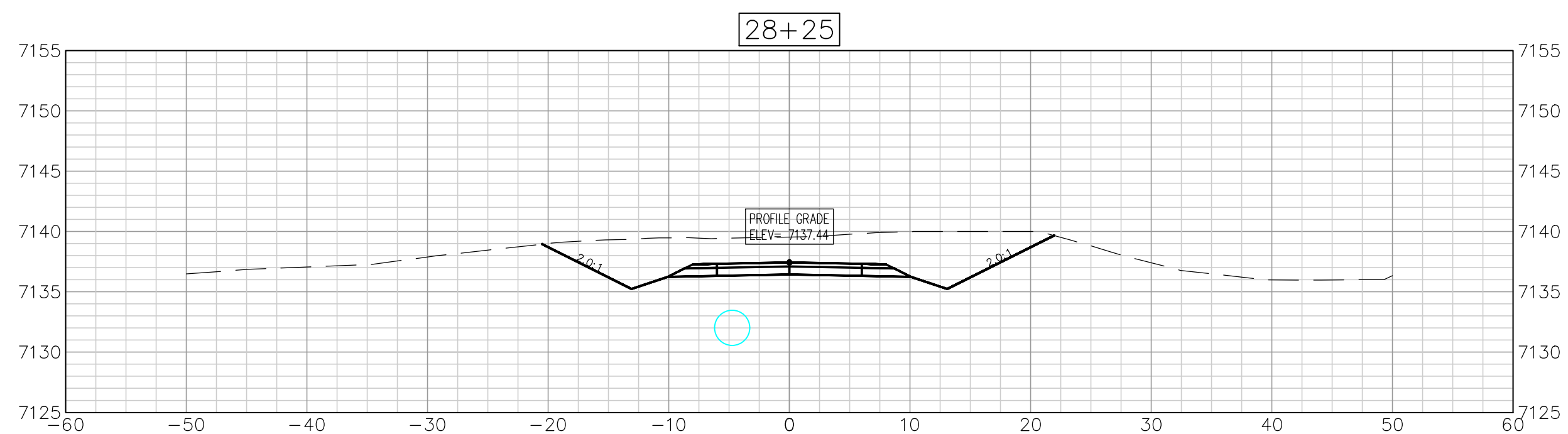
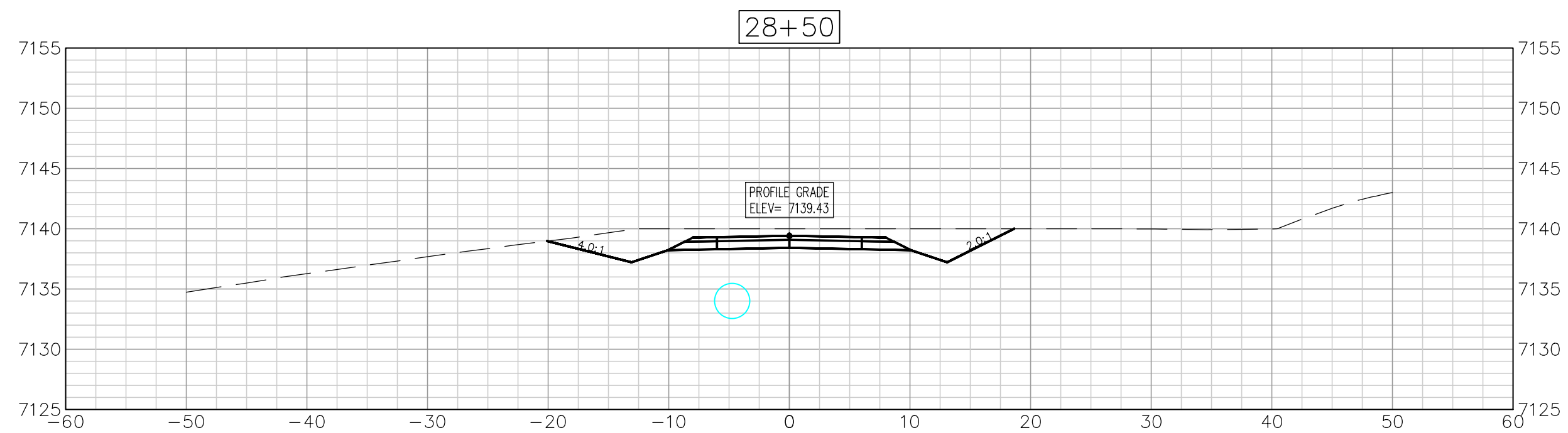
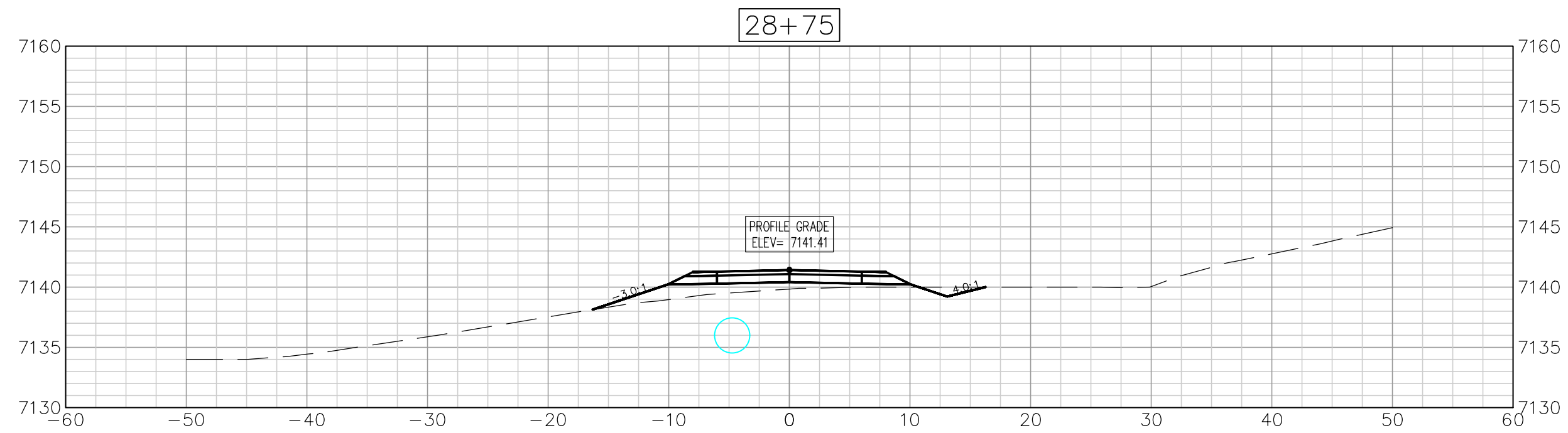
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**INTAKE ACCESS ROADWAY
ROADWAY SECTIONS**

RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO



DESIGNED:	RSH
DRAWN BY:	RSH
APPROVED BY:	RSH
DESIGN PROJ:	14-123
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	AS SHOWN
DATE:	OCTOBER 9, 2015
DRAWING NO:	C119
SHEET NO:	

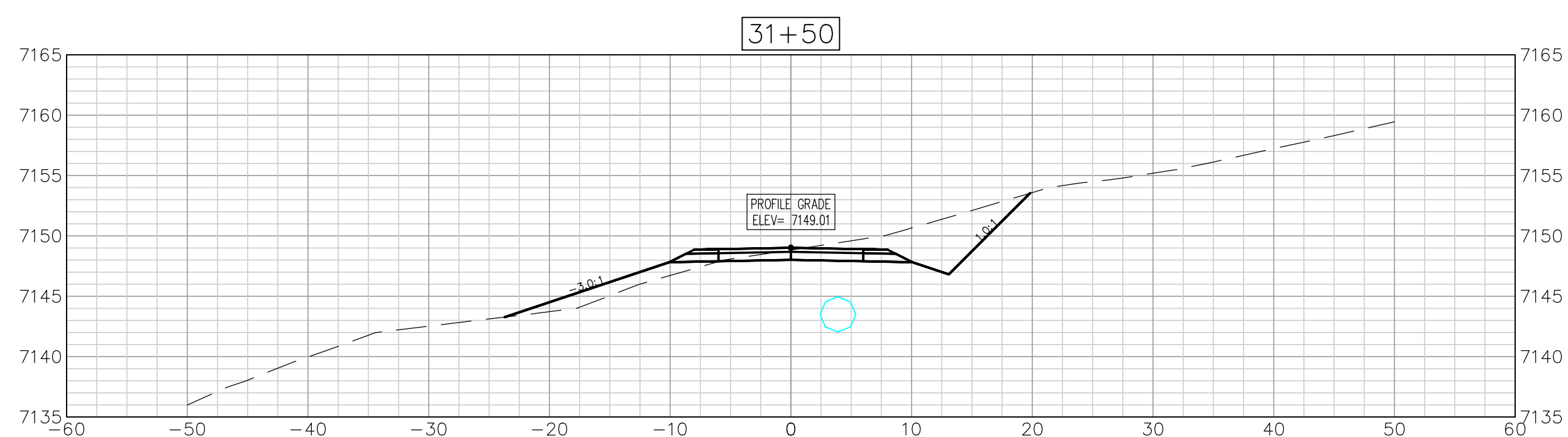
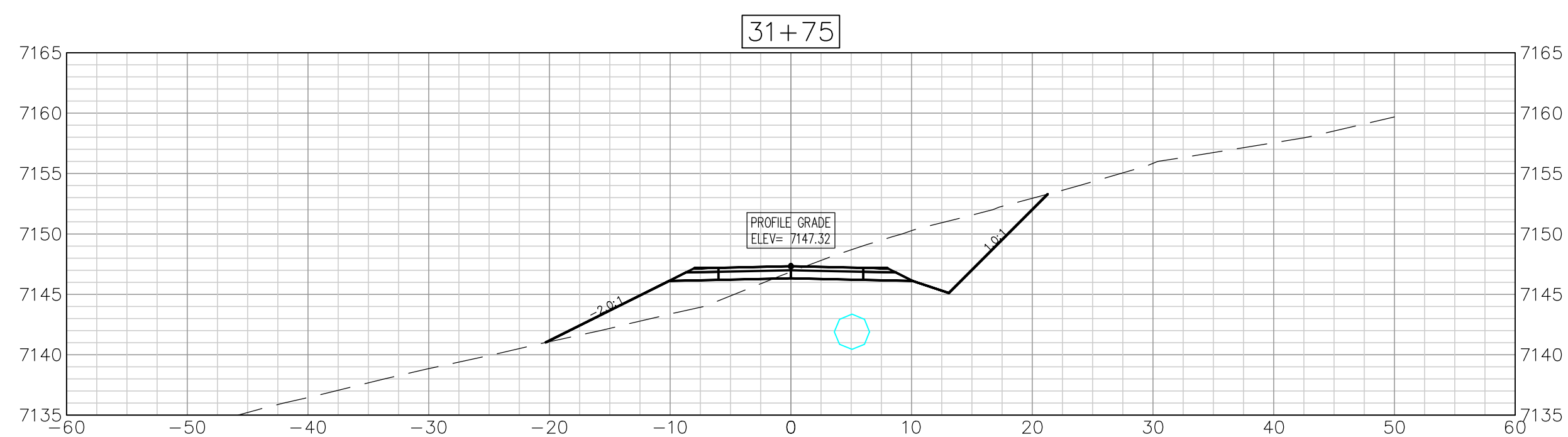
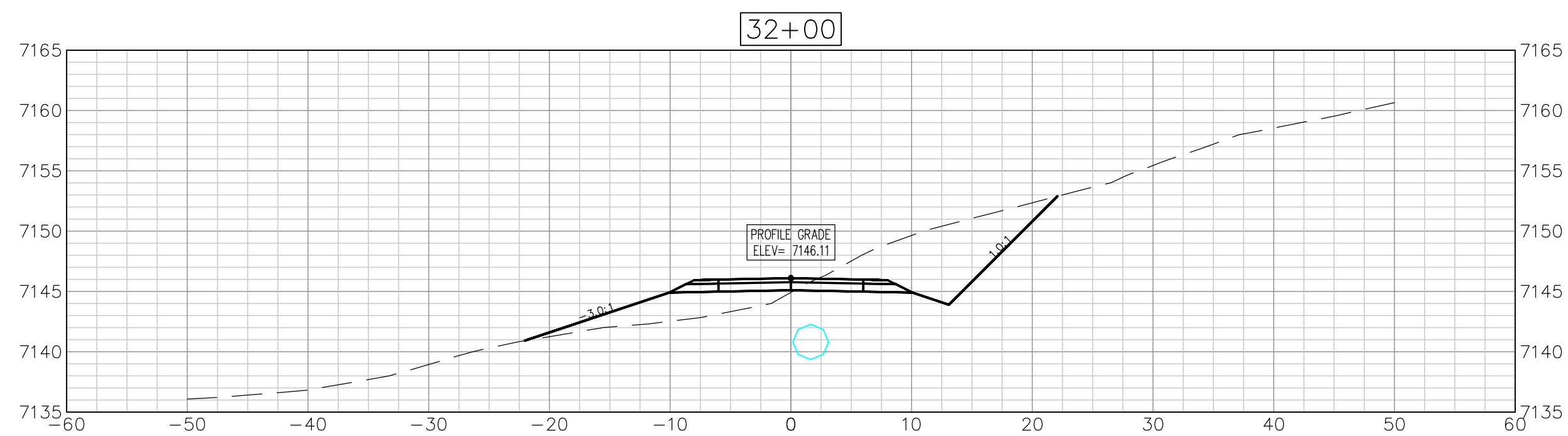
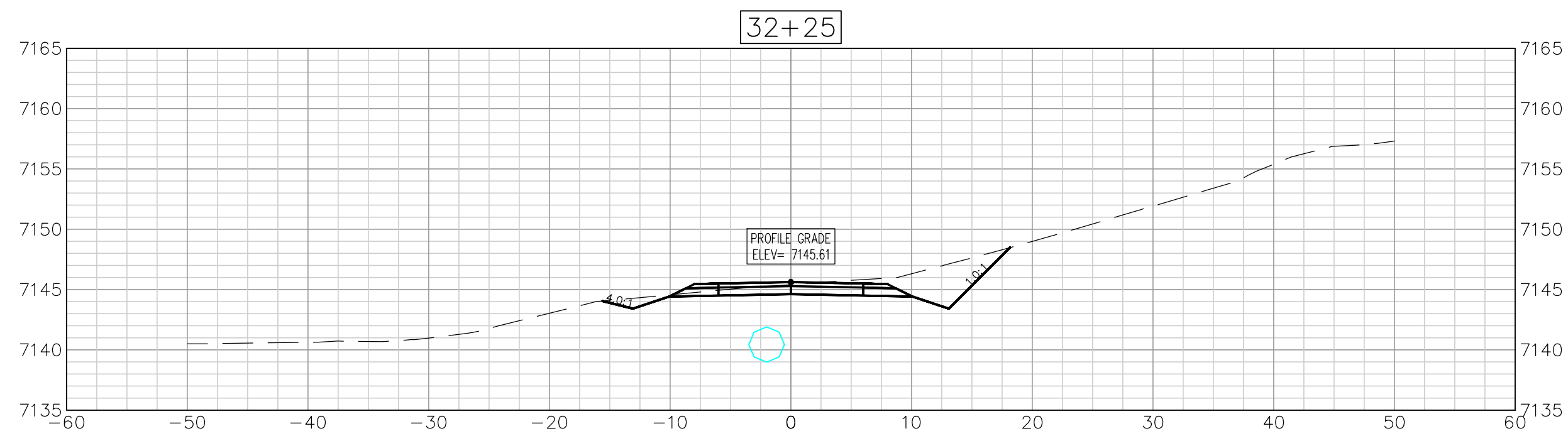
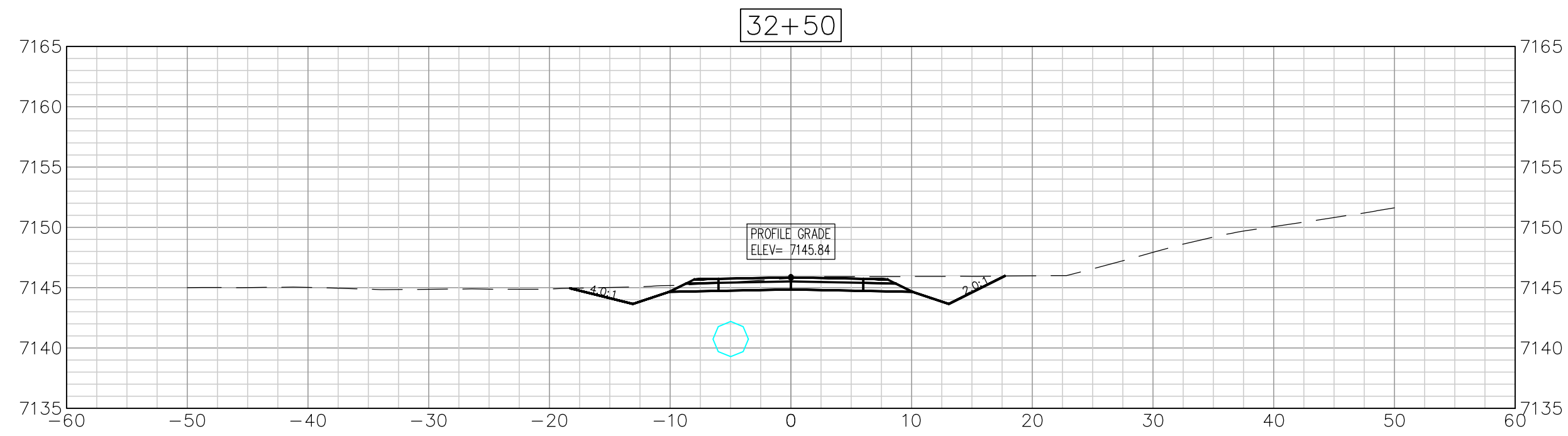
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INTAKE ACCESS ROADWAY ROADWAY SECTIONS



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APPROVED BY:	RSH
DESIGN PROJ:	14-123
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AS SHOWN	
DATE:	OCTOBER 9, 2015
DRAWING NO:	C120
SHEET NO:	20 of 114

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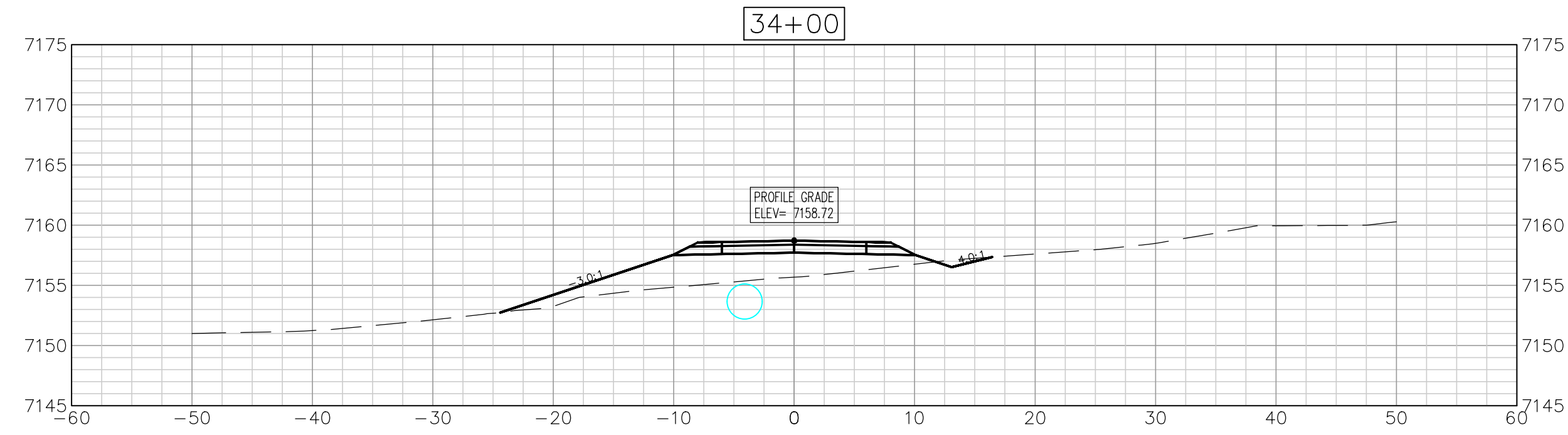
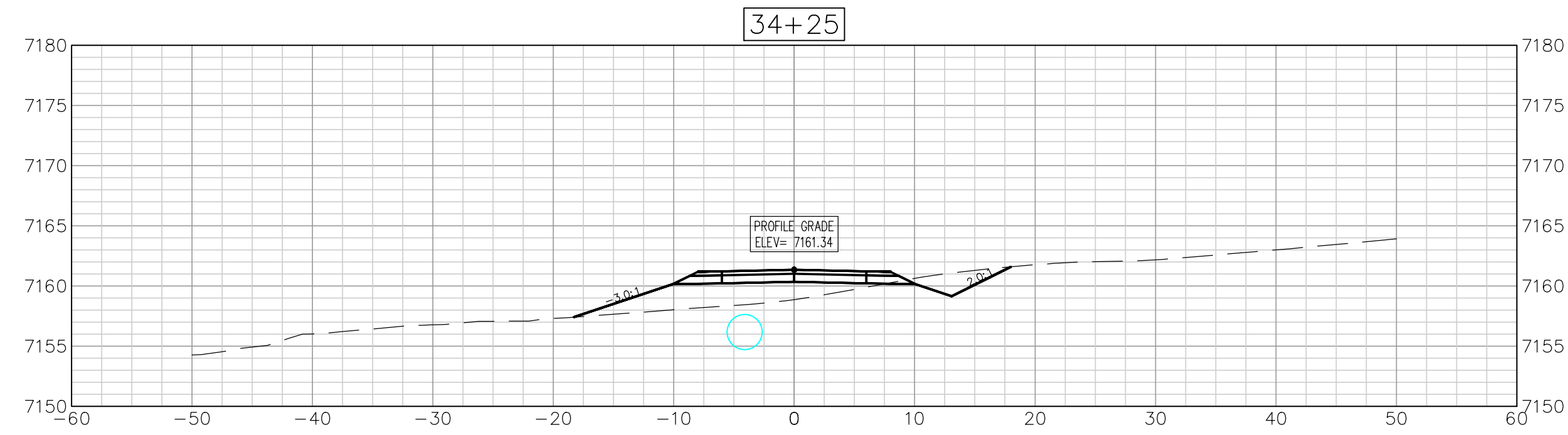
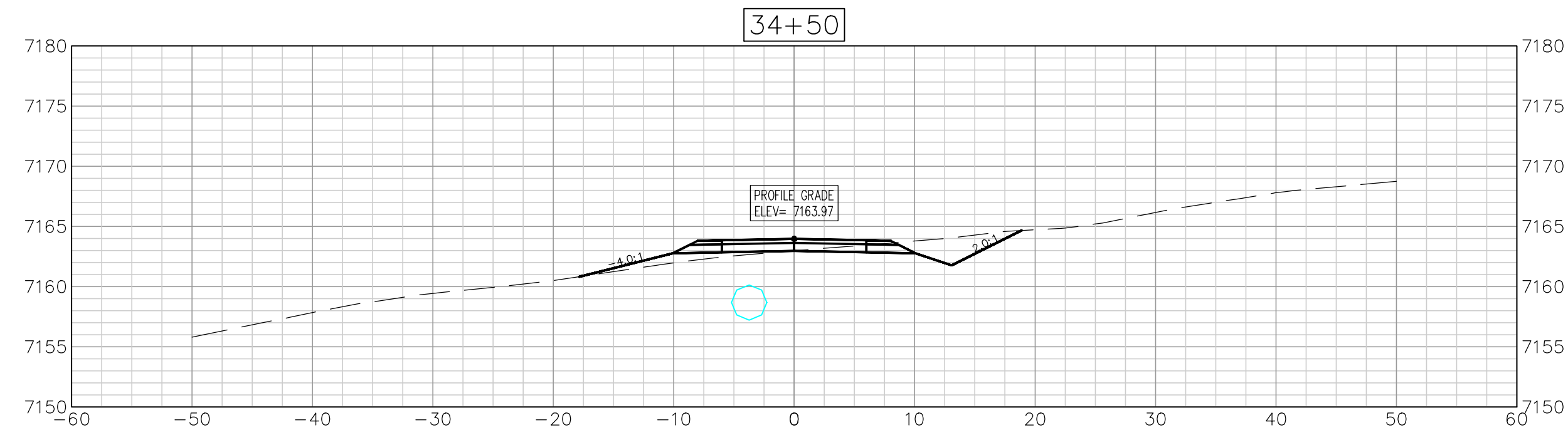
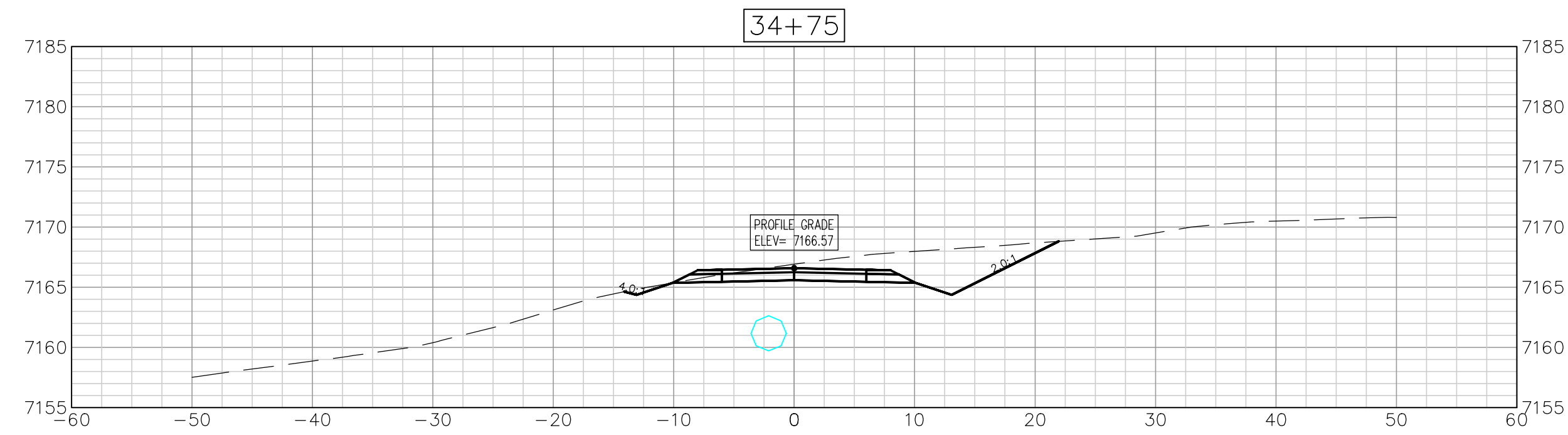
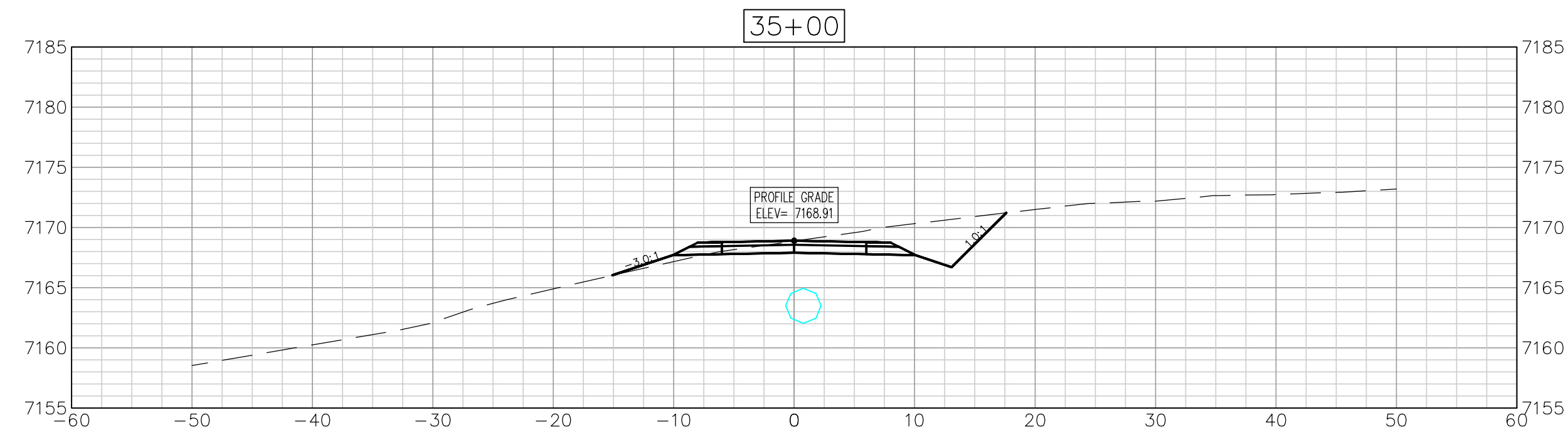
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INTAKE ACCESS ROADWAY ROADWAY SECTIONS

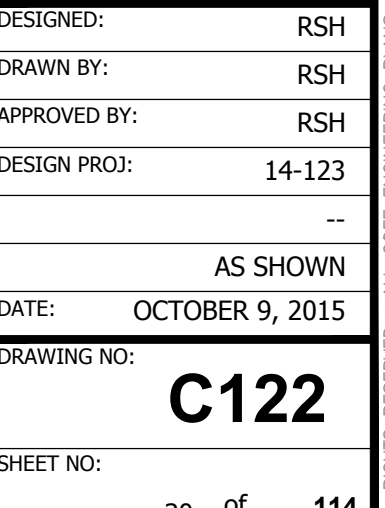
RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO

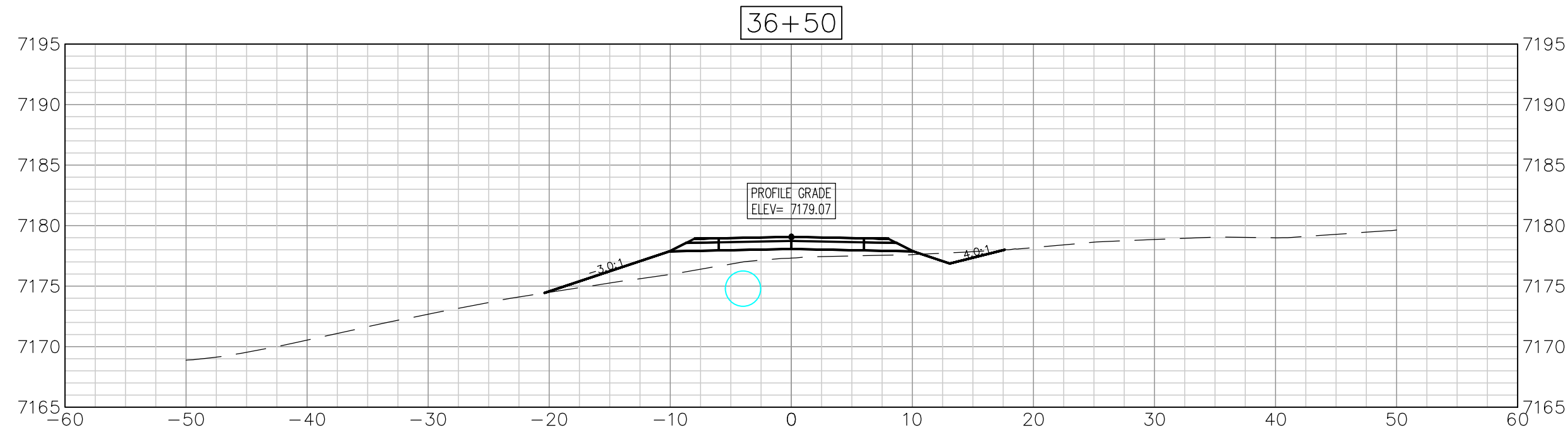
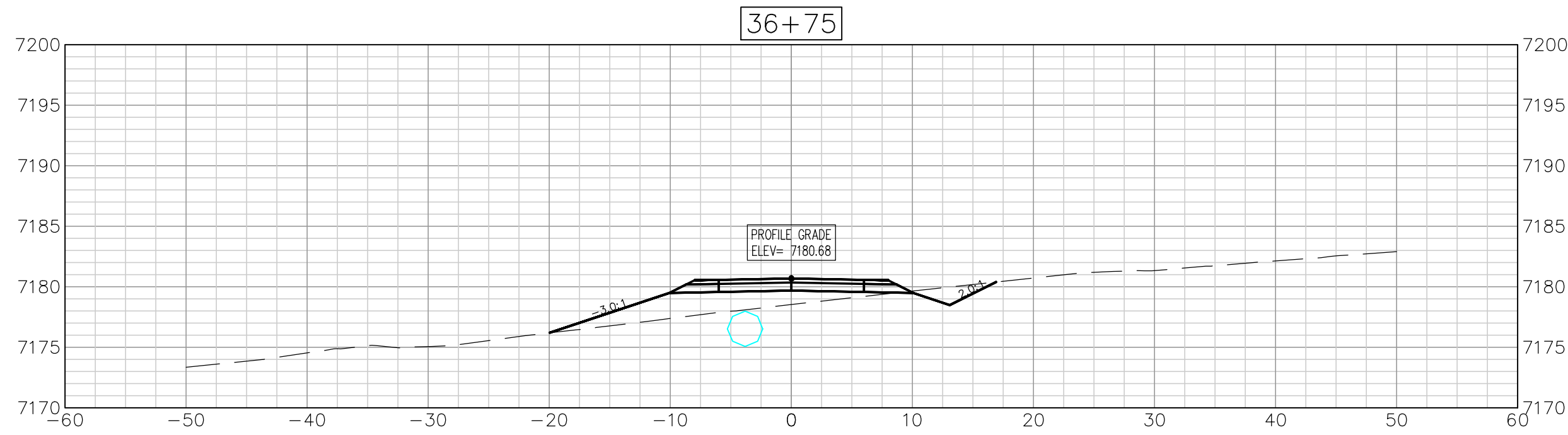
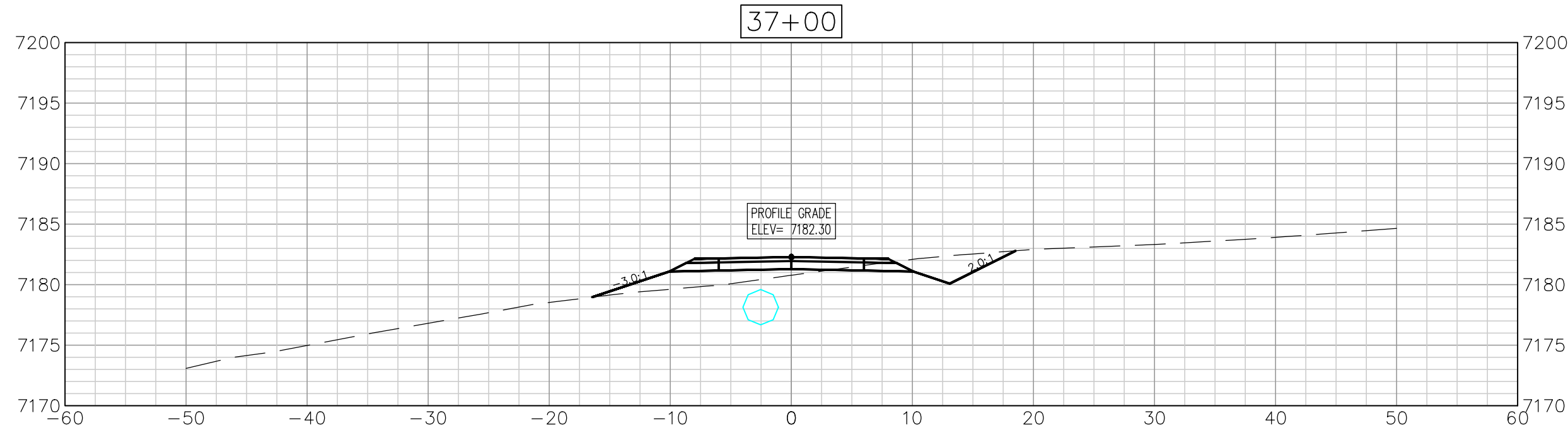
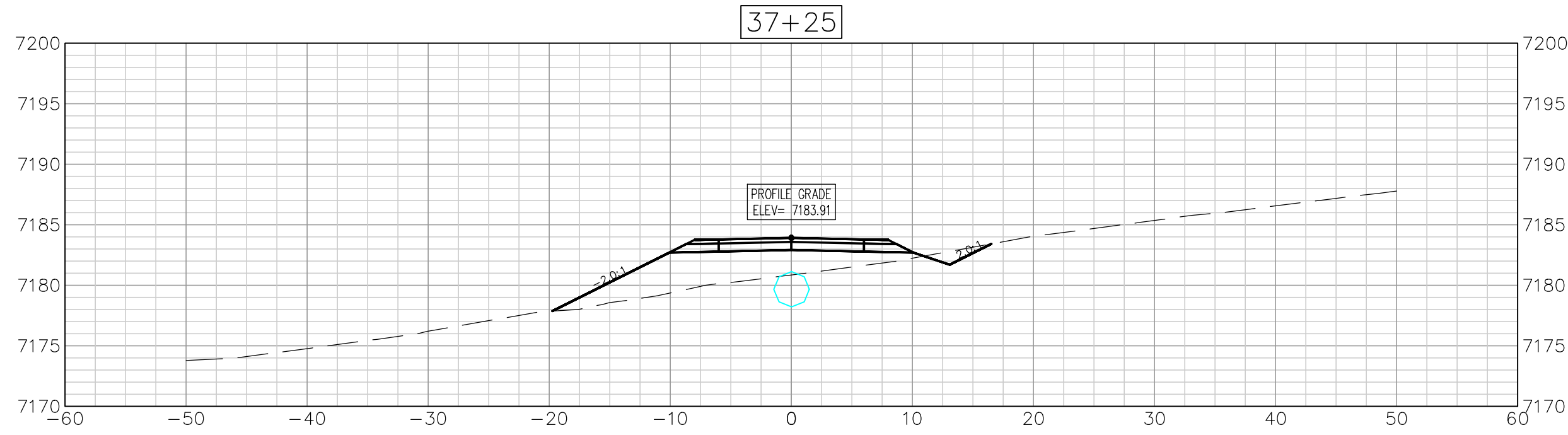
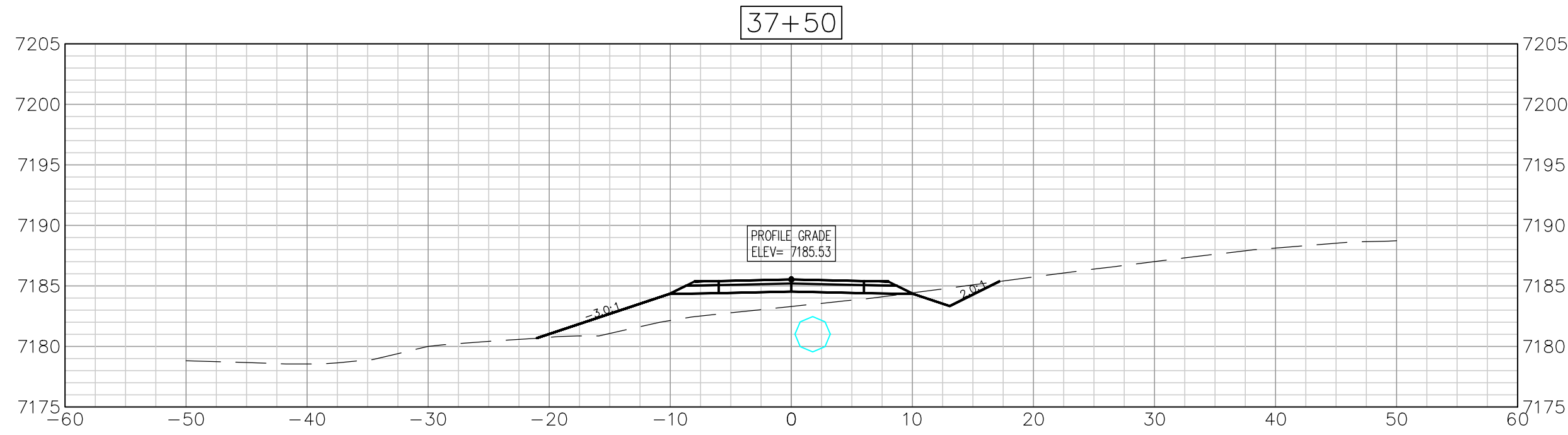
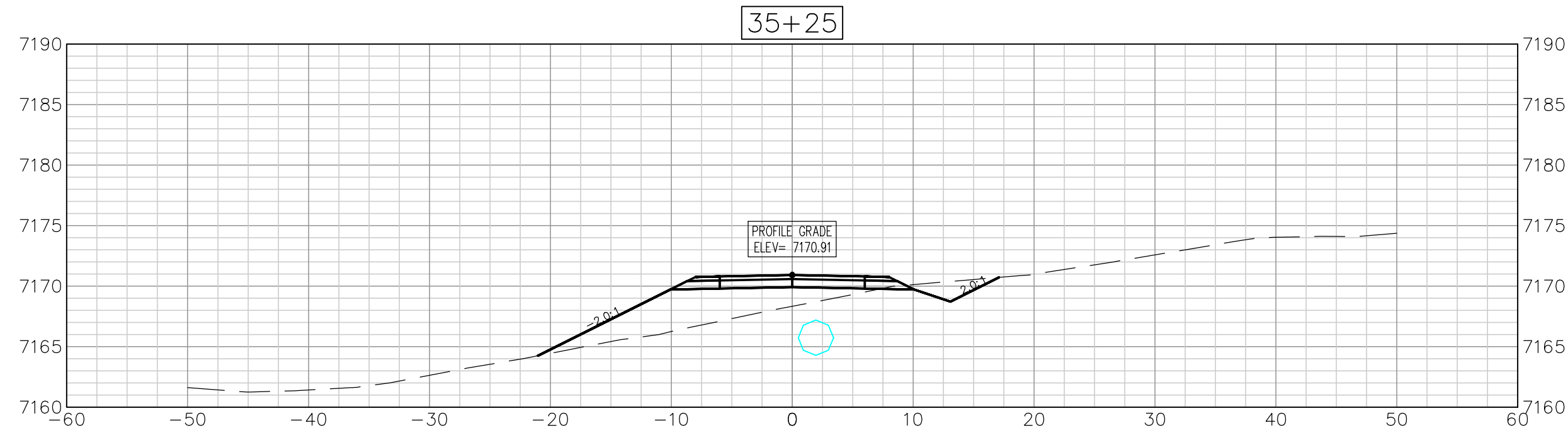
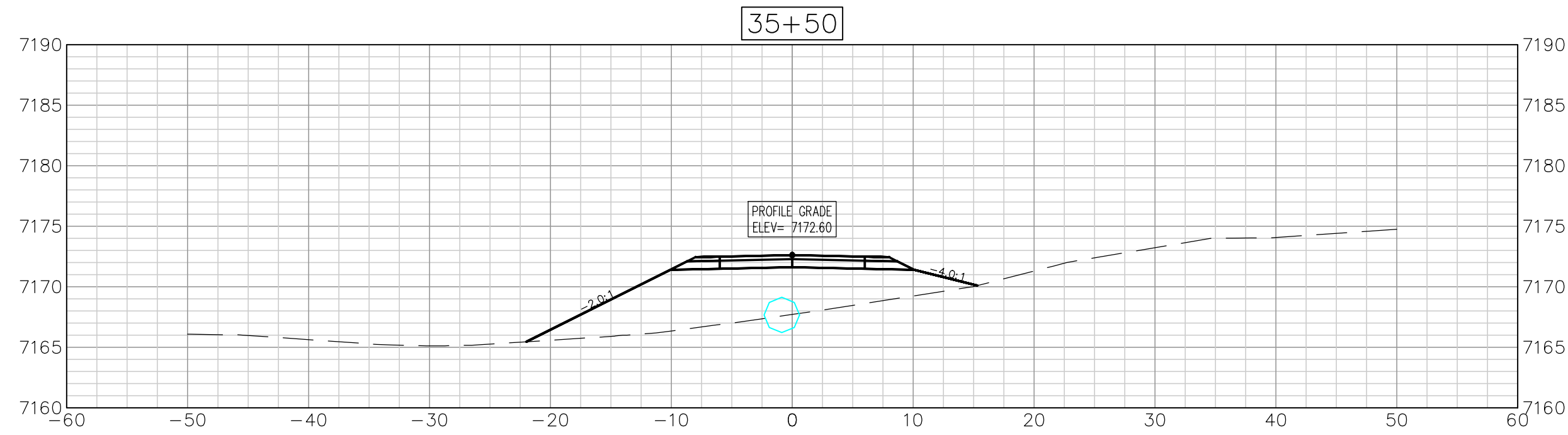
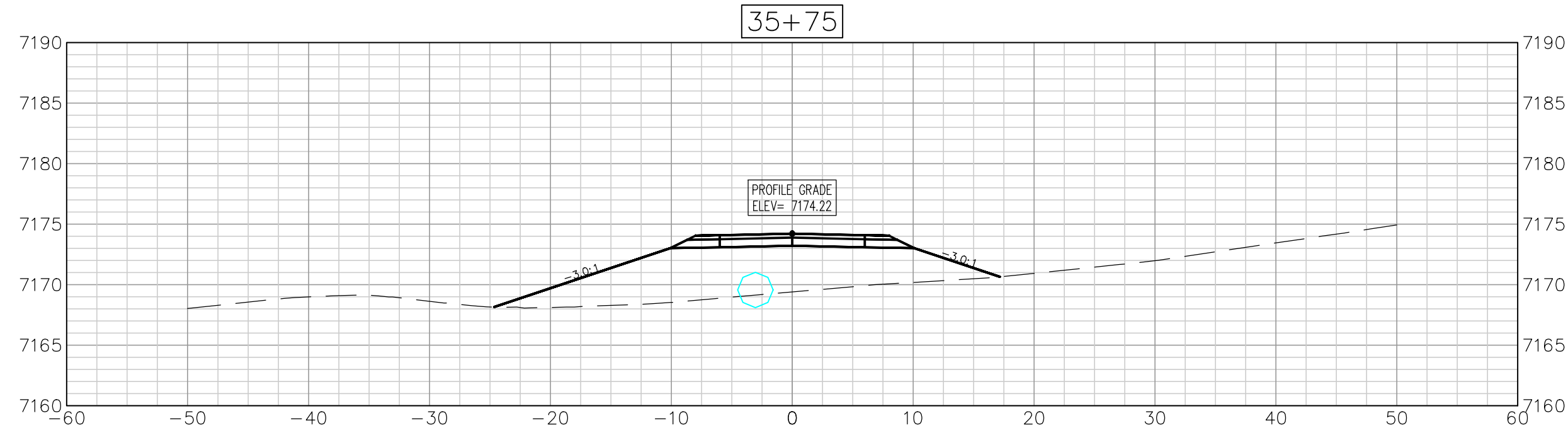
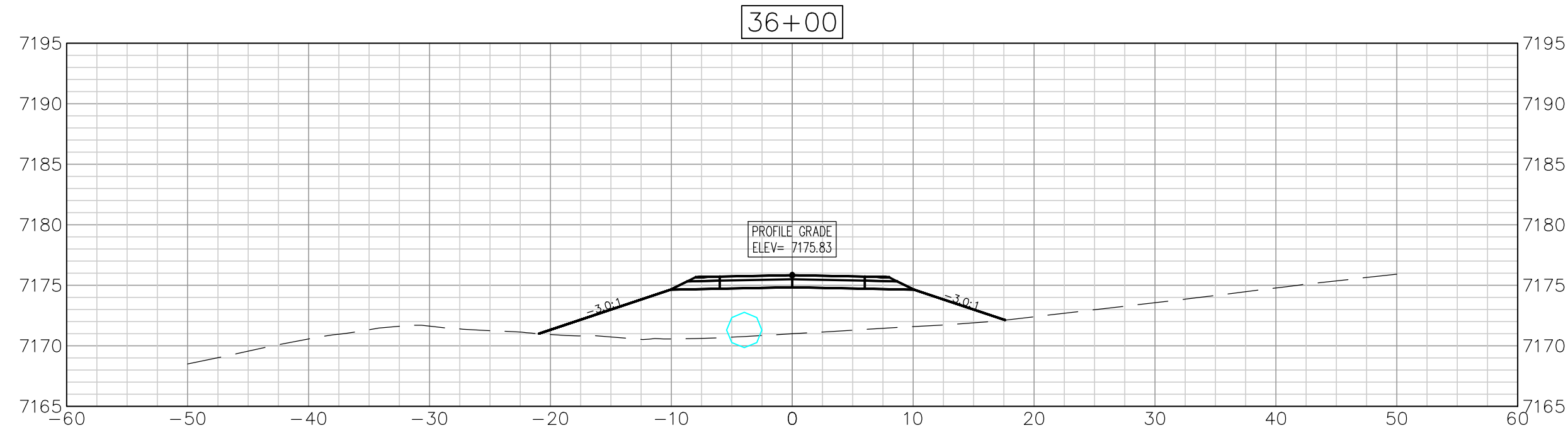
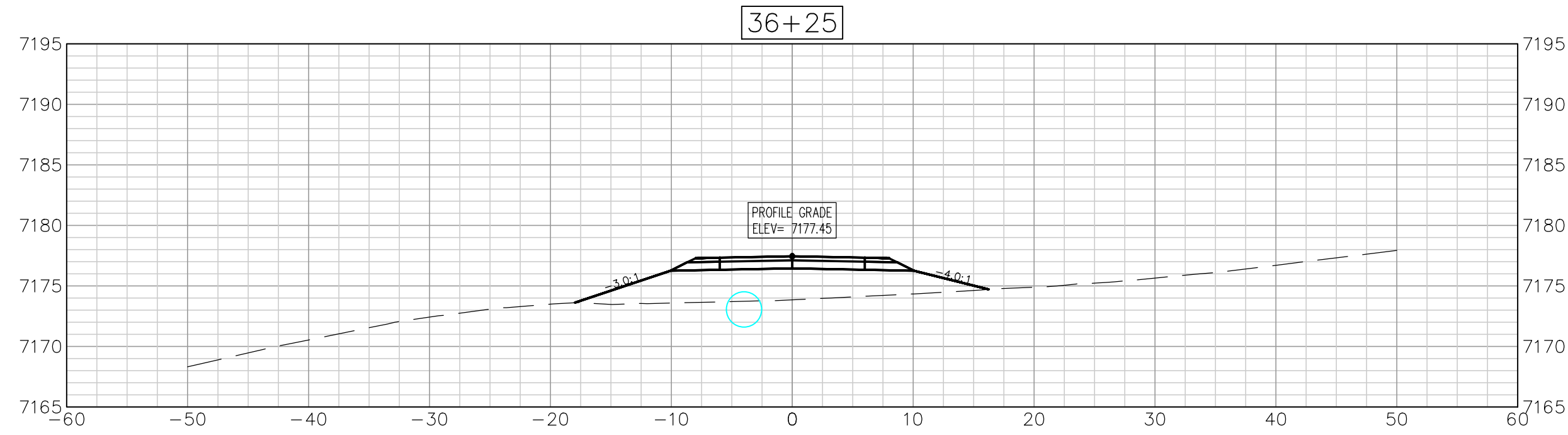


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DRAWN BY:	RSH
APPROVED BY:	RSH
DESIGN PROJ:	14-123
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DATE:	OCTOBER 9, 2015
DRAWING NO:	C121
SHEET NO:	



INTAKE ACCESS ROADWAY ROADWAY SECTIONS



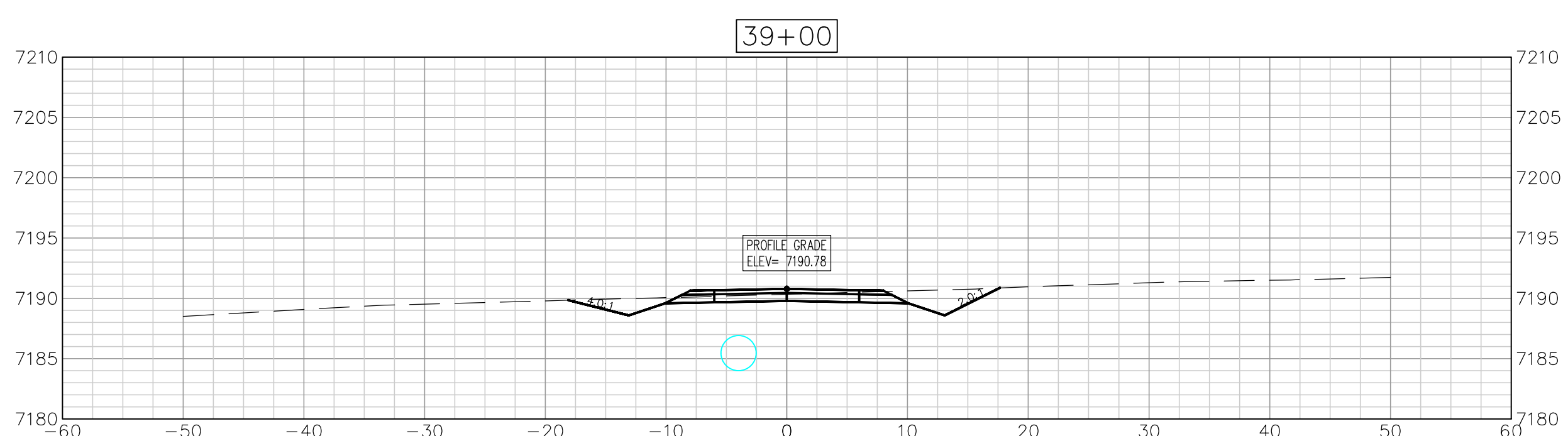
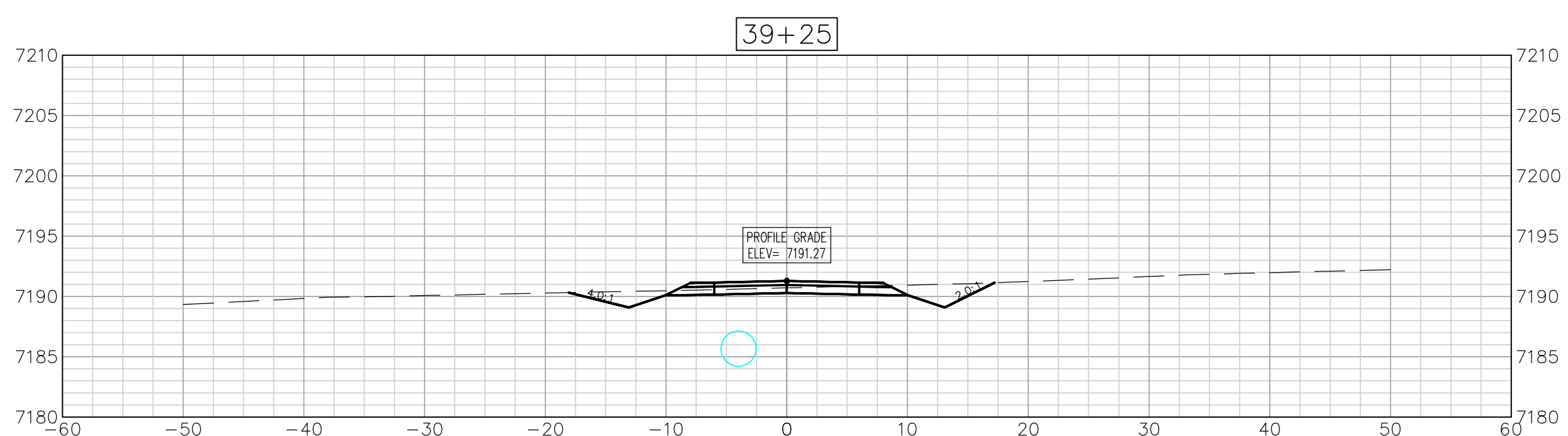
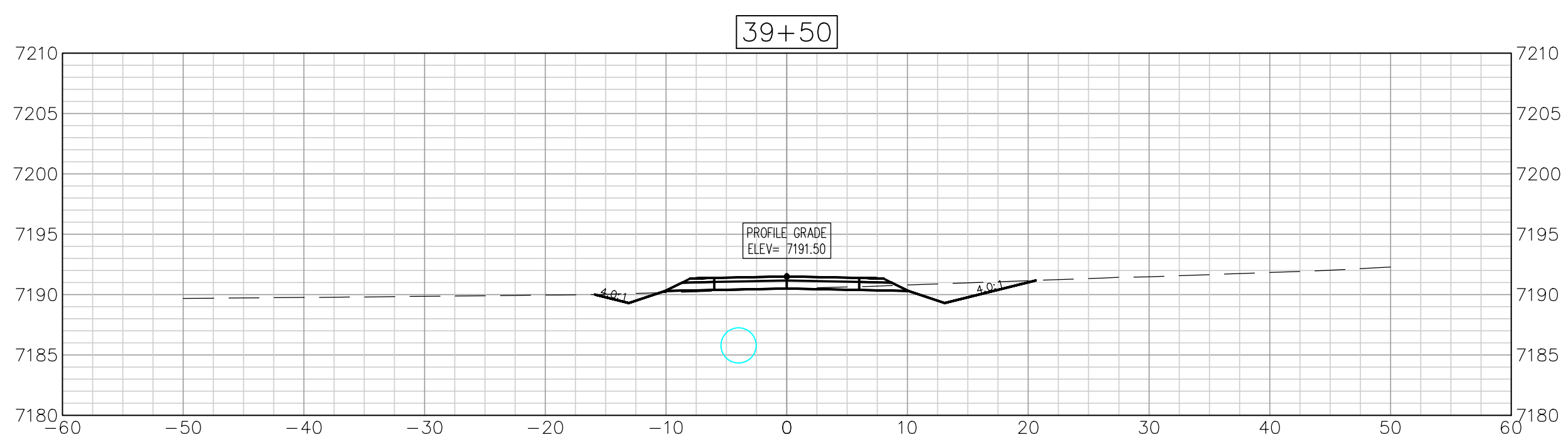
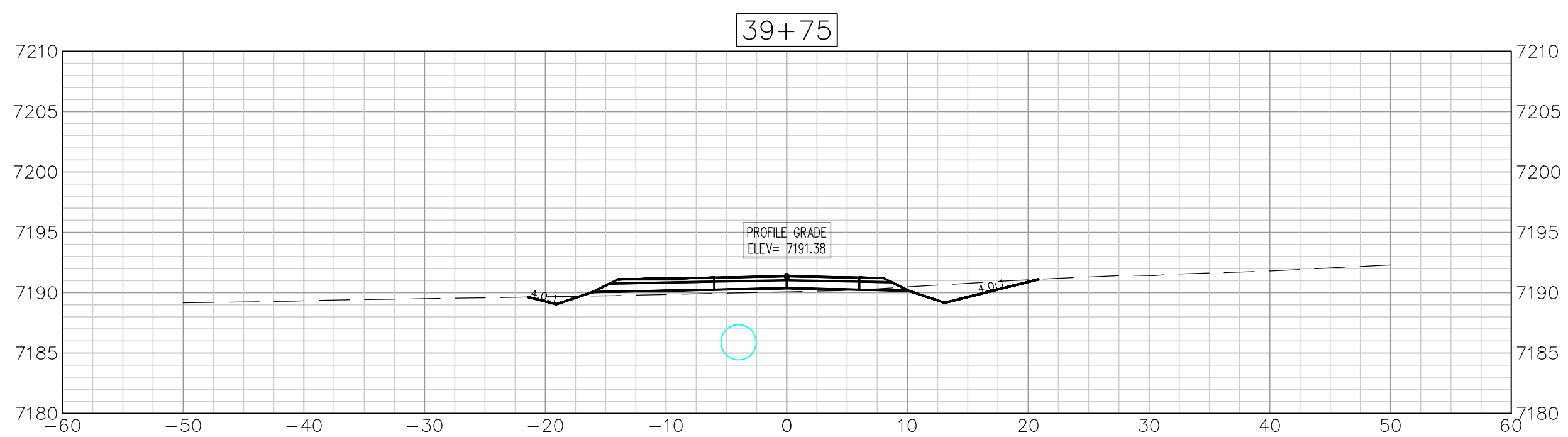
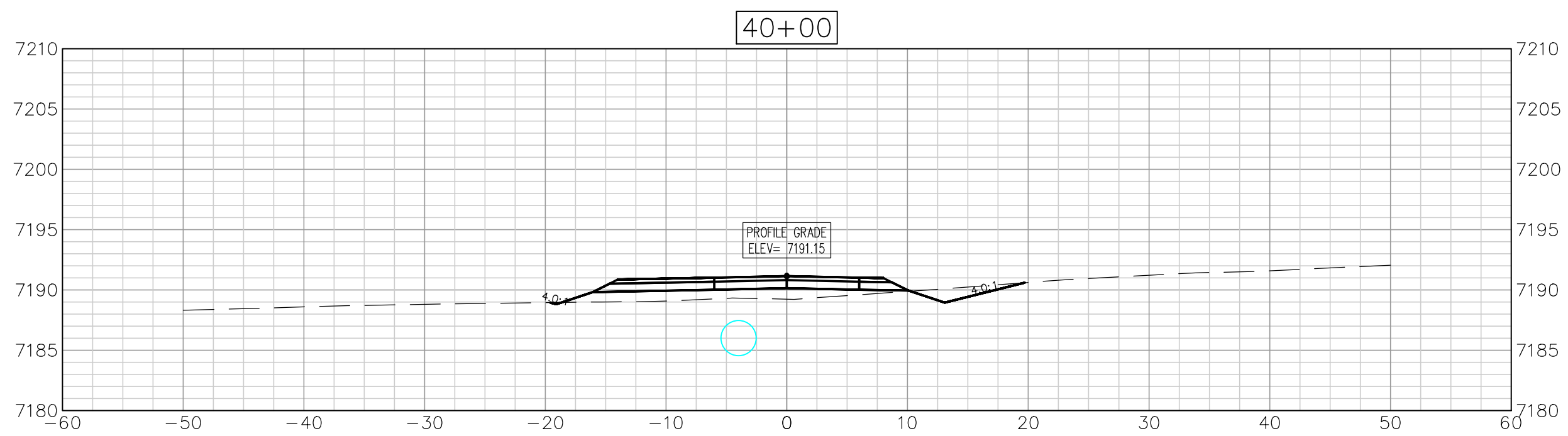
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INTAKE ACCESS ROADWAY ROADWAY SECTIONS



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DATE:	OCTOBER 9, 2015
DRAWING NO:	C123
SHEET NO:	

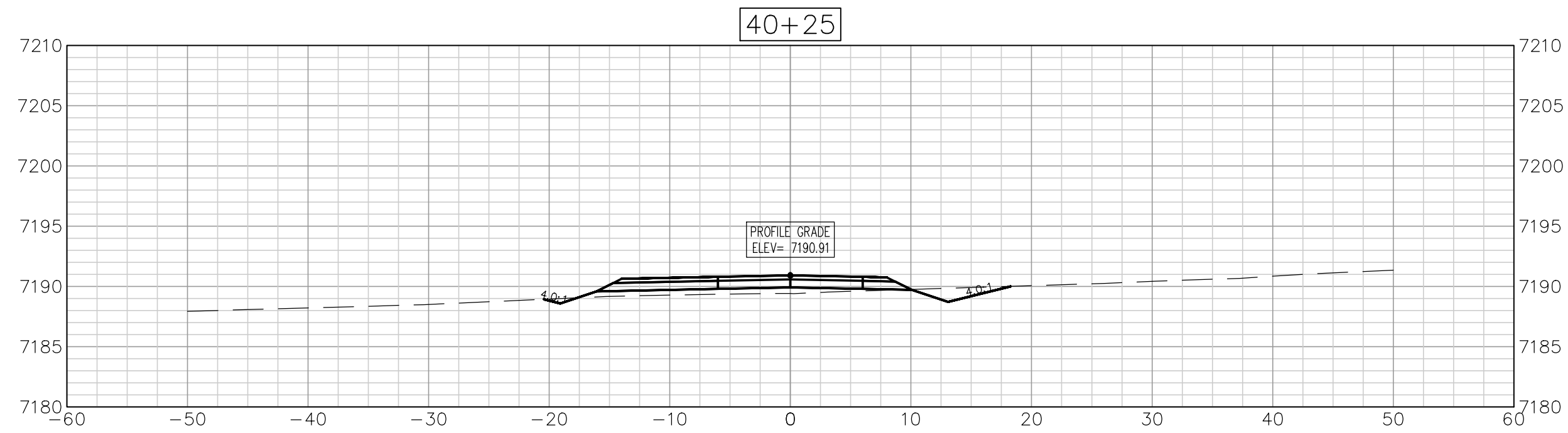
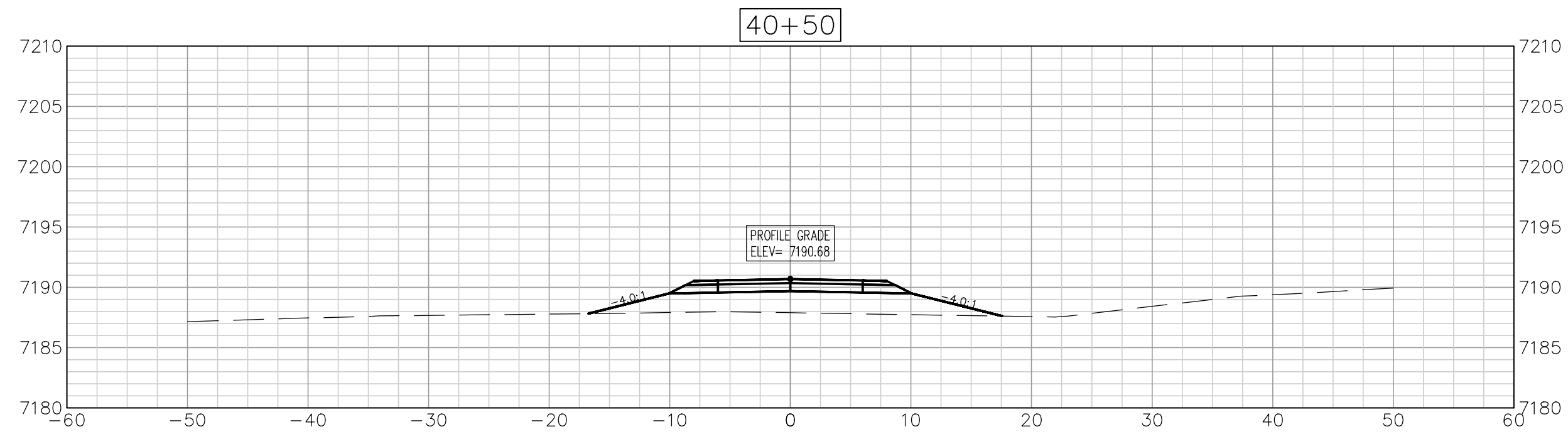
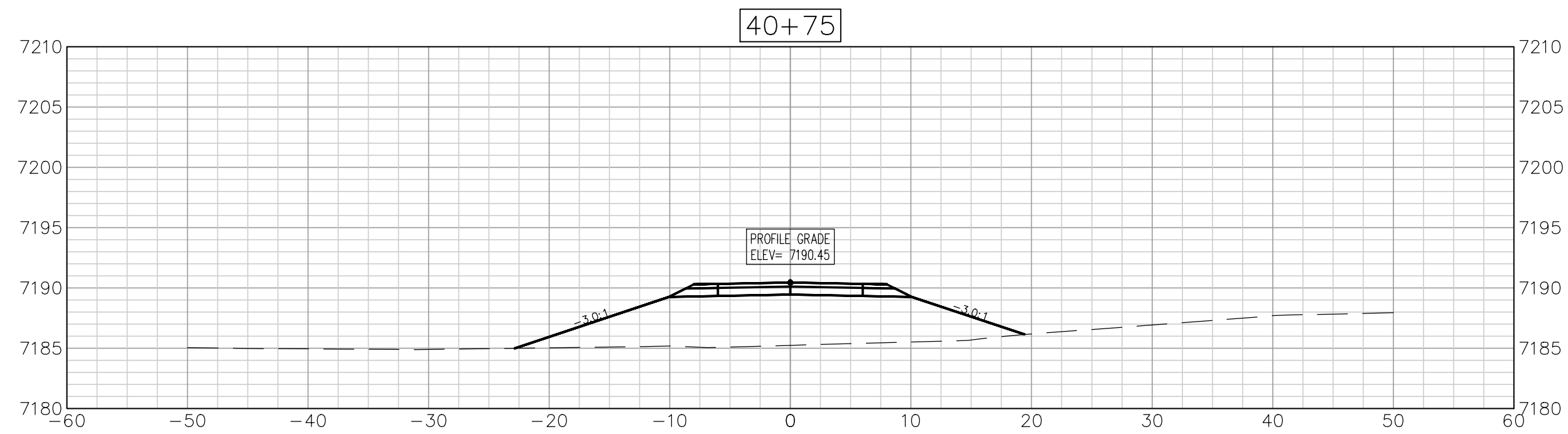
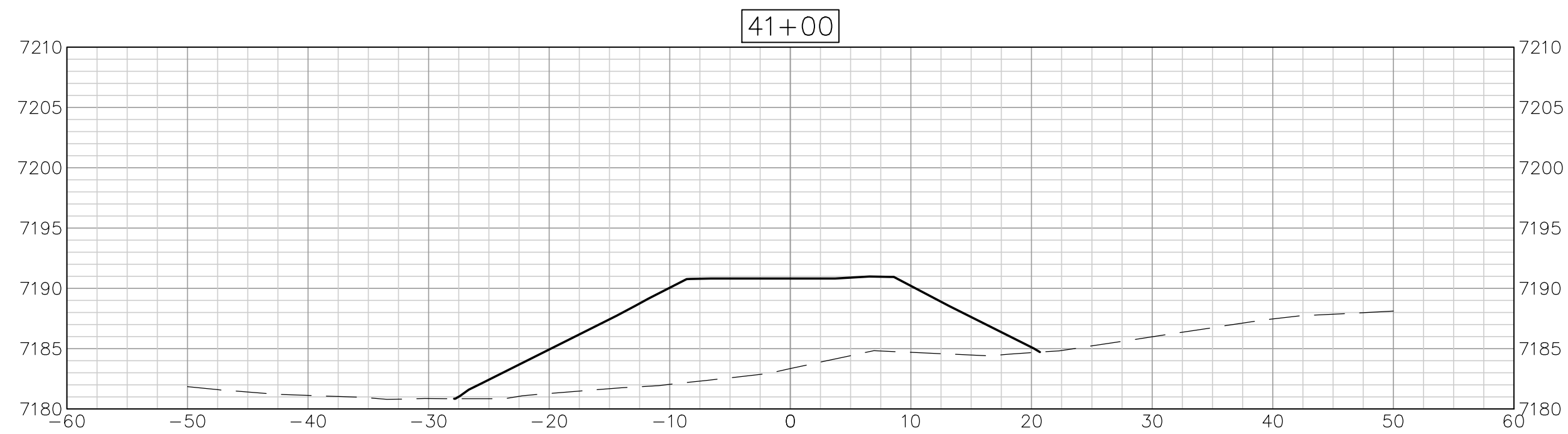
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INTAKE ACCESS ROADWAY ROADWAY SECTIONS



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DESIGN PROJ:	14-123
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DATE:	OCTOBER 9, 2015
DRAWING NO:	C125
SHEET NO:	

Total Volume Table						
Station	Fill Area	Cut Area	Fill Volume	Cut Volume	Cumulative Fill Vol	Cumulative Cut Vol
0+25	1.20	20.07	0.00	0.00	0.00	0.00
0+50	3.08	5.34	2.17	10.52	2.17	10.52
0+75	15.66	10.14	10.29	6.37	12.46	16.89
1+00	0.05	28.77	8.76	16.42	21.22	33.31
1+25	0.00	36.87	0.02	29.64	21.24	62.94
1+50	0.00	46.08	0.00	38.51	21.24	101.45
1+75	0.00	61.18	0.00	49.91	21.24	151.36
2+00	0.00	43.53	0.00	49.11	21.24	200.47
2+25	4.95	18.10	2.21	29.29	23.45	229.76
2+50	20.09	13.75	11.21	15.45	34.66	245.21
2+75	11.32	1.94	14.16	7.63	48.82	252.84
3+00	0.07	12.21	5.19	6.70	54.01	259.54
3+25	0.00	9.01	0.03	9.85	54.04	269.39
3+50	5.70	2.60	2.64	5.38	56.68	274.76
3+75	33.85	12.37	18.31	6.93	74.99	281.69
4+00	12.39	6.21	21.41	8.60	96.40	290.29
4+25	0.00	12.58	5.74	8.70	102.14	298.99
4+50	0.66	26.36	0.31	18.03	102.44	317.02
4+75	0.00	30.48	0.31	26.32	102.75	343.33
5+00	21.55	13.19	10.92	19.54	113.67	362.88
5+25	0.00	47.20	11.57	27.57	125.25	390.45
5+50	0.00	113.16	0.00	76.24	125.25	466.69
5+75	0.00	224.11	0.00	156.14	125.25	622.83
6+00	0.00	188.15	0.00	190.86	125.25	813.70
6+25	0.00	184.18	0.00	172.38	125.25	986.07
6+50	38.59	94.29	17.87	128.92	143.11	1115.00
6+75	28.36	78.14	31.00	79.83	174.11	1194.83
7+00	144.57	63.63	70.69	71.58	244.79	1266.41
7+25	129.20	4.00	120.90	33.02	365.70	1299.43
7+50	6.00	17.26	62.59	9.85	428.29	1309.27
7+75	0.58	106.25	3.05	57.18	431.34	1366.45
8+00	15.70	115.23	8.15	96.23	439.49	1462.68
8+25	0.00	134.12	8.42	101.20	447.91	1563.88
8+50	24.64	100.51	12.53	100.43	460.43	1664.31
8+75	33.93	92.17	27.11	89.20	487.55	1753.51
9+00	41.11	89.08	33.35	86.59	520.90	1840.10
9+25	140.06	11.84	80.32	48.64	601.22	1888.74
9+50	15.80	57.27	72.16	32.00	673.38	1920.74
9+75	2.74	87.46	8.58	67.01	681.96	1987.74
10+00	6.34	69.48	4.57	66.11	686.53	2053.85
10+25	0.00	101.29	3.21	74.17	689.74	2128.02
10+50	0.00	154.86	0.00	118.59	689.74	2246.61
10+75	1.77	140.44	0.82	136.71	690.56	2383.32
11+00	41.95	83.94	20.24	103.88	710.80	2487.20
11+25	25.05	46.47	32.54	57.06	743.34	2544.26
11+50	0.00	102.27	11.60	68.86	754.94	2613.12
11+75	0.00	184.62	0.00	132.82	754.94	2745.94
12+00	0.00	250.98	0.00	201.67	754.94	2947.61
12+25	0.00	295.53	0.00	253.01	754.94	3200.62
12+50	0.00	334.14	0.00	291.51	754.94	3492.14
12+75	0.00	332.08	0.00	308.43	754.94	3800.57
13+00	0.00	322.48	0.00	303.04	754.94	4103.60
13+25	0.00	268.23	0.00	273.48	754.94	4377.08
13+50	0.00	147.66	0.00	205.46	754.94	4582.54
13+75	0.00	114.37	0.00	123.54	754.94	4706.08
14+00	0.00	185.47	0.00	138.81	754.94	4844.89
14+25	0.00	231.71	0.00	188.95	754.94	5033.84
14+50	0.00	204.07	0.00	195.45	754.94	5229.29
14+75	0.00	228.83	0.00	200.42	754.94	5429.71
15+00	0.00	144.28	0.00	172.74	754.94	5602.44

Total Volume Table						
Station	Fill Area	Cut Area	Fill Volume	Cut Volume	Cumulative Fill Vol	Cumulative Cut Vol
15+25	0.00	114.01	0.00	119.58	754.94	5722.02
15+50	0.00	110.25	0.00	103.82	754.94	5825.85
15+75	4.51	44.44	2.09	71.62	757.03	5897.46
16+00	11.55	47.88	7.44	42.74	764.46	5940.21
16+25	0.01	71.46	5.35	55.25	769.81	5995.46
16+50	0.00	111.39	0.01	84.65	769.82	6080.11
16+75	0.00	107.25	0.00	101.22	769.82	6181.33
17+00	0.13	57.37	0.06	76.21	769.88	6257.55
17+25	16.55	26.26	7.72	38.72	777.60	6296.27
17+50	21.17	19.94	17.47	21.39	795.07	6317.66
17+75	17.99	29.04	18.13	22.67	813.20	6340.33
18+00	35.70	18.89	24.86	22.19	838.05	6362.52
18+25	74.01	3.75	51.45	10.21	889.50	6372.73
18+50	78.30	0.00	74.20	1.50	963.70	6374.23
18+75	59.58	0.00	64.07	0.00	1027.77	6374.23
19+00	51.04	0.00	51.22	0.00	1078.99	6374.23
19+25	23.60	1.32	34.56	0.61	1113.54	6374.84
19+50	1.56	19.07	11.65	9.44	1125.19	6384.28
19+75	0.00	55.52	0.72	34.53	1125.92	6418.82
20+00	0.00	68.39	0.00	57.37	1125.92	6476.18
20+25	0.00	64.88	0.00	61.26	1125.92	6537.44
20+50	0.00	74.79	0.00	62.78	1125.92	6600.23
20+75	0.00	74.68	0.00	66.08	1125.92	6666.31
21+00	19.04	46.64	9.51	52.95	1135.42	6719.25
21+25	22.12	19.96	20.33	28.76	1155.75	6748.02
21+50	30.35	23.08	25.61	18.41	1181.37	6766.42
21+75	19.81	24.36	23.57	21.50	1204.94	6787.93
22+00	9.05	24.64	13.36	22.69	1218.30	6810.61
22+25	0.00	106.62	4.19	60.77	1222.49	6871.38
22+50	0.00	89.97	0.00	91.02	1222.49	6962.40
22+75	0.00	69.12	0.00	73.65	1222.49	7036.05
23+00	0.00	84.98	0.00	71.34	1222.49	7107.39
23+25	0.00	112.59	0.00	91.46	1222.49	7198.86
23+50	0.00	132.56	0.00	117.13	1222.49	7315.98
23+75	0.00	183.83	0.00	151.65	1222.49	7467.63
24+00	0.00	204.86	0.00	185.79	1222.49	7653.42
24+25	0.00	195.71	0.00	188.42	1222.49	7841.83
24+50	0.00	187.93	0.00	177.61	1222.49	8019.44
24+75	0.00	187.39	0.00	173.76	1222.49	8193.21
25+00	0.00	136.69	0.00	150.04	1222.49	8343.24
25+25	0.00	57.15	0.00	89.74	1222.49	8432.98
25+50	7.98	34.49	3.69	42.43	1226.18	8475.41
25+75	0.00	30.93	3.69	30.29	1229.88	8505.70
26+00	0.00	87.41	0.00	54.79	1229.88	8560.49
26+25	0.00	152.37	0.00	110.97	1229.88	8671.46
26+50	0.00	188.08	0.00	157.62	1229.88	8829.08
26+75	0.00	200.64	0.00	179.96	1229.88	9009.04
27+00	0.00	209.52	0.00	189.89	1229.88	9198.93
27+25	0.00	194.84	0.00	187.20	1229.88	9386.13
27+50	0.00	162.68	0.00	165.51	1229.88	9551.64
27+75	0.00	124.09	0.00	130.67	1229.88	9682.31
28+00	0.00	95.16	0.00	100.25	1229.88	9782.57
28+25	0.00	128.08	0.00	104.08	1229.88	9886.64
28+50	0.00	64.52	0.00	89.17	1229.88	9975.81
28+75	15.78	2.18	7.31	30.88	1237.18	10006.70
29+00	68.89	0.00	39.20	1.01	1276.38	10007.70
29+25	26.71	4.83	44.26	2.23	1320.64	10009.94
29+50	32.40	32.61	27.37	17.33	1348.01	10027.27
29+75	10.24	20.87	19.74	24.76	1367.75	10052.04
30+00	0.00	51.79	4.74	33.64	1372.49	10085.67

Total Volume Table						
Station	Fill Area	Cut Area	Fill Volume	Cut Volume	Cumulative Fill Vol	Cumulative Cut Vol
30+25	0.00	50.84	0.00	47.51	1372.49	10133.19
30+50	36.36	23.47	17.78	32.57	1390.27	10165.76
30+75	90.11	19.29	58.55	19.80	1448.82	10185.56
31+00	19.77	31.30	50.87	23.42	1499.69	10208.98
31+25	0.00	60.99	9.66	40.77	1509.35	10249.75
31+50	14.63	47.16	7.76	45.85	1517.11	10295.60
31+75	27.79	64.42	21.97	46.15	1539.08	10341.75
32+00	29.31	71.96	28.17	58.38	1567.25	10400.13
32+25	0.00	38.19	13.57	51.00	1580.82	10451.13
32+50	0.00	36.06	0.00	35.04	1580.82	10486.16
32+75	0.10	147.13	0.03	91.66	1580.85	10577.83
33+00	0.00	242.09	0.03	196.16	1580.88	10773.98
33+25	0.00	320.11	0.00	270.16	1580.88	11044.14
33+50	0.00	270.63	0.00	273.49	1580.88	11317.63
33+75	7.62	32.28	3.53	140.24	1584.41	11457.87
34+00	56.51	1.40	29.69	15.59	1614.09	11473.46
34+25	33.05	9.15	41.46	4.88	1655.55	11478.35
34+50	6.62	16.93	18.37	12.07	1673.92	11490.42
34+75	0.00	55.22	3.07	33.40	1676.99	11523.82
35+00	2.12	40.90	0.98	44.50	1677.97	11568.33
35+25	49.95	7.15	25.93	20.30	1703.90	11588.63
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37+00	16.04	14.76	22.24	9.36	2167.63	11606.39
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DESIGN VEHICLE = SU-40 (AASHTO 2011)

MAXIMUM GRADIENT = 14%

DESIGN TRAFFIC VOLUME = 10 ADT

1. CONTRACTOR IS ADVISED THAT UNDERGROUND WATER, SEWER, DRAINAGE, TELEPHONE, FIBER OPTIC, GAS, AND CABLE TV FACILITIES ARE LOCATED IN THE VICINITY OF THIS PROJECT. LOCATIONS SHOWN FOR EXISTING UTILITIES ARE APPROXIMATE. OTHER UTILITIES MAY EXIST WHICH ARE NOT SHOWN ON THE PLANS. SEWER AND WATER SERVICE CONNECTIONS ARE NOT SHOWN BUT ARE KNOWN TO EXIST.

2. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO DETERMINE THE TRUE AND CORRECT LOCATIONS OF EXISTING UTILITIES THAT MAY IMPACT EACH PORTION OF THE WORK. 48 HOURS PRIOR TO PERFORMING WORK, THE CONTRACTOR SHALL CONTACT THE UTILITY LOCATION SERVICE AT (800) 922-1987. CONTRACTOR SHALL NOTIFY ENGINEER PRIOR TO COMMENCING CONSTRUCTION IF MARKED UTILITIES APPEAR TO CONFLICT WITH PROPOSED IMPROVEMENTS. THE COST OF LOCATING, PROTECTING AND ACCOMMODATING EXISTING UTILITIES SHALL BE INCIDENTAL TO THE COST OF THE PROJECT. IF AN ACTUAL CONFLICT REQUIRES RELOCATION OF AN EXISTING UTILITY OR THE REDESIGN OF THE PROPOSED IMPROVEMENT, THE ENGINEER WILL DETERMINE IF EXTRA PAY IS WARRANTED TO ACCOMMODATE THE CHANGED OR UNFORESEEN CONDITION. MINOR HORIZONTAL OR VERTICAL ADJUSTMENTS OF THE PROPOSED IMPROVEMENTS TO AVOID CONFLICTS SHALL NOT ENTITLE THE CONTRACTOR TO EXTRA PAY.

1. THE CONTRACTOR SHALL SUBMIT A STORM WATER MANAGEMENT PLAN (SWMP) PLAN AND OBTAIN A SWMP PERMIT PRIOR TO ANY CONSTRUCTION.
2. A COMPREHENSIVE RESTORATION PLAN SHALL BE DETAILED AND APPROVED BEFORE CONSTRUCTION BEGINS.

1. ALL WORK WITHIN THE COUNTY AND PRIVATE ROAD AREAS SHALL BE SIGNED IN ACCORDANCE WITH THE MUNICIPAL UNIFORM TRAFFIC CONTROL DISTRICT (M.U.T.C.D.).

2. ALL SUBGRADE AND PAVEMENT MATERIALS SHALL COMPLY WITH COLORADO DEPARTMENT OF TRANSPORTATION (CDOT) STANDARDS FOR ROAD AND BRIDGE CONSTRUCTION.

3. ALL EXCAVATION AND EMBANKMENT SHALL BE PERFORMED IN AN ACCORDANCE WITH CDOT SPECIFICATION SECTION 200.

4. ANY BLASTING SHALL BE PERFORMED BY A COMPETENT BLASTER. BLAST AREAS SHALL BE PROPERLY BLANKETED. PROPER NOTIFICATION SHALL BE GIVEN TO ALL LANDOWNERS WITHIN THE BLAST ZONE PRIOR TO BLASTING OPERATIONS.

5. PROPER MEASURES SHALL BE TAKEN FOR DUST CONTROL AND SWEEPING ROADWAYS OF TRACKED MUD DURING CONSTRUCTION.

6. COMPACTION TESTING OF AGGREGATE BASE COURSE (A.B.C.), ASPHALT PAVEMENT, AND CONCRETE SHALL BE PERFORMED IN ACCORDANCE WITH CDOT SPECIFICATION SECTION 106.

7. TRAFFIC PATTERNS SHALL BE MAINTAINED ON ALL EXISTING ROADWAYS IN ACCORDANCE WITH CDOT SPECIFICATION SECTION 104.04.

8. CONTRACTOR SHALL COORDINATE WITH ENGINEER PRIOR TO CONSTRUCTION FOR DIMENSION SITE PLAN, COORDINATE TABLE AND CUT SHEET, AS NEEDED.

9. AREAS WHERE SUBGRADE COMPACTION CANNOT BE ACHIEVED WILL BE STABILIZED BY OVER-EXCAVATION TO A DEPTH OF 24" BENEATH SUBGRADE AND REPLACING THE MATERIAL WITH 8" LIFTS OF CLEAN 1" MINUS CRUSHED ROCK. GEOTEXTILE FABRIC (TENSOR 1100-X (O.A.E.)) SHALL BE PLACED AT THE NATIVE SOIL INTERFACE AND AS DIRECTED BY THE FIELD ENGINEER.

10. PERMANENT TURF REINFORCEMENT MAT MAY BE USED IN LIEU OF RIP-RAP EROSION PROTECTION FOR ROADSIDE DRAINAGE SWALES. MAT SHALL BE NORTH AMERICAN GREEN P-300 (OAE) AND INSTALLED PER MANUFACTURER'S DIRECTION.

11. PREPARED SUBGRADE TO CONSIST OF EITHER 12" MIN THICKNESS OF COMPACTED STRUCTURAL FILL OR 12" MIN THICKNESS OF SCARIFIED, MOISTURE CONDITIONED & RECOMPACTED NATIVE SOIL. SUBGRADE COMPACTION TO BE PERFORMED BY PROOF-ROLLING METHODS TO THE SATISFACTION OF THE ENGINEER.

12. ALL BASE GRAVELS SHALL BE COMPACTED TO AT LEAST 95% OF THE MAXIMUM DRY DENSITY AS DEFINED BY ASTM D1557 (MODIFIED PROCTOR)

13. ALL CLEARING AND WASTING OF EXCAVATED MATERIAL SHALL BE COORDINATED WITH THE OWNER AND/OR THEIR REPRESENTATIVE. GRUBBED TREES SHALL BE BURIED PER B.O.R. SPECIFICATIONS. ORGANIC MATERIAL SHALL NOT BE USED IN STRUCTURAL FILL AREAS.

14. ALL GUARD RAIL MATERIALS AND INSTALLATION SHALL COMPLY WITH CDOT STANDARD PLAN M-606-1.

15. PRIOR TO CONSTRUCTION OF THE ACCESS ROAD AND IMPROVEMENTS WITHIN THE COUNTY RIGHT-OF-WAY, AN ACCESS PERMIT MUST BE OBTAINED FROM LA PLATA COUNTY FOR ACCESS ONTO COUNTY ROAD 211.

1. ALL WATER MAIN PIPING AND FITTINGS SHALL BE CLASS 235 PVC PIPE, COMPLYING WITH AWWA C-905.

2. ALL PIPE LINES SHALL BE BURIED A MINIMUM OF 42 INCHES, AND BEDDED IN A ROCK FREE MATERIAL TO 12" ABOVE THE PIPE. IF 3-1/2 FOOT BURIAL IS UNACHIEVABLE, CONTACT ENGINEER FOR SUBSTANDARD BURIAL REQUIREMENTS.

3. ALL FITTINGS SHALL MEET THE APPROPRIATE AWWA SPECIFICATION.

4. ALL LINES SHALL BE PRESSURE TESTED TO 250 PSI FOR A MINIMUM OF ONE HOUR. A LEAKAGE TEST SHALL BE PERFORMED FOR TWO HOURS TO A TEST PRESSURE OF 200 PSI. ALLOWABLE LEAKAGE SHALL BE DETERMINED BY THE ENGINEER PER ACCEPTED STANDARDS.

5. ALL PIPING, FITTINGS, AND APPURTENANCES FOR THE WATER SYSTEM SHALL BEAR THE N.S.F. SEAL OF APPROVAL FOR POTABLE WATER USE.

6. ALL BENDS, TEES AND FITTINGS SHALL BE RESTRAINED WITH MECHANICAL THRUST RESTRAINTS AND CONCRETE THRUST BLOCKS POURED AGAINST UNDISTURBED EARTH OR ROCK. THE MINIMUM FACE AREA FOR ALL THRUST BLOCKS SHALL BE AS SHOWN IN THE THRUST BLOCK TABLE.

7. WHERE MINOR BENDS ARE SHOWN FOR WATER LINES, DEFLECTION IS TO BE TAKEN IN JOINTS NO GREATER THAN .75 DEGREES (3-1/4 INCHES PER 20 FOOT SECTION), OR ONE HALF THAT RECOMMENDED BY THE MANUFACTURER, WHICHEVER IS MORE RESTRICTIVE.



INTAKE ACCESS ROADWAY **DETAILS**

**RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO**



DESIGNED: RSH

DRAWN BY: RSH

APPROVED BY: RSH

DESIGN PROJ: 14-123

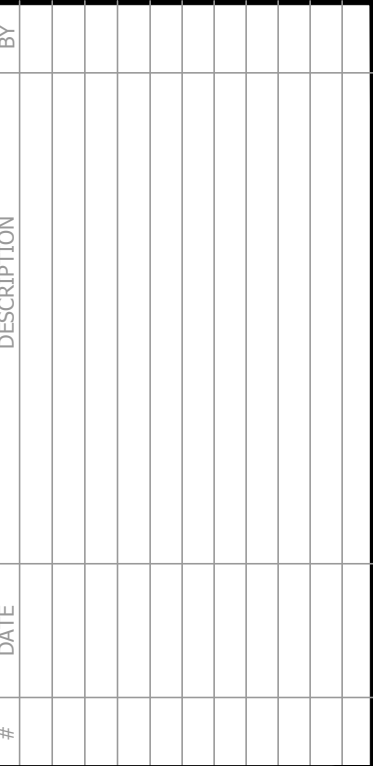
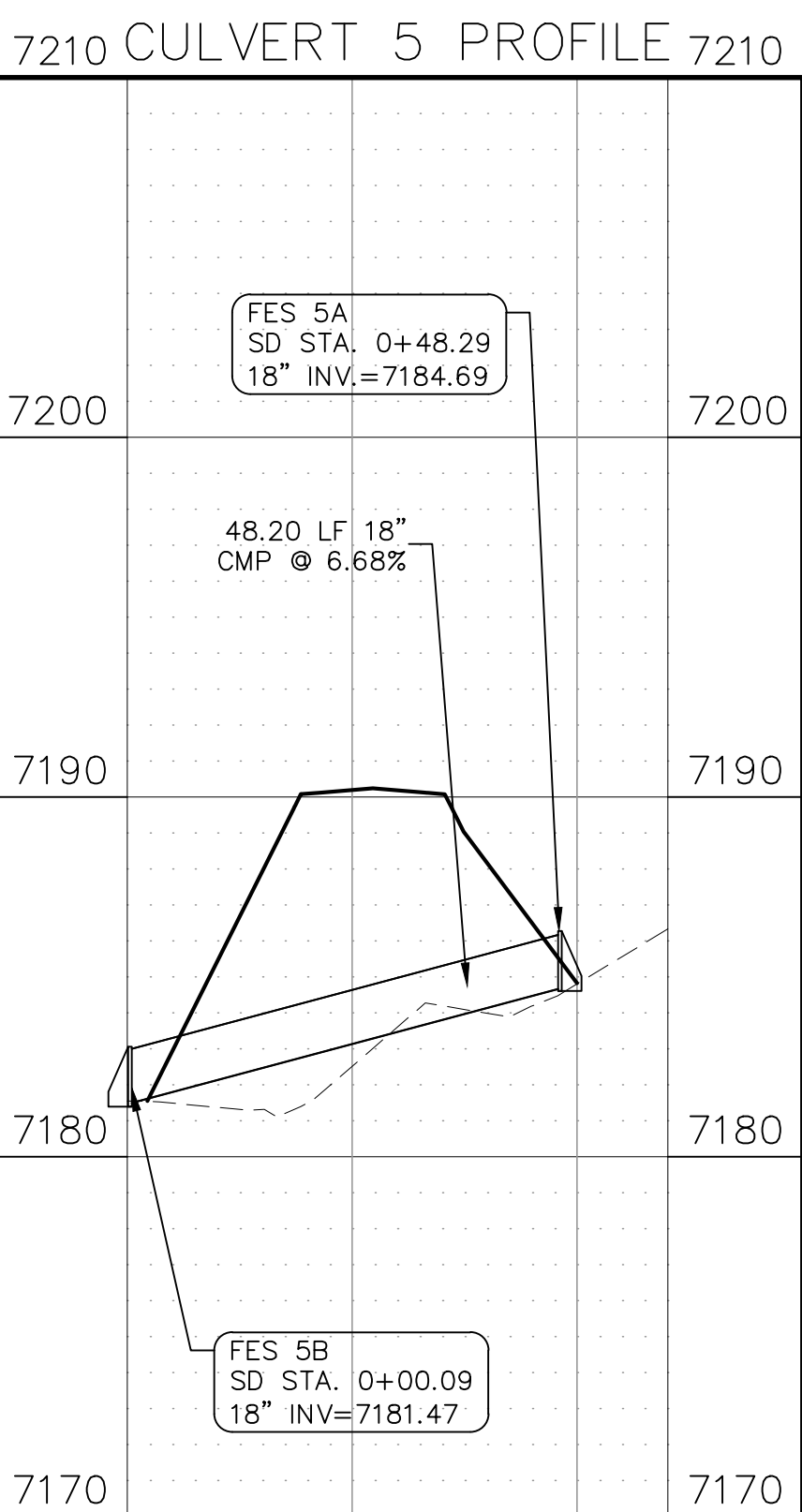
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AS SHOWN

DATE: OCTOBER 9, 2015

DRAWING NO: **C127**

0127

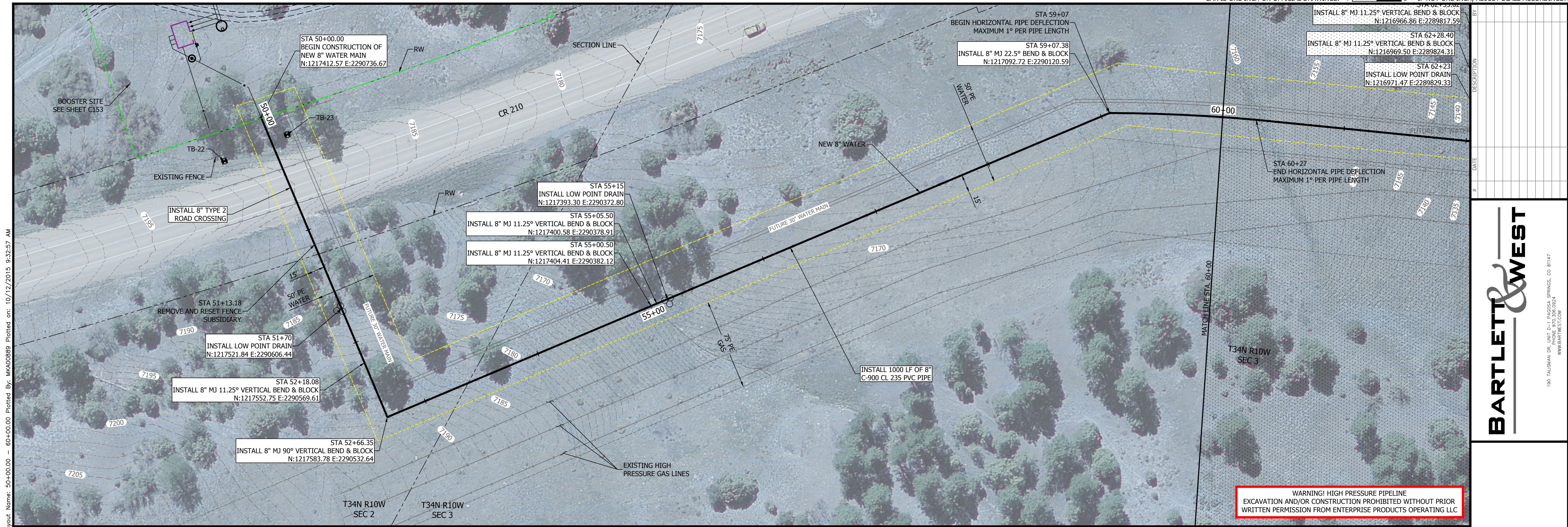


INTAKE ACCESS ROADWAY DETAILS

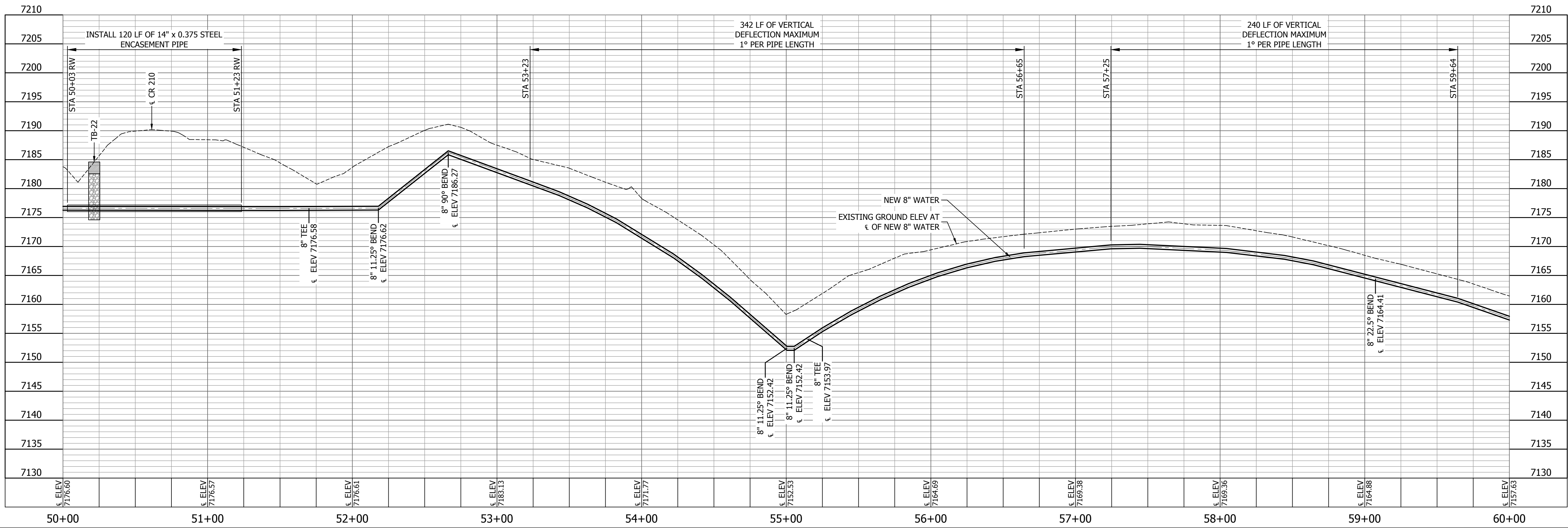
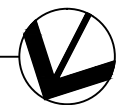


DESIGNED:	RSH
DRAWN BY:	RSH
APPROVED BY:	RSH
DESIGN PROJ:	14-123
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	AS SHOWN
DATE:	OCTOBER 9, 2015
DRAWING NO:	C128
SHEET NO:	

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Last edit on: 00/00/00



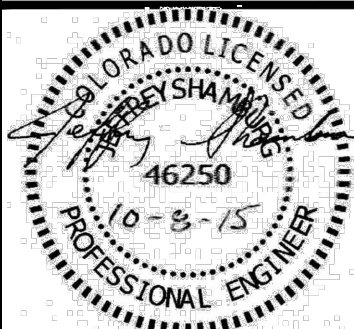
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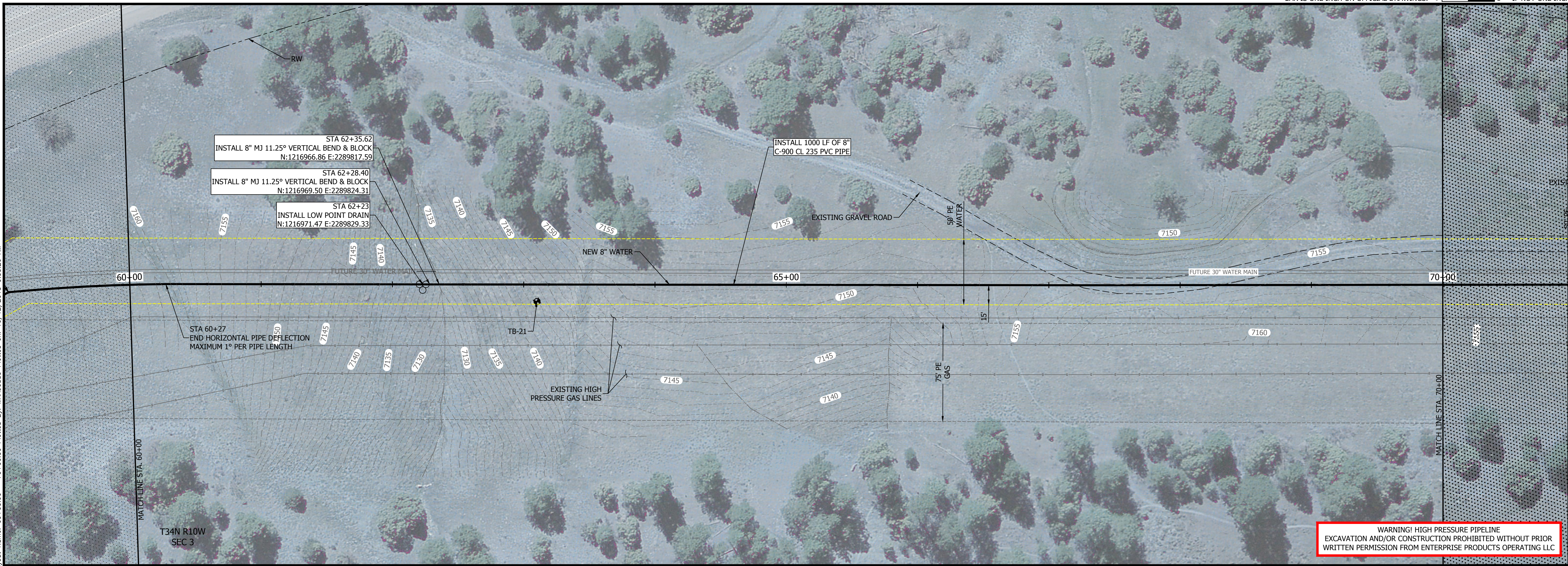
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**WATER PIPELINE
STA 50+00 - 60+00**
**RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO**

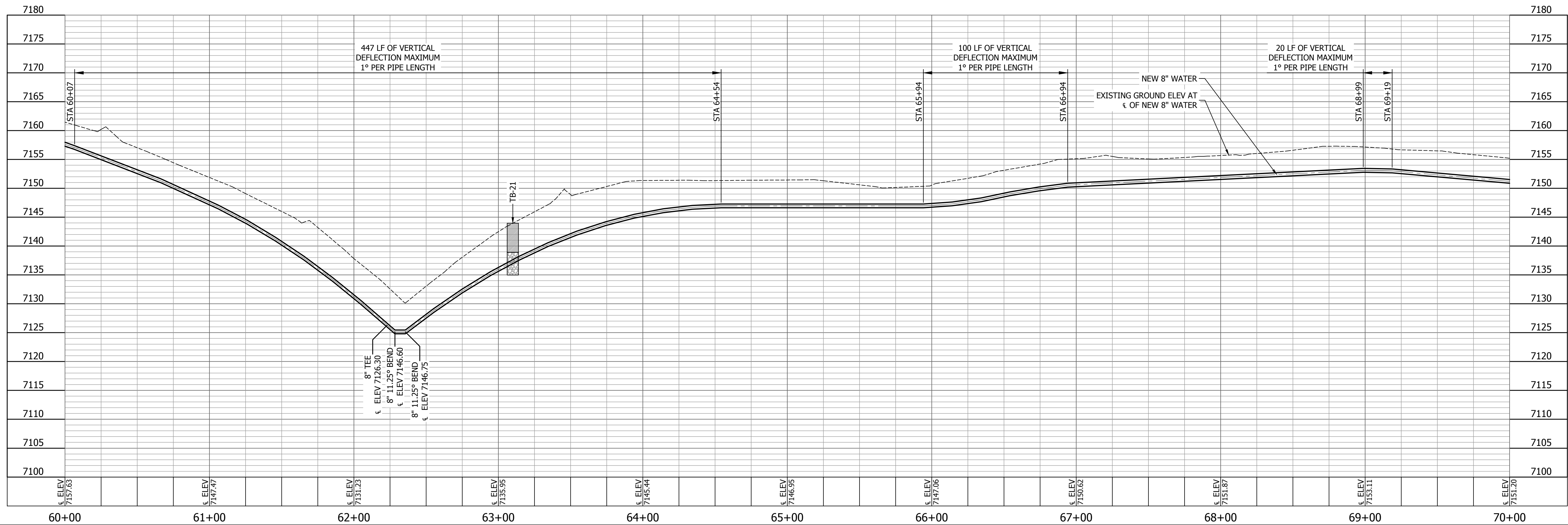
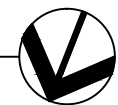


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DRAWN BY:	MKA
APPROVED BY:	JAS
DESIGN PROJ:	17865.005
CONST PROJ:	----
SCALE:	AS NOTED
DATE:	OCT 2015
DRAWING NO:	C129
SHEET NO:	37 of 114

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Last edit on: 00/00/00



STA 60+00 - 70+00
SCALE: HORZ-1" = 40' VERT-1"=10'



BAR IS ONE INCH ON OFFICIAL DRAWINGS. 0 1" IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.

BY
DATE
#

DESCRIPTION

EXIST

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WATER PIPELINE

STA 60+00 - 70+00

RAW WATER PROJECT

LA PLATA WEST WATER AUTHORITY

LA PLATA COUNTY, COLORADO

UNITED STATES OF AMERICA

COLORADO LICENSED

PROFESSIONAL ENGINEER

46250

10-8-15

DESIGNED BY: RHT

DRAWN BY: MKA

APPROVED BY: JAS

DESIGN PROJ: 17865.005

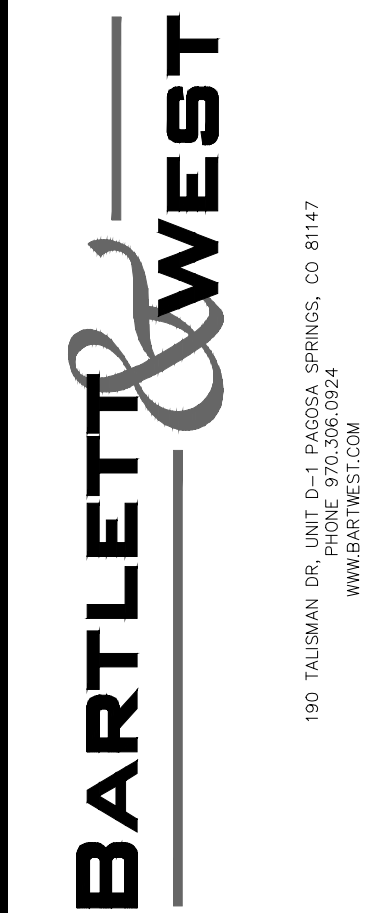
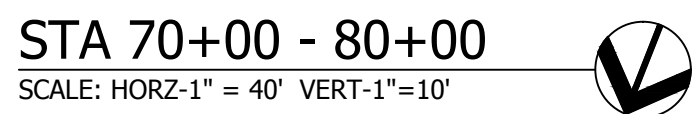
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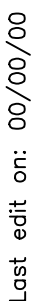
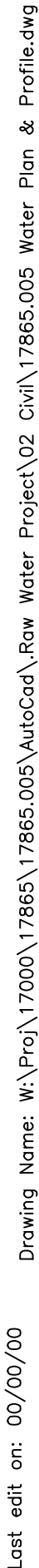
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WATER PIPELINE
STA 70+00 - 80+00

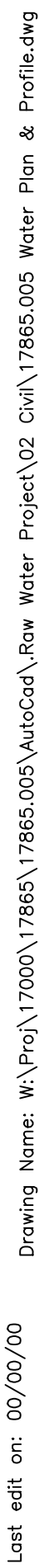


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APPROVED BY:	JAS
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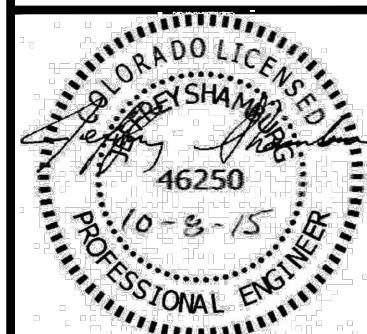
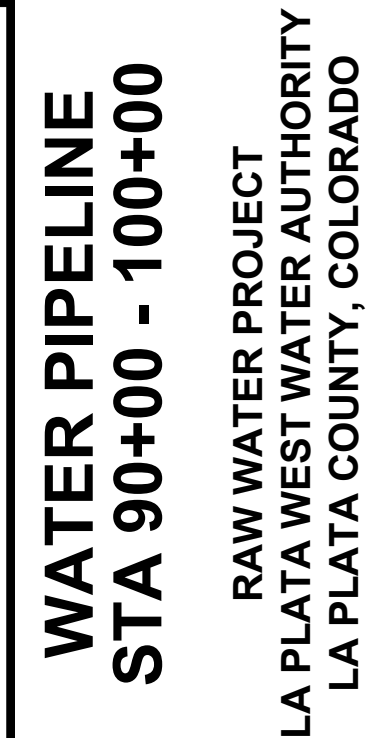
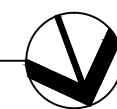


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C132
SHEET NO: 40 of 114



SCALE: HORZ-1" = 40' VERT-1"=10'



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DRAWN BY:	MKA
APPROVED BY:	JAS
DESIGN PROJ:	17865.005
CONST PROJ:	----
SCALE:	AS NOTED
DATE:	OCT 2015

DRAWING NO: **C133**

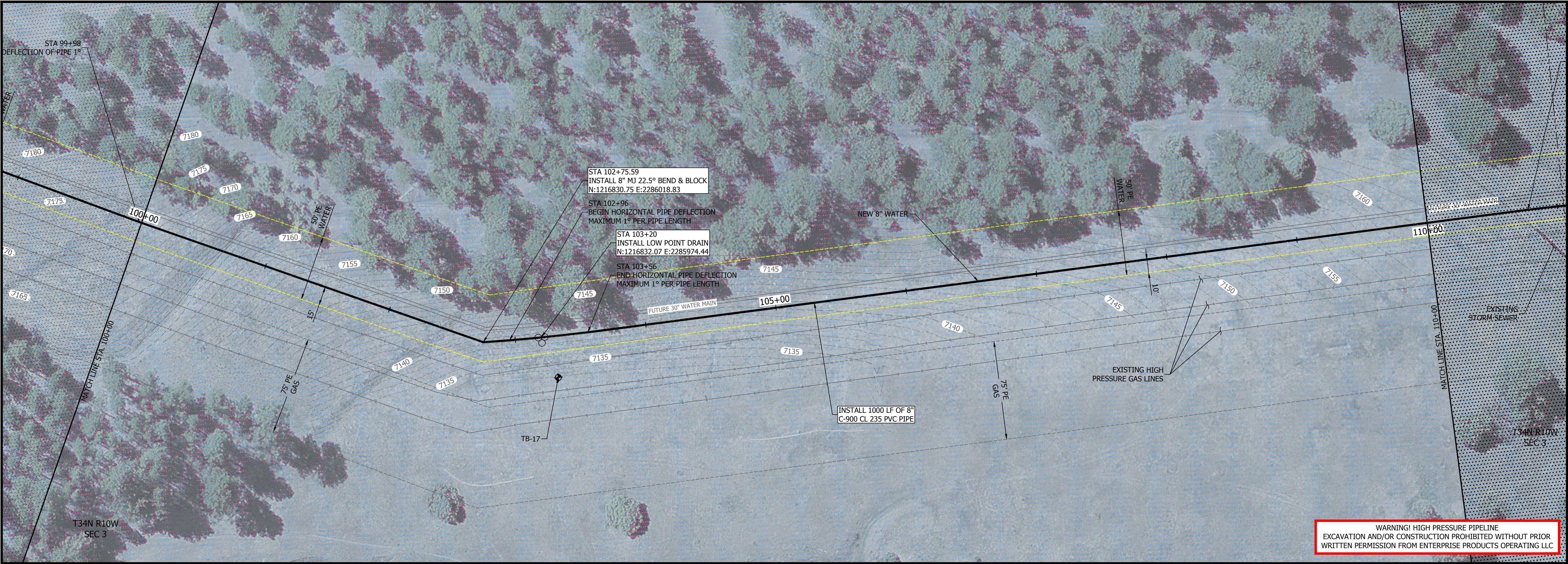
SHEET NO: 41 of 114

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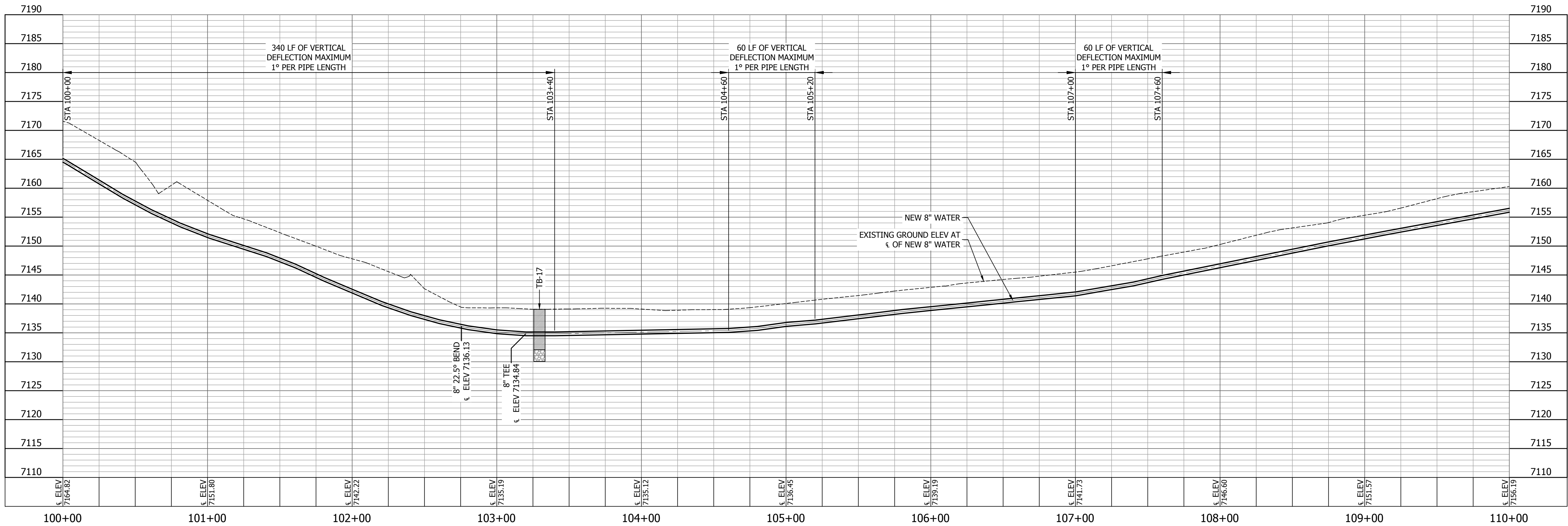
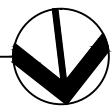
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STA 100+00 - 110+00

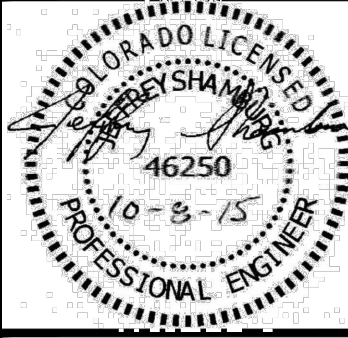
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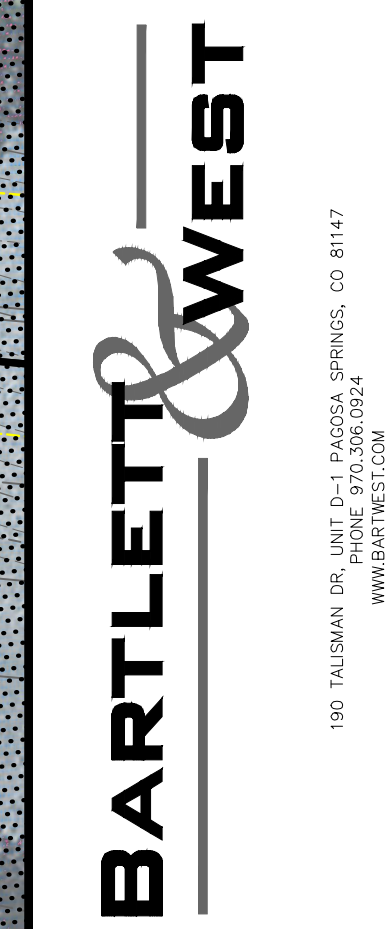
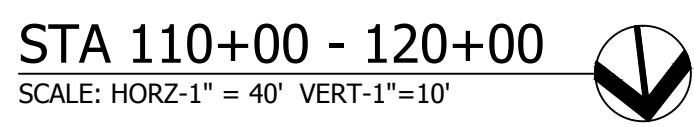
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WATER PIPELINE
STA 100+00 - 110+00
RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO

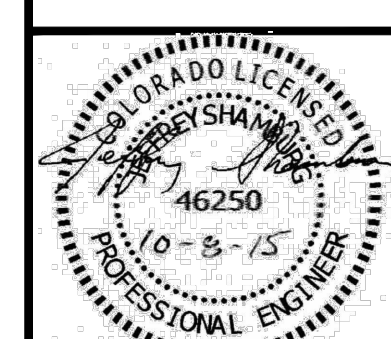


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SHEET NO:	42 of 114



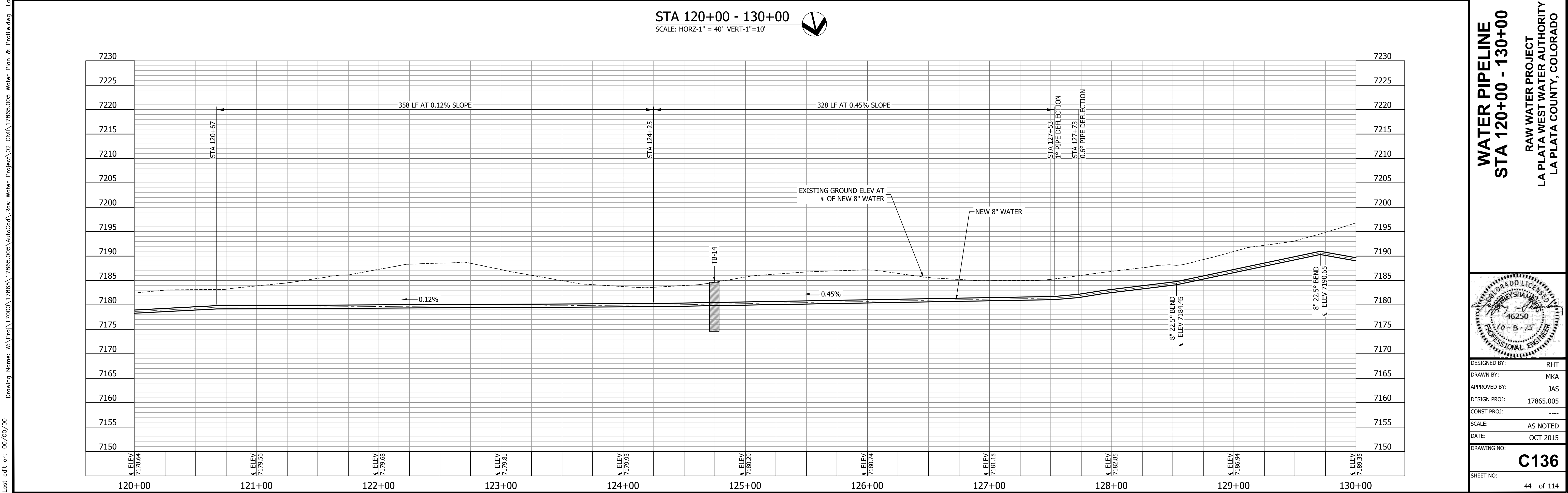
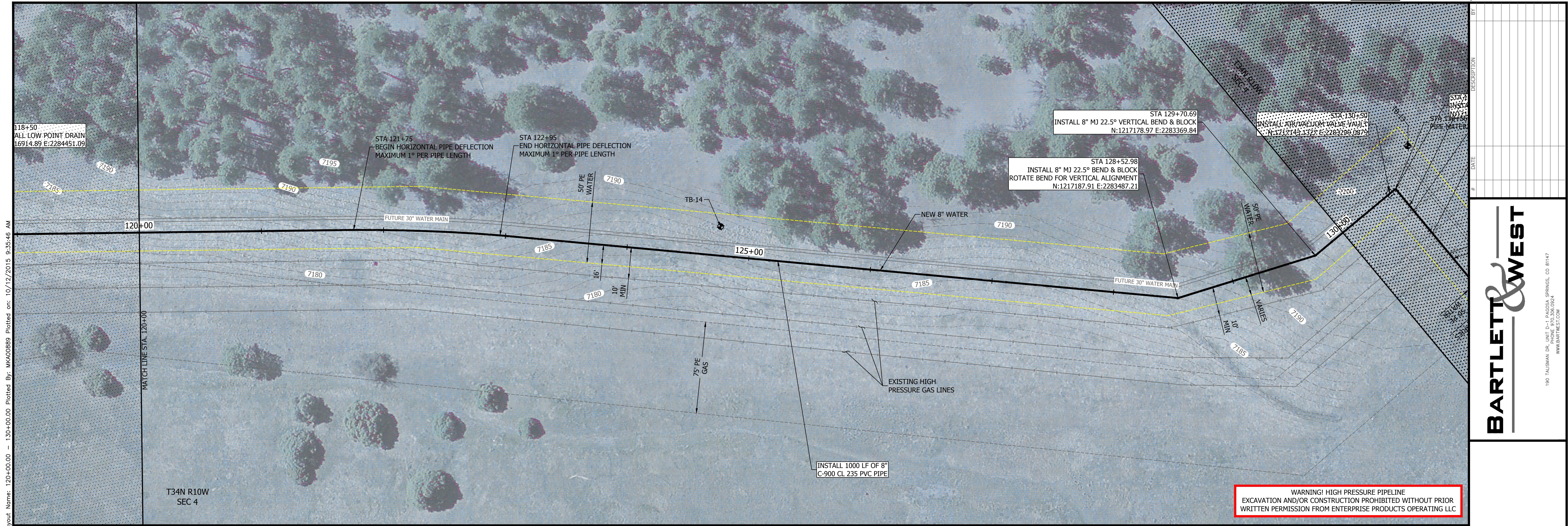
WATER PIPELINE
STA 110+00 - 120+00

RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO



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APPROVED BY:	JAS
DESIGN PROJ:	17865.005
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SCALE:	AS NOTED
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SHEET NO:	43 of 114

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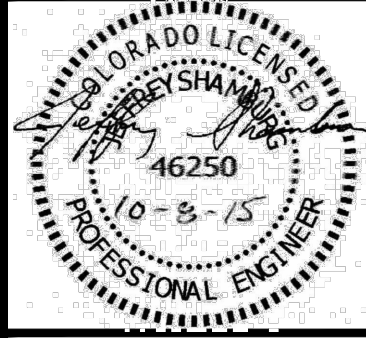


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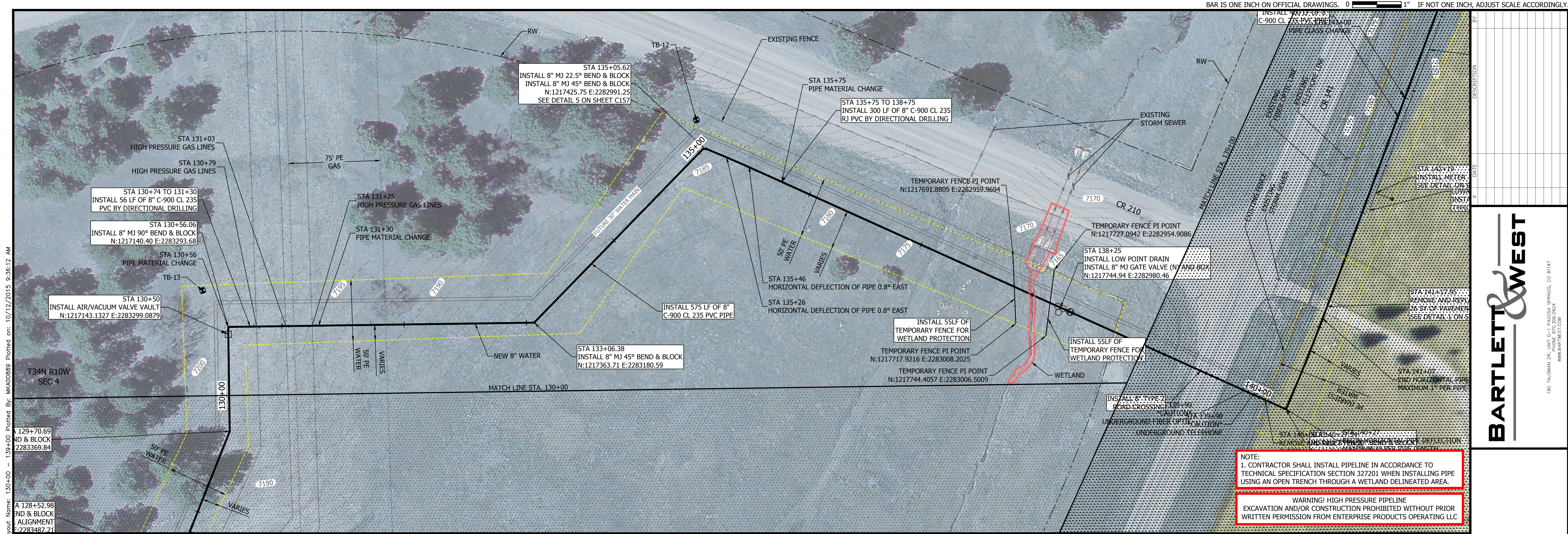
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**RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO**

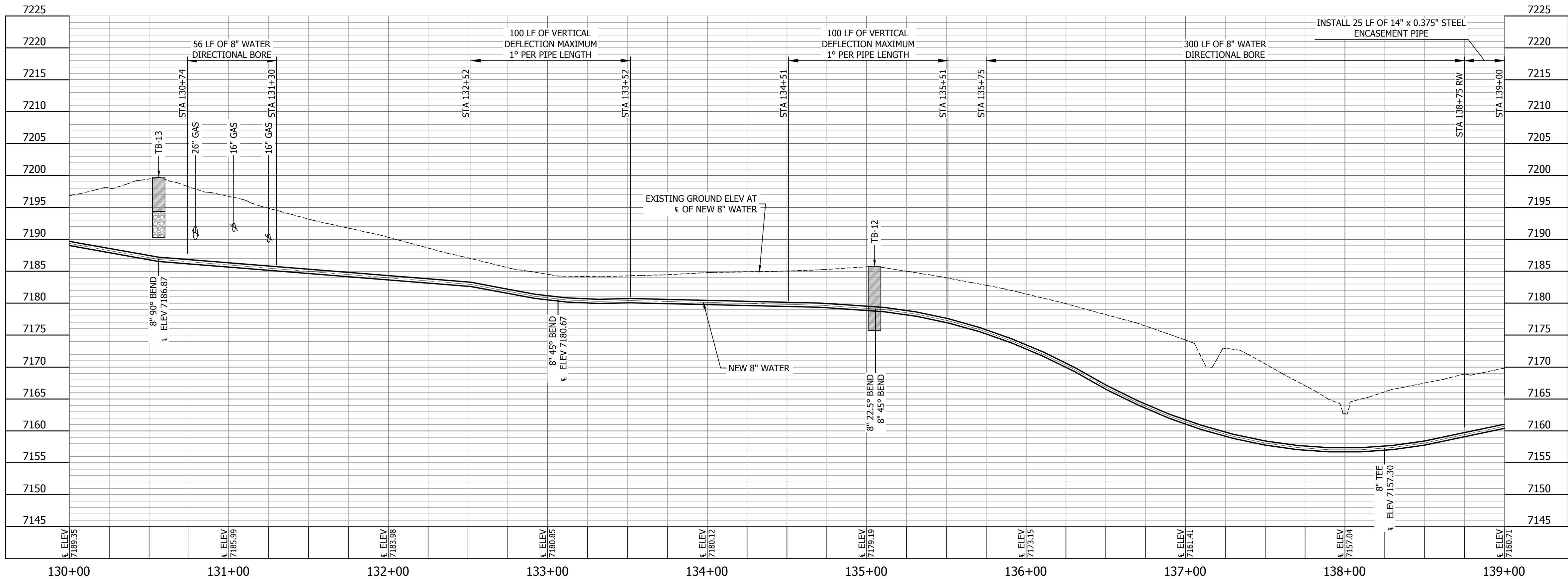
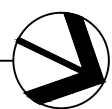


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APPROVED BY:	JAS
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SCALE:	AS NOTED
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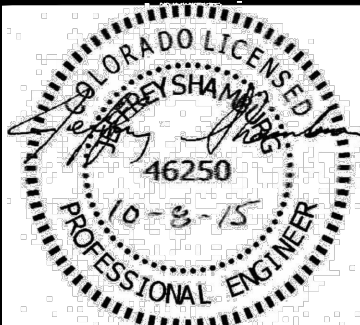
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STA 130+00 - 139+00
SCALE: HORIZ-1" = 40' VERT-1"=10'



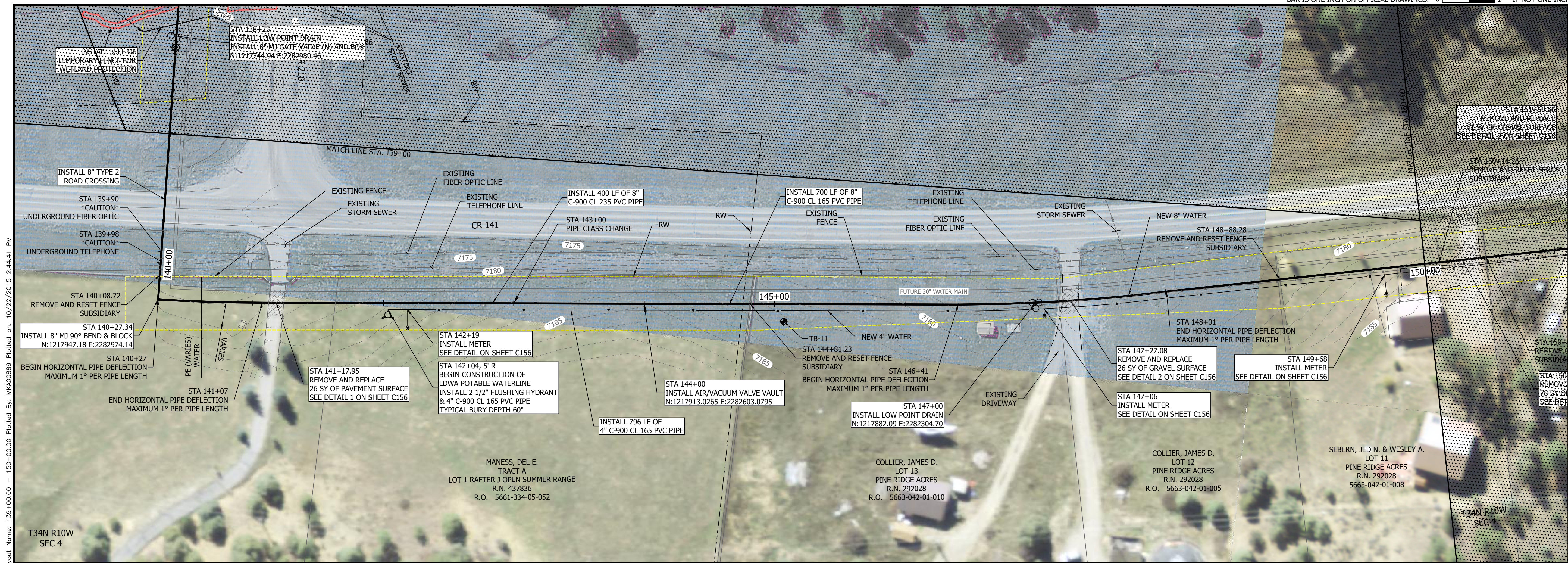
WATER PIPELINE
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RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO



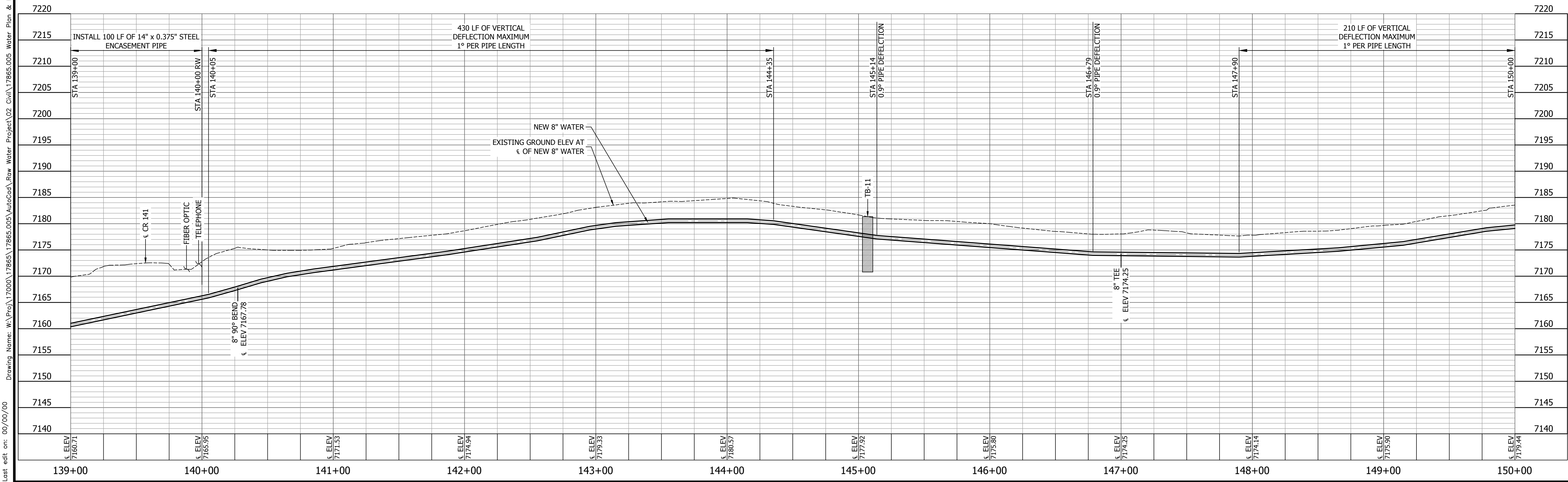
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DATE: OCT 2015

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SHEET NO: 45 of 114

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Drawing Name: W:\Pro\17000\17865\17865.005\AutoCad\Raw Water Project\02 Civil\17865.005 Water Plan & Profile.dwg
Last edit on: 00/00/00



STA 139+00 - 150+00
SCALE: HORZ-1" = 40' VERT-1"=10'



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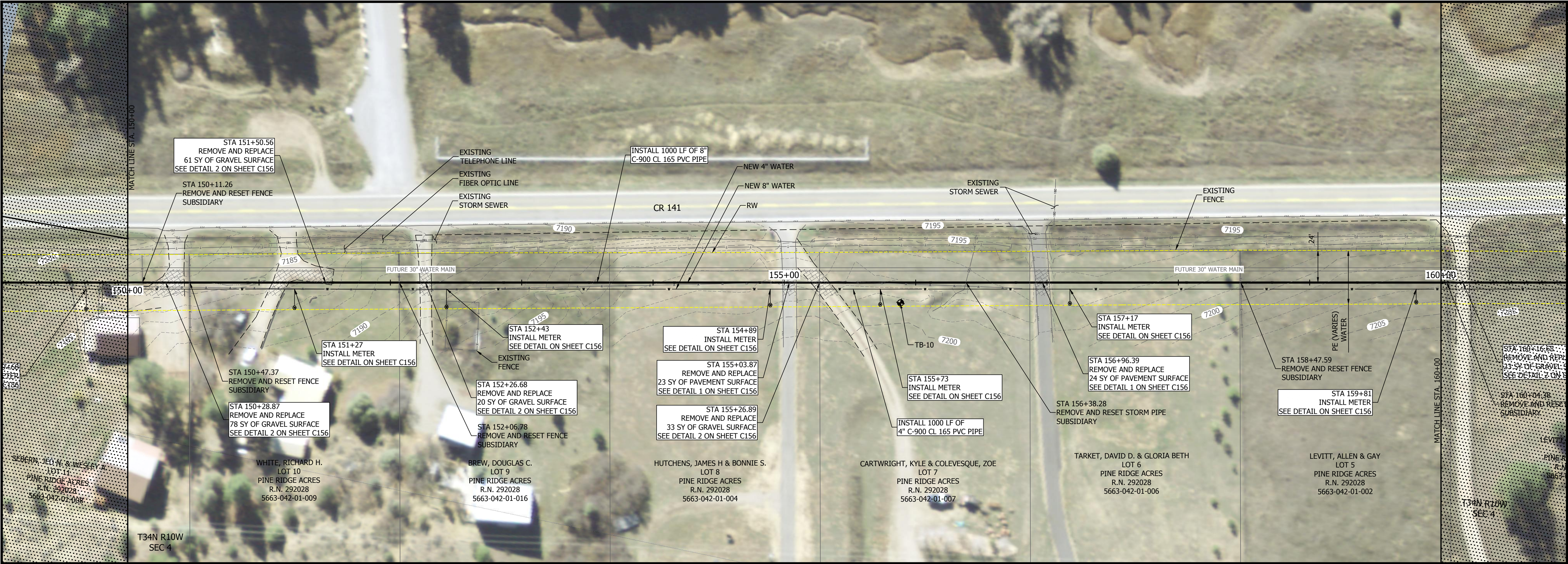
**WATER PIPELINE
STA 139+00 - 150+00**
RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO

DESIGNED BY: RHT
DRAWN BY: MKA
APPROVED BY: JAS
DESIGN PROJ: 17865.005
CONST PROJ: ----
SCALE: AS NOTED
DATE: OCT 2015
DRAWING NO: **C138**
SHEET NO: 46 of 114

Layout Name: 150+00.00 - 160+00.00 Plotted on: 10/22/2015 2:45:00 PM

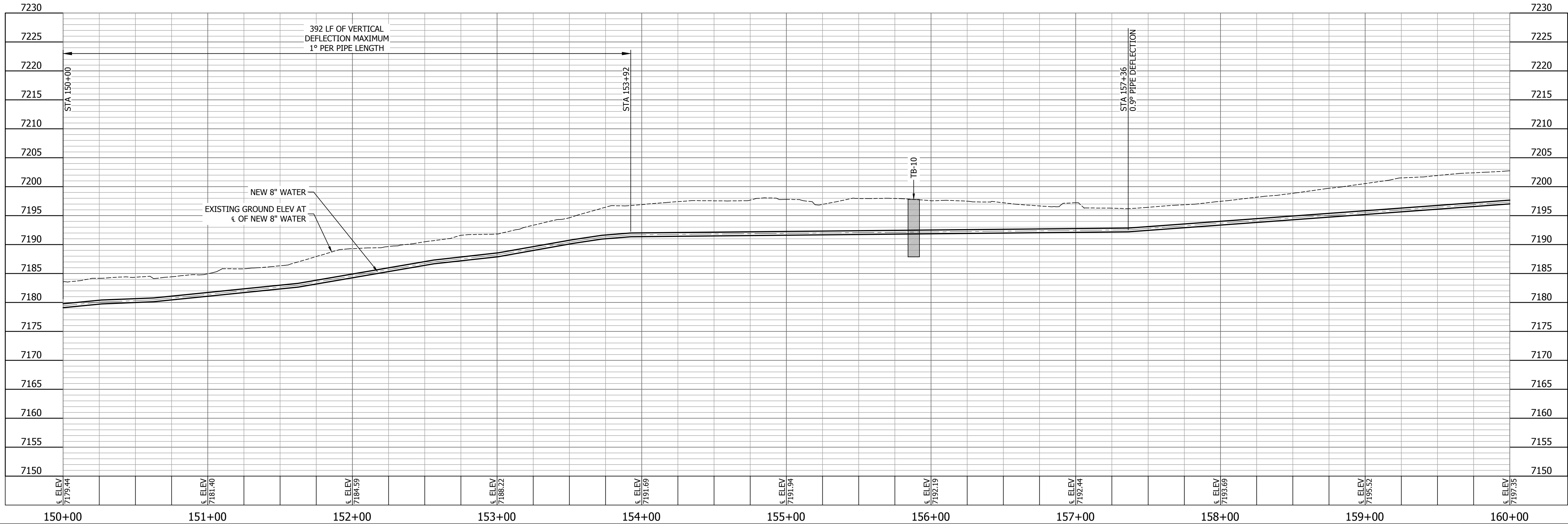
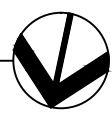
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Last edit on: 00/00/00



STA 150+00 - 160+00

SCALE: HORIZ-1" = 40' VERT-1"=10'



WATER PIPELINE
STA 150+00 - 160+00
RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO



DESIGNED BY:	RHT
DRAWN BY:	MKA
APPROVED BY:	JAS
DESIGN PROJ:	17865.005
CONST PROJ:	----
SCALE:	AS NOTED
DATE:	OCT 2015
DRAWING NO:	C139
SHEET NO:	47 of 114

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Drawing Name: W:\Pro\17000\17865\17865.005\AutoCad\Raw Water Project\02 Civil\17865.005 Water Plan & Profile.dwg
Layout Name: 160+00.00 - 170+00.00 Plotted By: MKAC0889 Plotted on: 10/22/2015 2:45:17 PM
Last edit on: 00/00/00

LEVITT, ALLEN & GAY
LOT 4
PINE RIDGE ACRES
R.N. 292028
5663-042-01-002

LEVITT, ALLEN & GAY
LOT 5
PINE RIDGE ACRES
R.N. 292028
5663-042-01-002

160+00

161+00

162+00

163+00

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464+00

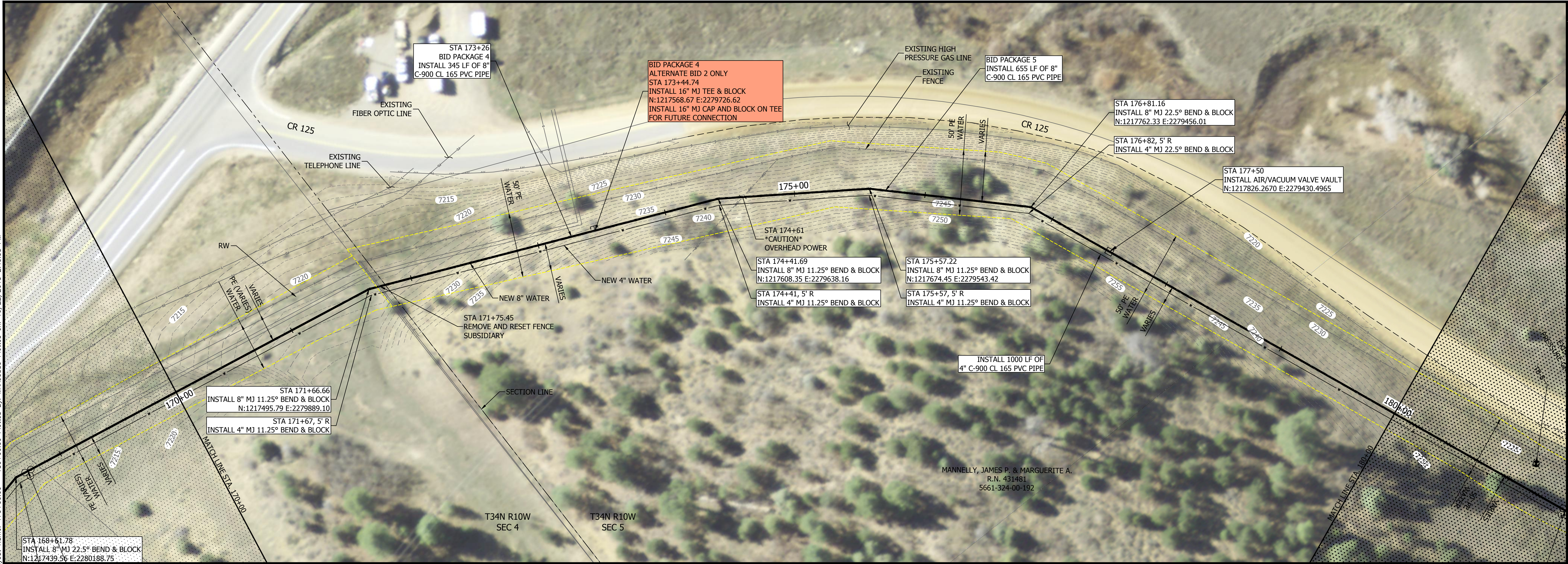
465+00

466+00

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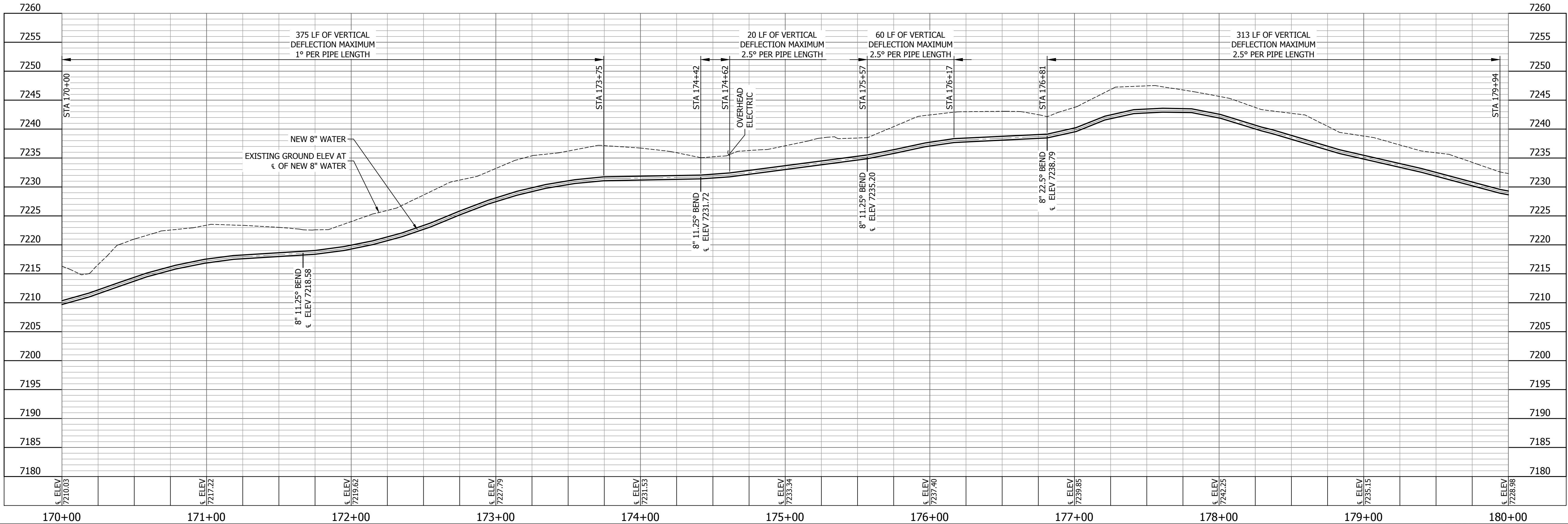
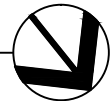
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Last edit on: 00/00/00



STA 170+00 - 180+00

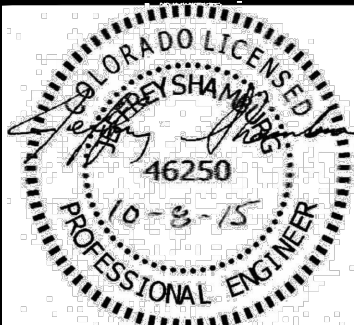
SCALE: HORZ-1" = 40' VERT-1"=10'



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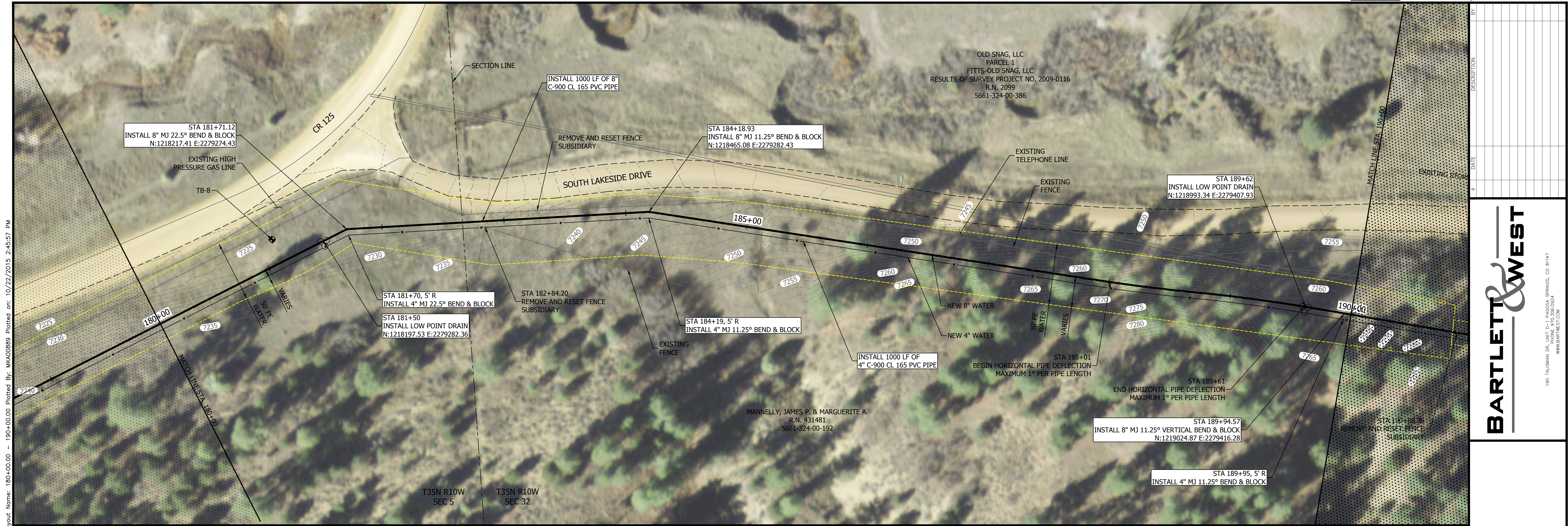
**WATER PIPELINE
STA 170+00 - 180+00**
**RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO**



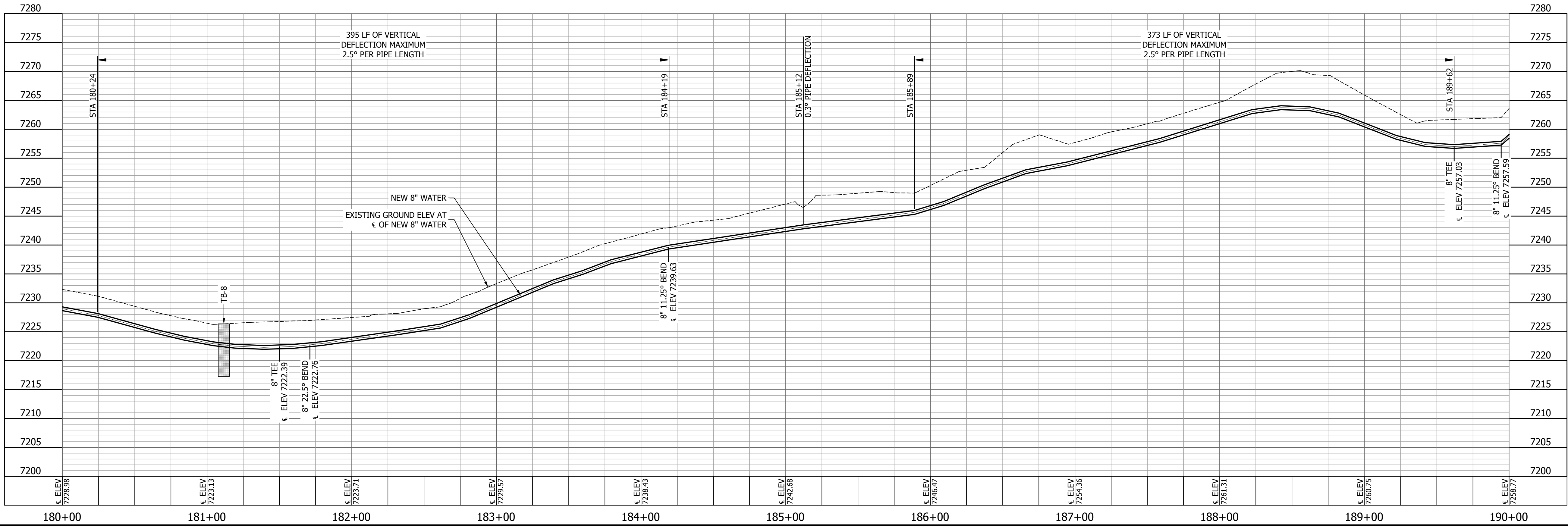
DESIGNED BY: RHT
DRAWN BY: MKA
APPROVED BY: JAS
DESIGN PROJ: 17865.005
CONST PROJ: ----
SCALE: AS NOTED
DATE: OCT 2015

DRAWING NO: **C141**
SHEET NO: 49 of 114

Last edit on: 00/00/00
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 Plotted By: MKA00889
 Plotted on: 10/22/2015 2:45:57 PM
 Layout Name: 180+00.00 - 190+00.00



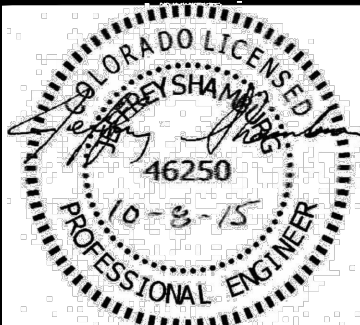
STA 180+00 - 190+00
 SCALE: HORZ-1" = 40' VERT-1"=10'



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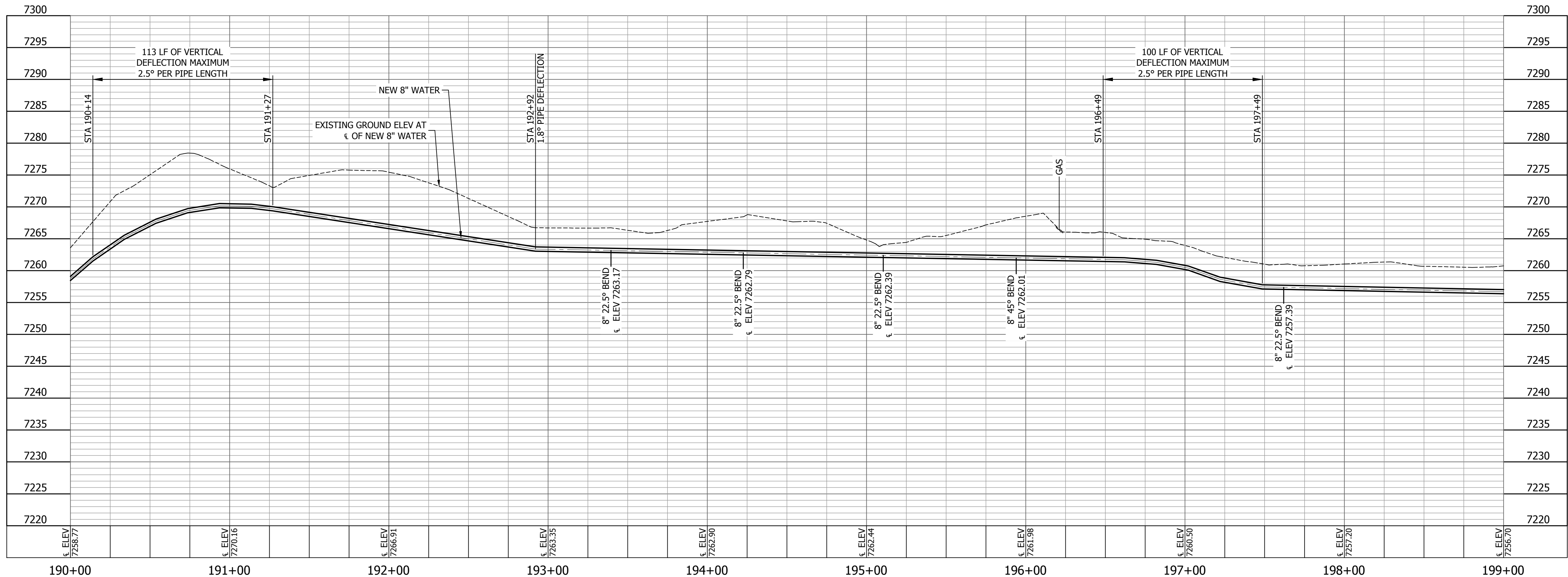
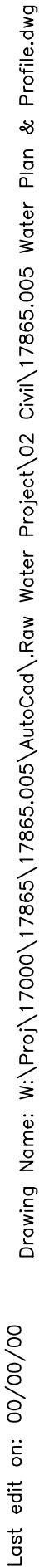
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WATER PIPELINE
 STA 180+00 - 190+00
 RAW WATER PROJECT
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DESIGNED BY:	RHT
DRAWN BY:	MKA
APPROVED BY:	JAS
DESIGN PROJ:	17865.005
CONST PROJ:	----
SCALE:	AS NOTED
DATE:	OCT 2015
DRAWING NO:	C142
SHEET NO:	50 of 114

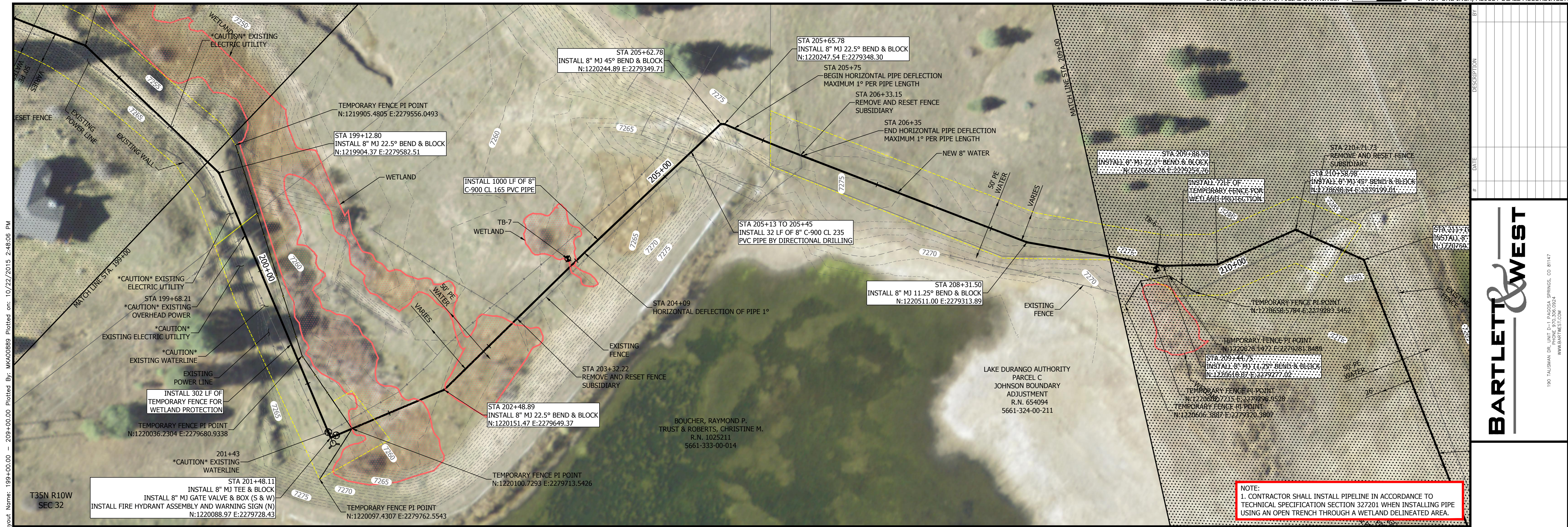
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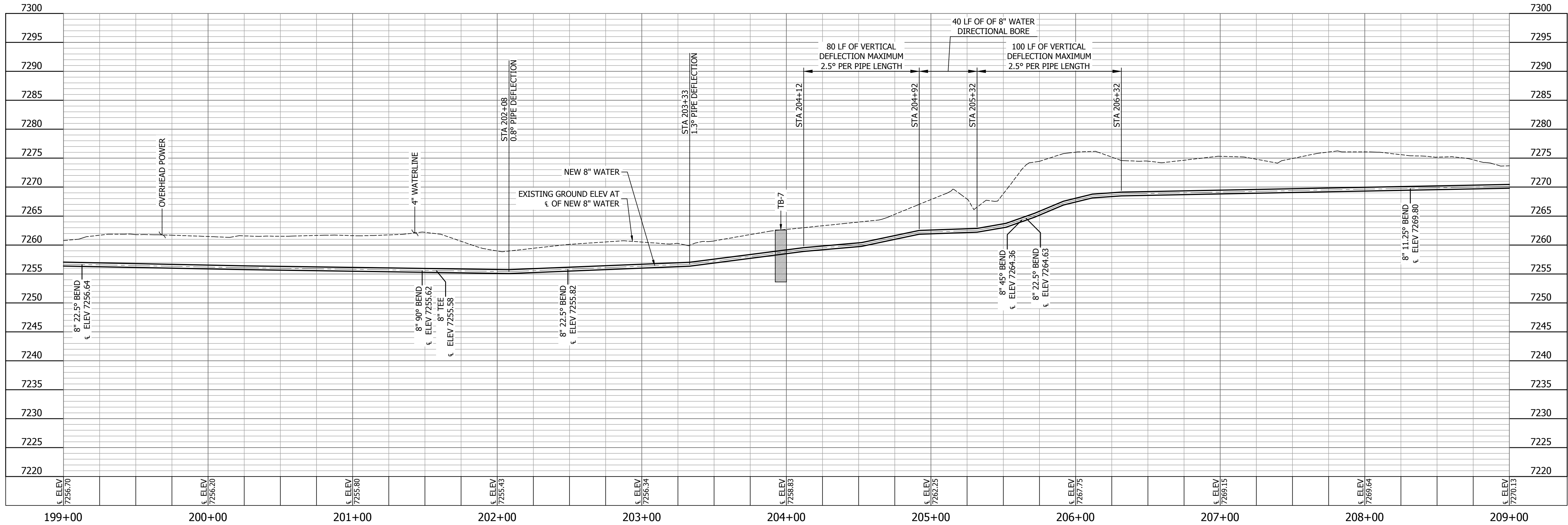
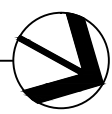
190 TALISMAN DR, UNIT D-1 PAGOSA SPRINGS, CO 81147
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51 of 114

Layout Name: 199+00.00 - 209+00.00 Plotted on: 10/22/2015 2:48:05 PM
Drawing Name: W:\Pro\17000\17865\17865.005\AutoCad\Raw Water Project\02 Civil\17865.005 Water Plan & Profile.dwg
Last edit on: 00/00/00

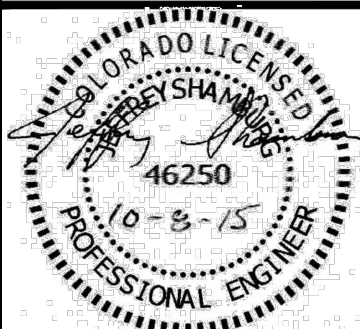


STA 199+00 - 209+00
SCALE: HORZ-1" = 40' VERT-1"=10'

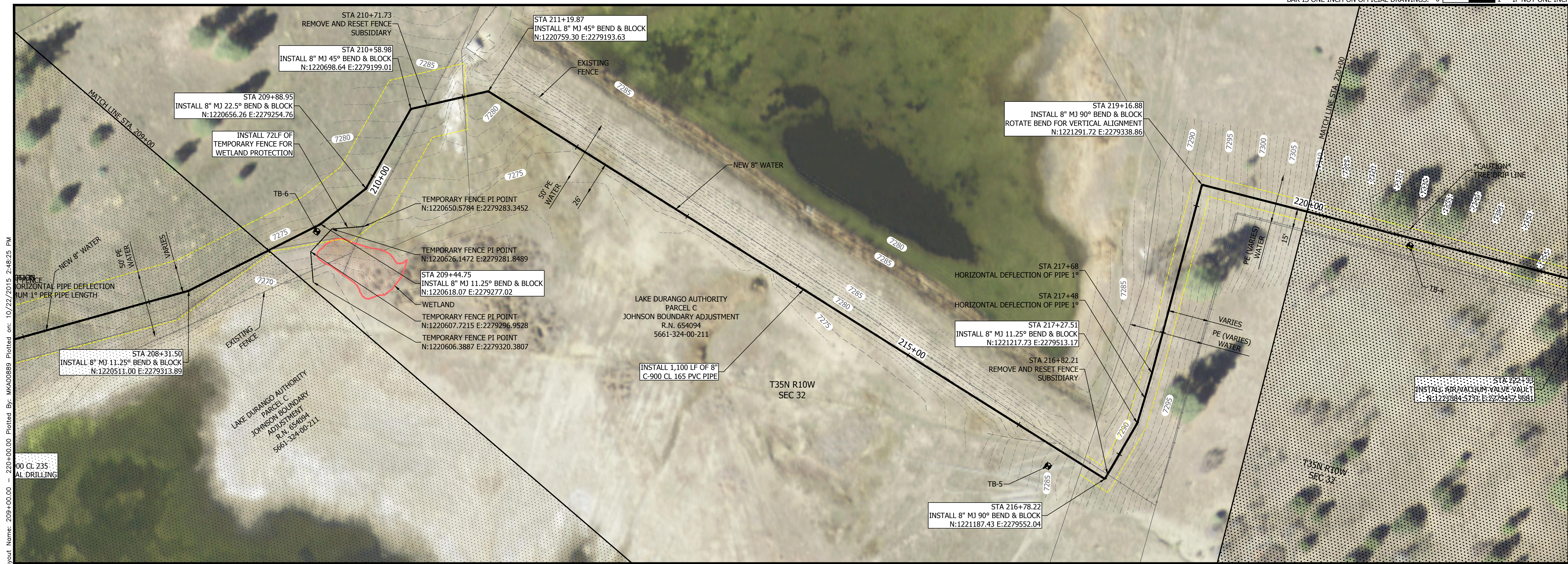


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**WATER PIPELINE
STA 199+00 - 209+00**
**RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO**

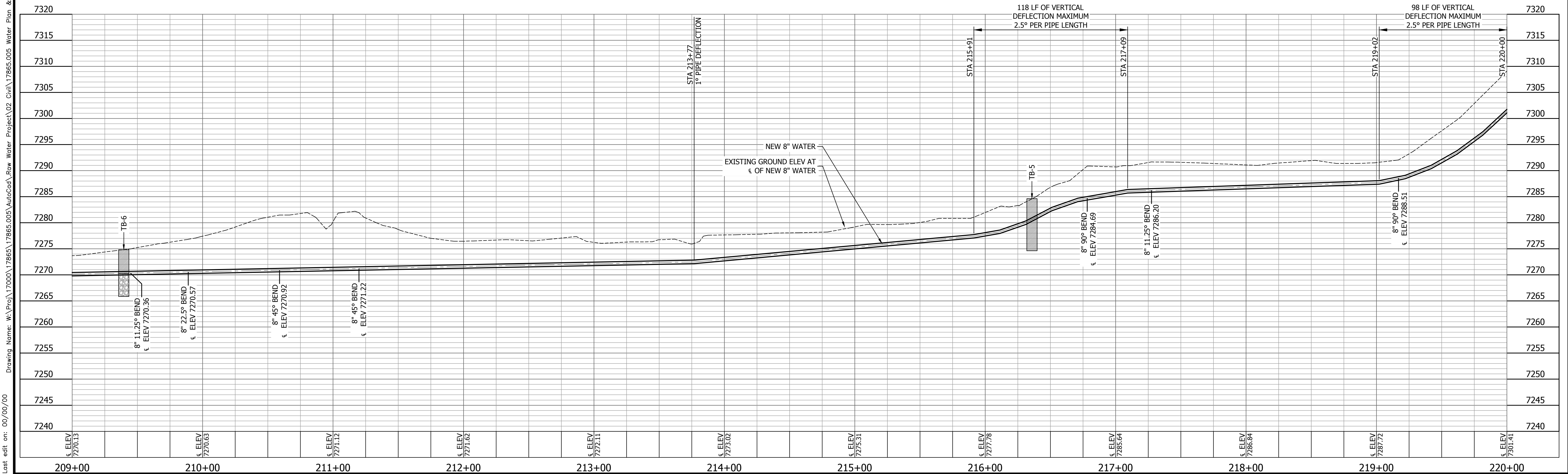
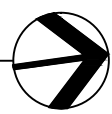


DESIGNED BY: RHT
DRAWN BY: MKA
APPROVED BY: JAS
DESIGN PROJ: 17865.005
CONST PROJ: ----
SCALE: AS NOTED
DATE: OCT 2015
DRAWING NO: **C144**
SHEET NO: 52 of 114



STA 209+00 - 220+00

SCALE: HORZ-1" = 40' VERT-1"=10'



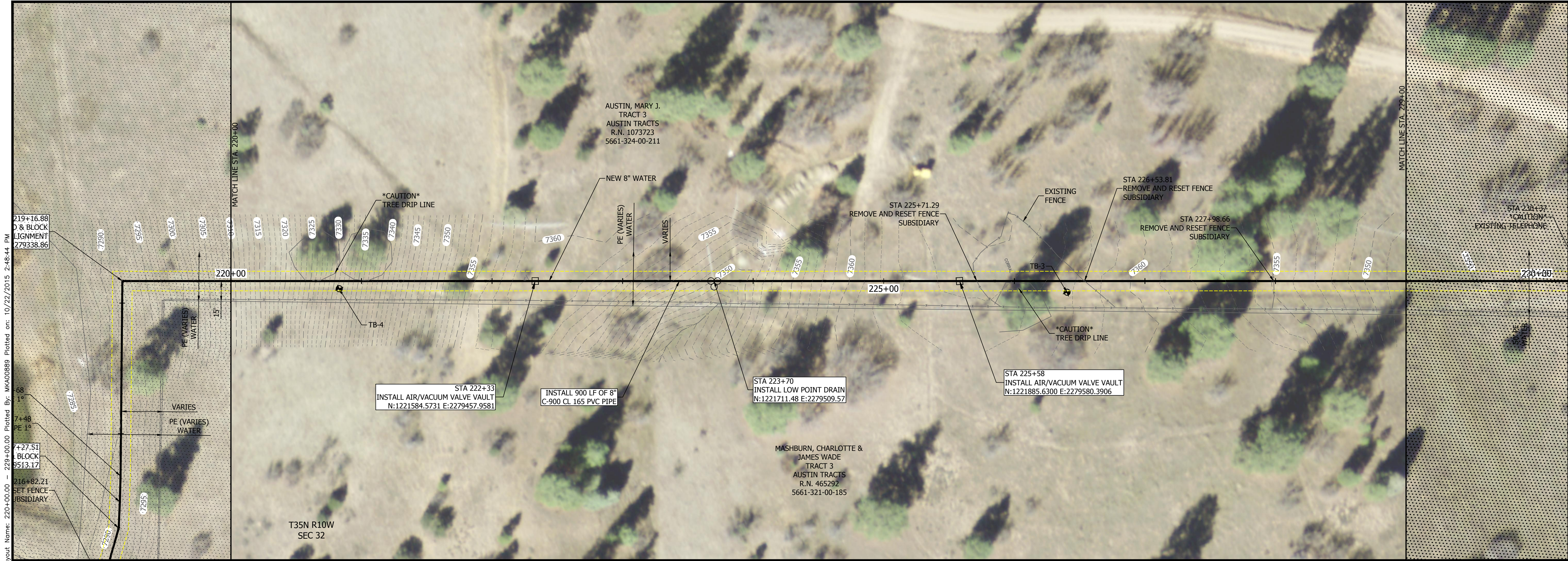
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**WATER PIPELINE
STA 209+00 - 220+00**
**RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO**

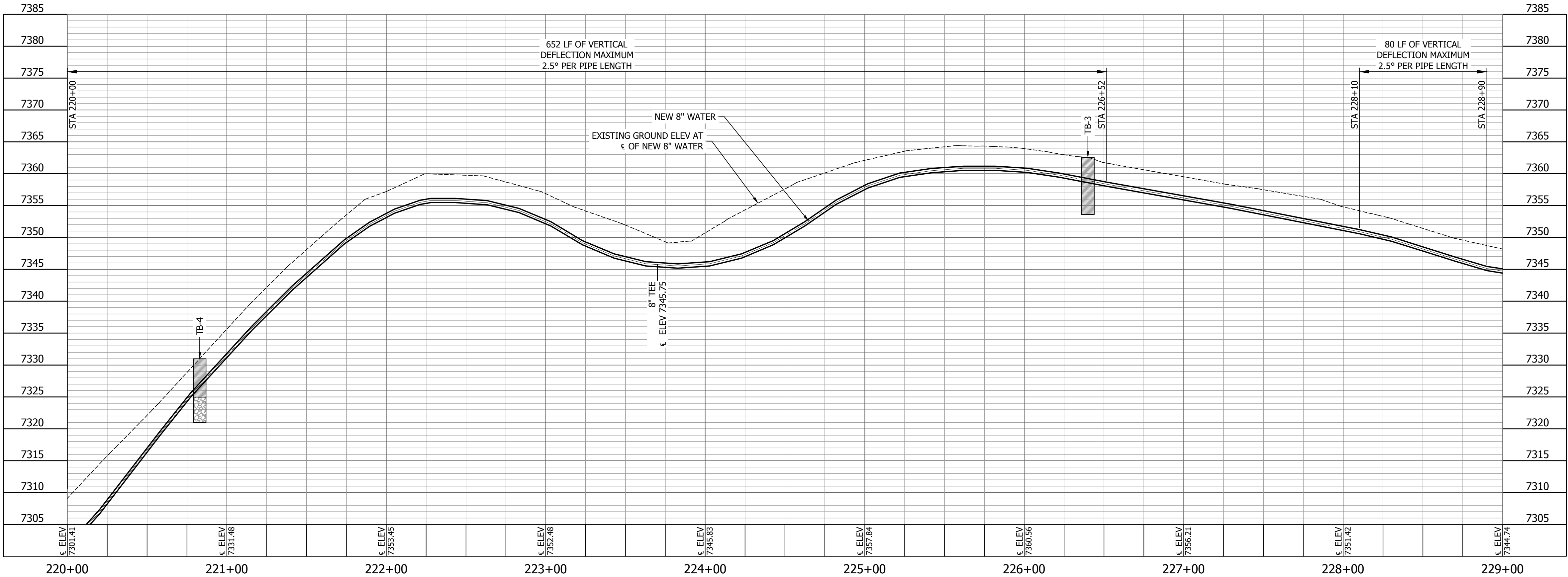
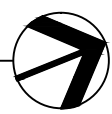


DESIGNED BY:	RHT
DRAWN BY:	MKA
APPROVED BY:	JAS
DESIGN PROJ:	17865.005
CONST PROJ:	----
SCALE:	AS NOTED
DATE:	OCT 2015
DRAWING NO:	C145
SHEET NO:	53 of 114



STA 220+00 - 229+00

SCALE: HORZ-1" = 40' VERT-1"=10'



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**WATER PIPELINE
STA 220+00 - 229+00**
**RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO**



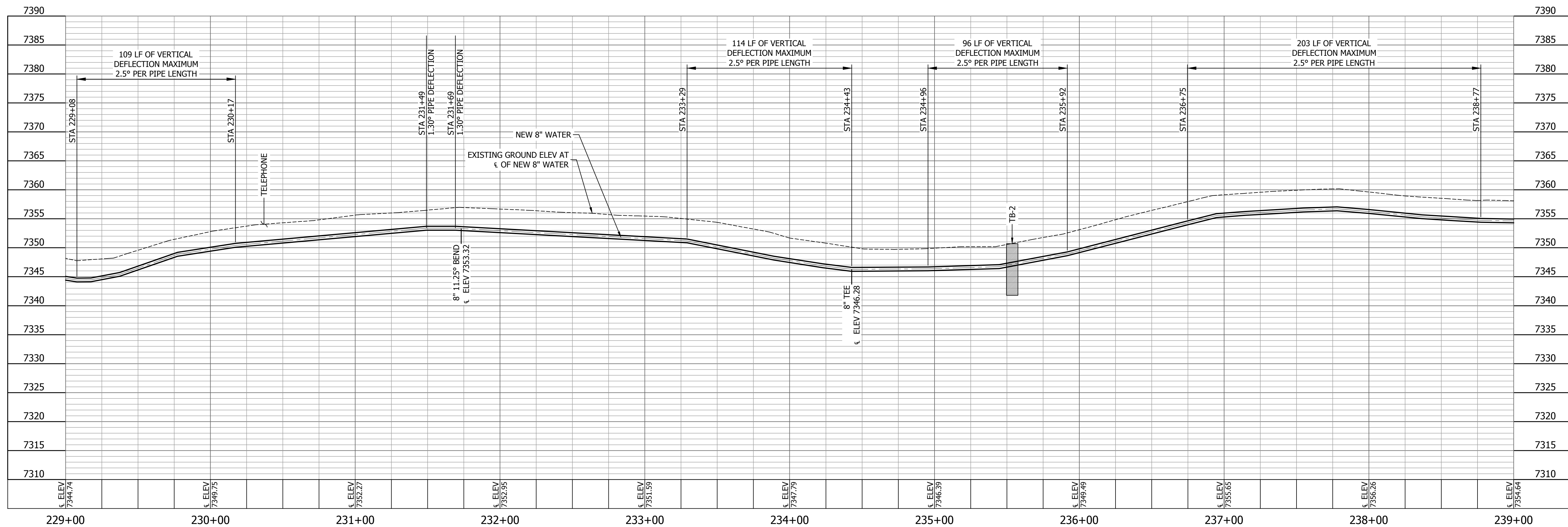
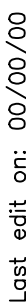
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DRAWN BY: MKA
APPROVED BY: JAS
DESIGN PROJ: 17865.005
CONST PROJ: ----
SCALE: AS NOTED
DATE: OCT 2015

DRAWING NO: **C146**
SHEET NO: 54 of 114

Layout Name: 220+00.00 - 229+00.00 Plotted on: 10/22/2015 2:48:44 PM

Drawing Name: W:\Proj\17000\17865\17865.005\AutoCad_Raw Water Project\02 Civil\17865.005 Water Plan & Profile.dwg

Last edit on: 00/00/00



DRAWING NO: **C147**

SHEET NO: 55 of 114

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WATER PIPELINE
STA 239+00 - 245+73

RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO



DESIGNED BY:	RHT
DRAWN BY:	MKA
APPROVED BY:	JAS
DESIGN PROJ:	17865.005
CONST PROJ:	----
SCALE:	AS NOTED
DATE:	OCT 2015

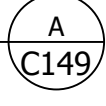
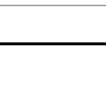
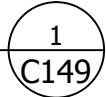
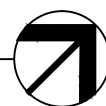
DRAWING NO:
C148

SHEET NO:
56 of 114

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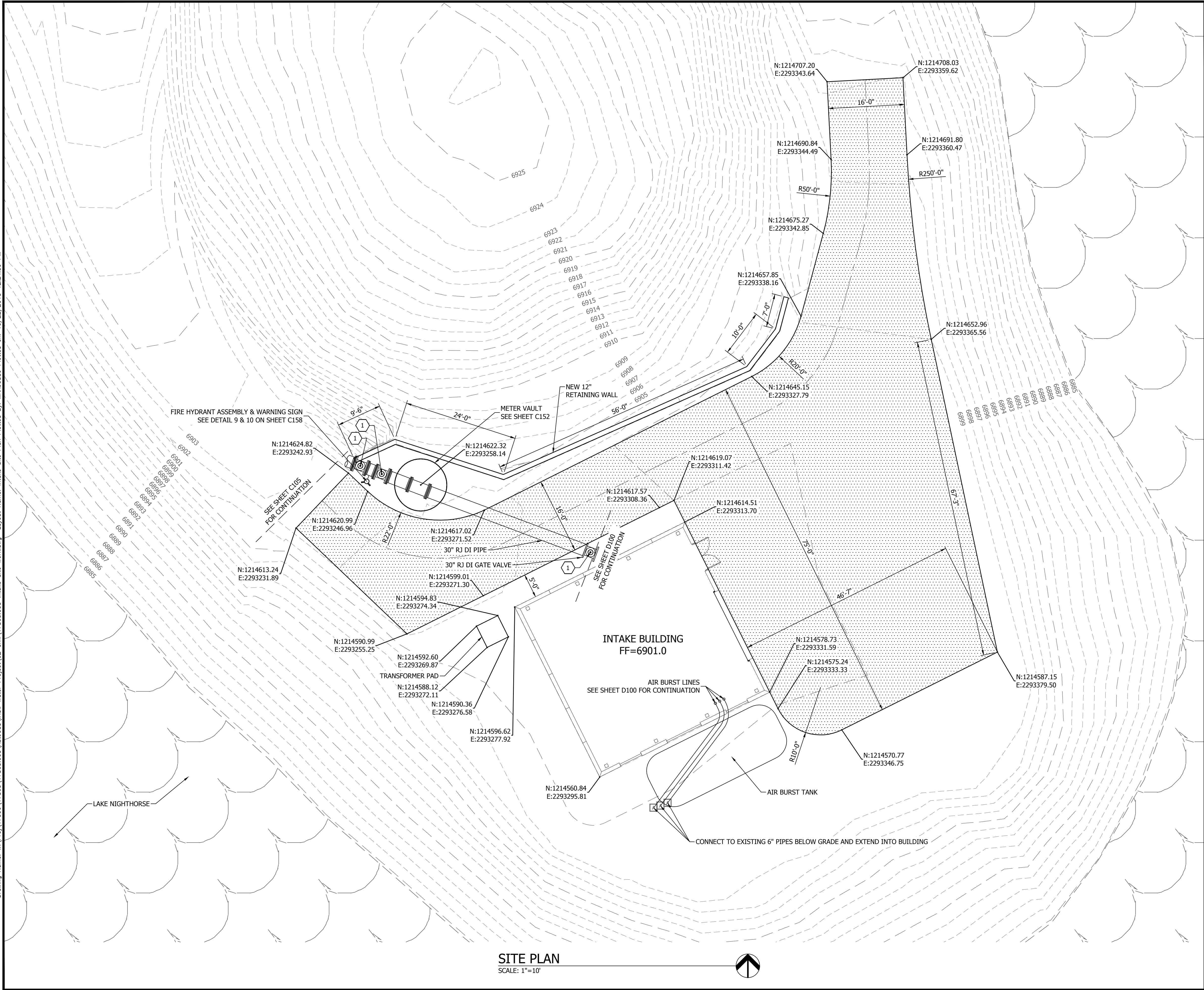
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PHONE 970.306.0924
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DESIGNED BY:	MIKA
DRAWN BY:	MIKA
APPROVED BY:	JAS
DESIGN PROJ:	17865.005
CONSTR PROJ:	----
SCALE:	AS NOTED
DATE:	OCT 2015
DRAWING NO:	C149
SHEET NO:	57 of 114

Drawing Name: W:\Proj\17000\17865\17865.005\AutoCad\Raw Water Project\02 Civil\17865.005 Intake Site Work.dwg Layout Name: Intake Site Plan Plotted on: 10/22/2015 12:24:59 PM
Last edit on: 00/00/00



SITE PLAN
SCALE: 1"=10'

GENERAL NOTES

- SEE DETAIL 9 ON SHEET C156 FOR ACCESS ROAD AGGREGATE THICKNESS
- SEE DETAIL 5 ON SHEET C156 FOR GATE VALVE INSTALLATION

REFERENCE NOTES

- 1 30" GATE VALVE, SEE DETAIL 5 ON SHEET C156

LEGEND

- NEW GRAVEL
NEW CONCRETE

BARTLETT & WEST

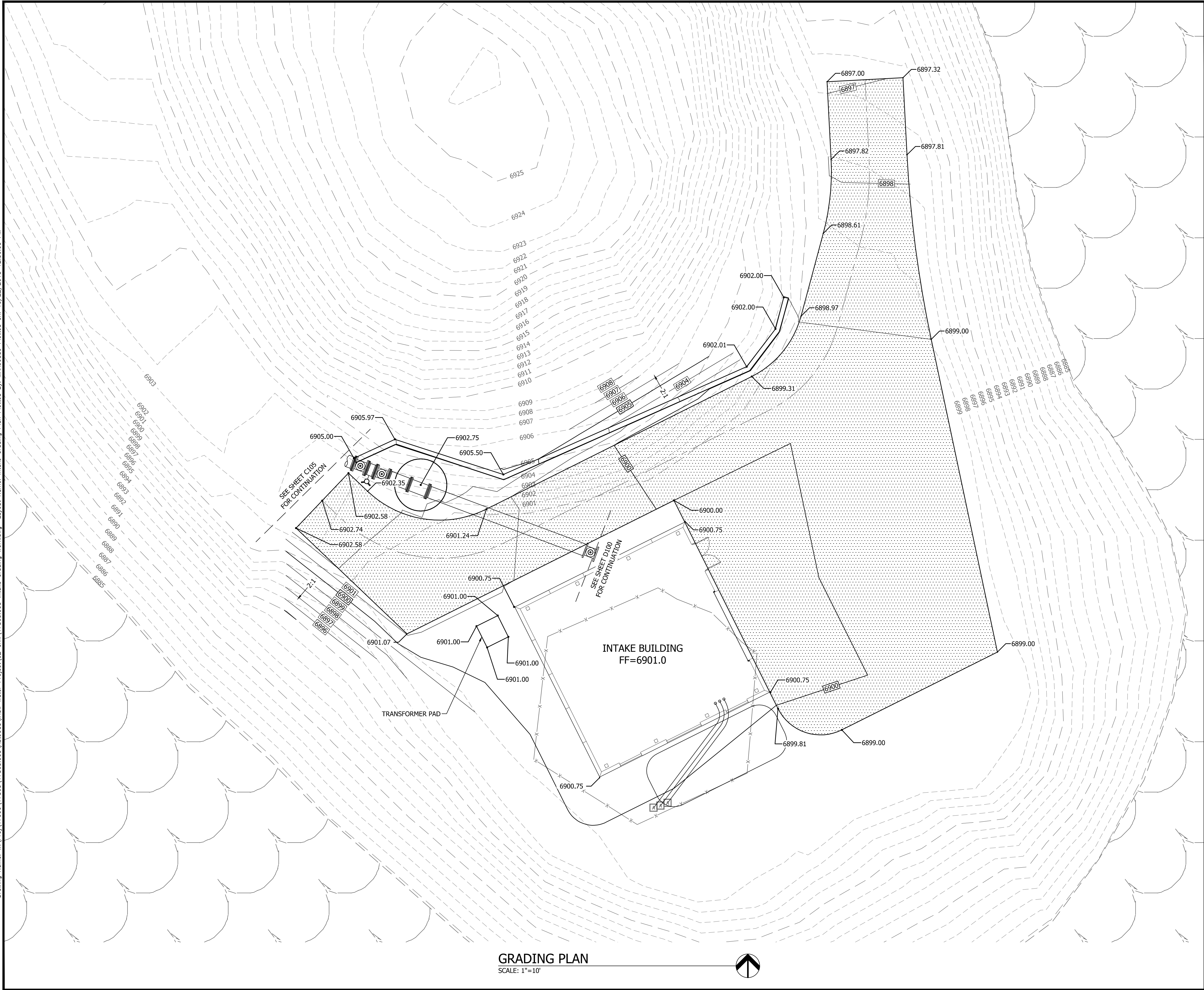
190 TALISMAN DR., UNIT D-1, PABOBA SPRINGS, CO 81147
TEL: 719.441.1147
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**INTAKE
SITE PLAN**
RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO



DESIGNED BY:	MKA
DRAWN BY:	MKA
APPROVED BY:	JAS
DESIGN PROJ:	17865.005
CONST PROJ:	----
SCALE:	AS NOTED
DATE:	OCT 2015
DRAWING NO:	C150
SHEET NO:	58 of 114

Drawing Name: W:\Proj\17000\17865\AutoCad\Raw Water Project\02 Civil\17865.005 Intake Grading Working.dwg Layout Name: Intake Grading Plan Plotted on: 10/22/2015 12:36:03 PM
Last edit on: 00/00/00



GRADING PLAN
SCALE: 1"=10'



GENERAL NOTES

- SEE SHEET C102 FOR EROSION CONTROL
- RETAINING WALL SHALL NOT EXCEED 3'-0" IN HEIGHT
- CONTRACTOR SHALL DEMO FENCE AROUND EXISTING INTAKE CAISSON

SITE SUMMARY

ESTIMATE EARTHWORK
CUT: 92 CY
FILL: 249 CY
NET FILL: 157 CY

LEGEND

- NEW GRAVEL
- NEW CONCRETE

BARTLETT & WEST

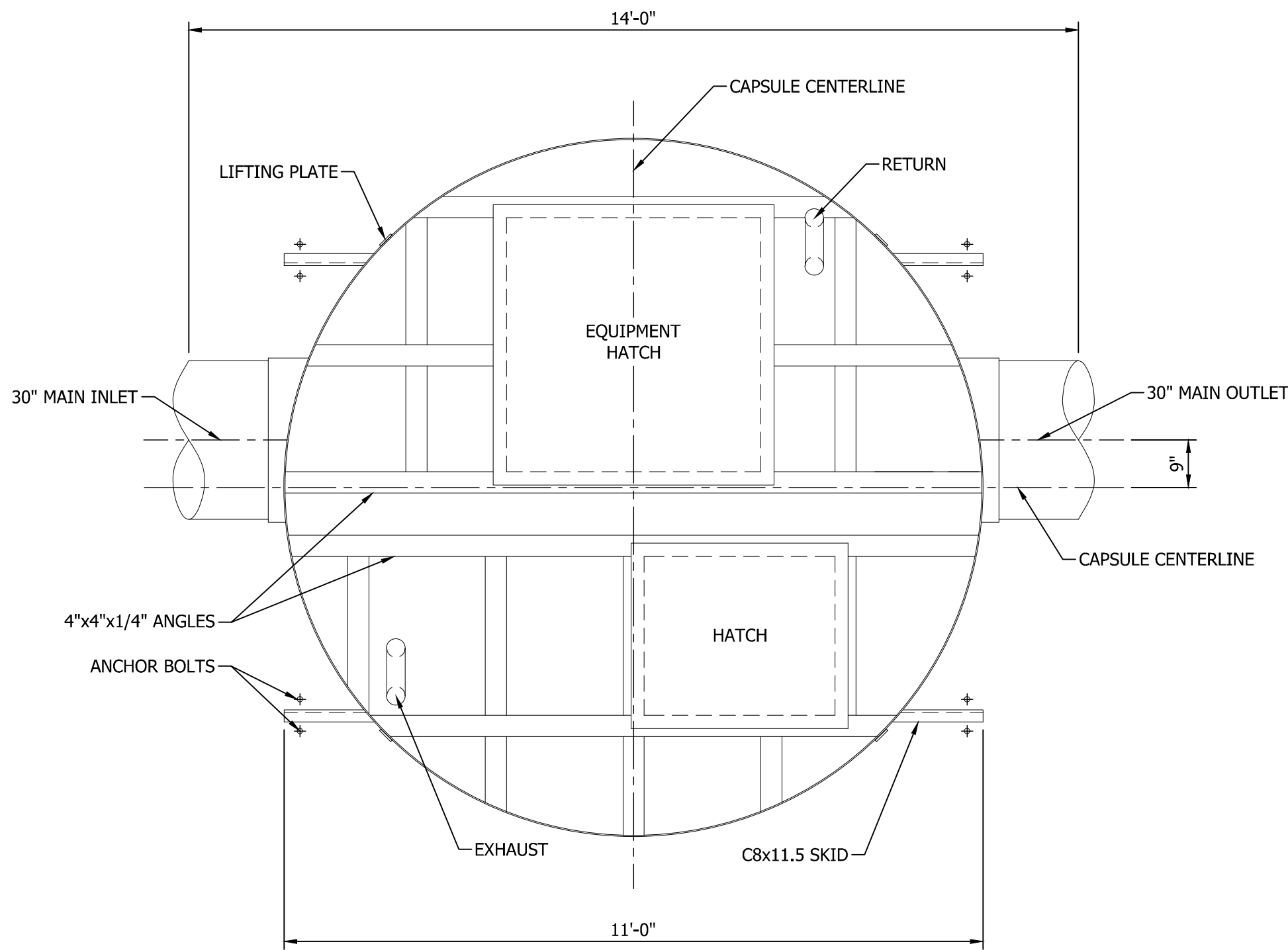
190 TALISMAN DR., UNIT D-1, PABOEA SPRINGS, CO 81147
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**INTAKE
GRADING PLAN**
RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
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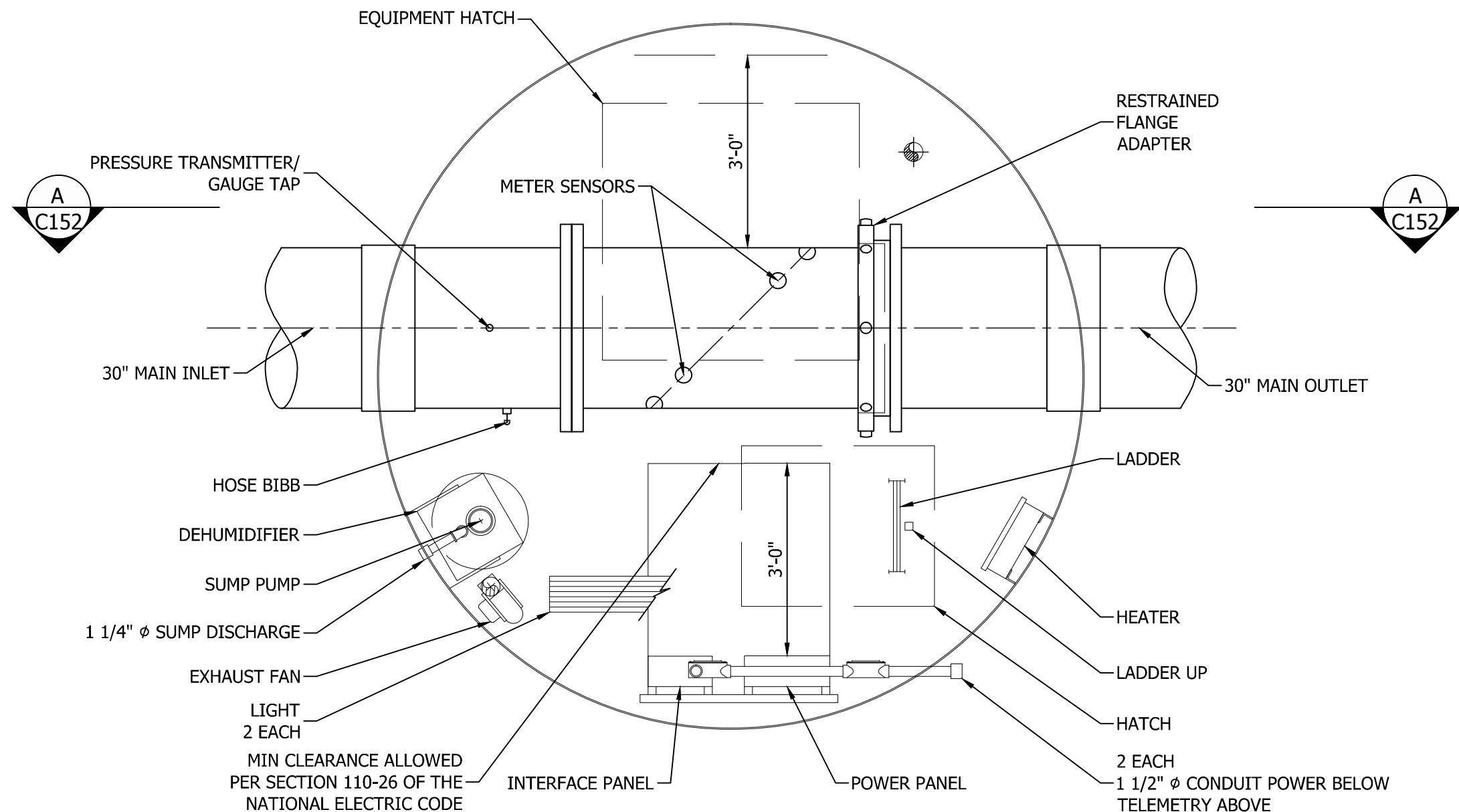


DESIGNED BY: MKA
DRAWN BY: MKA
APPROVED BY: JAS
DESIGN PROJ: 17865.005
CONST PROJ: ---
SCALE: AS NOTED
DATE: OCT 2015
DRAWING NO: **C151**
SHEET NO: 59 of 114

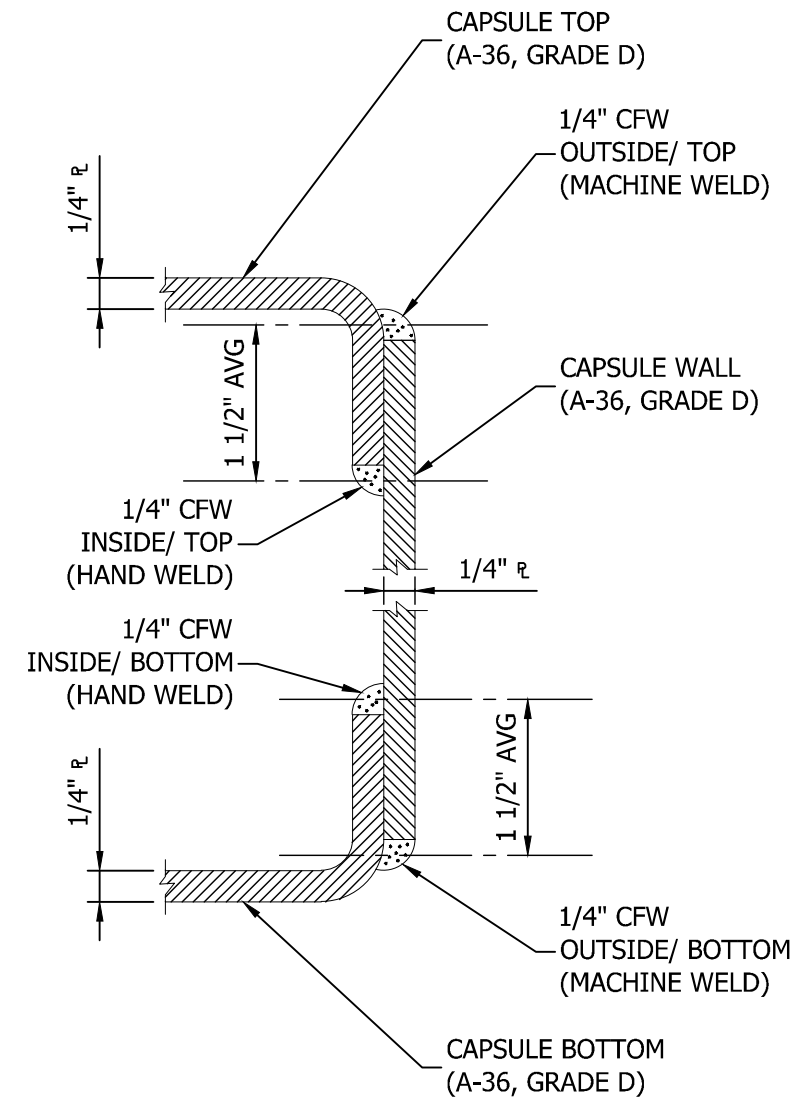
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Last edit on: 00/00/00



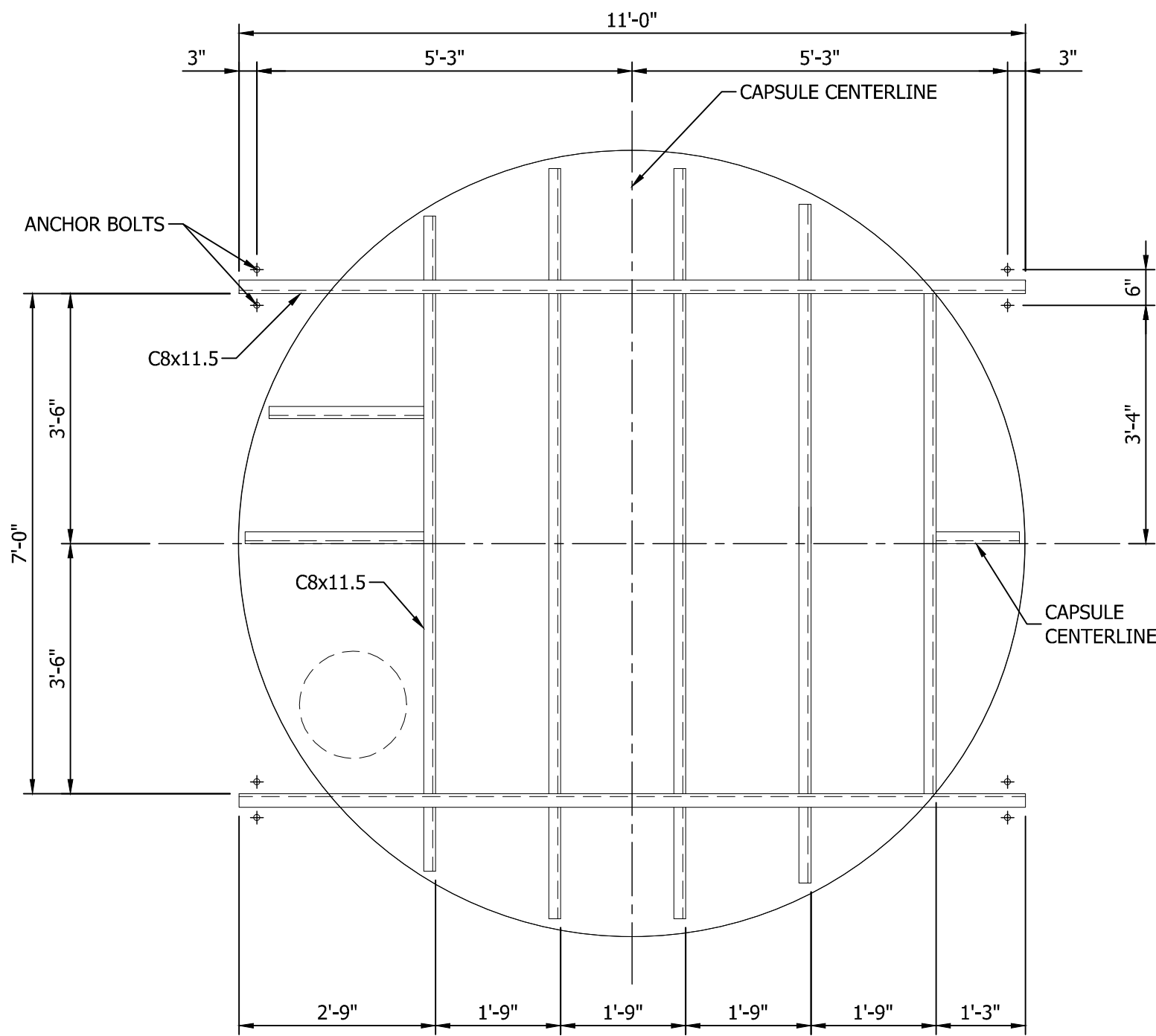
INTAKE METER VAULT EXTERIOR PLAN
SCALE: 1/2"=1'-0"



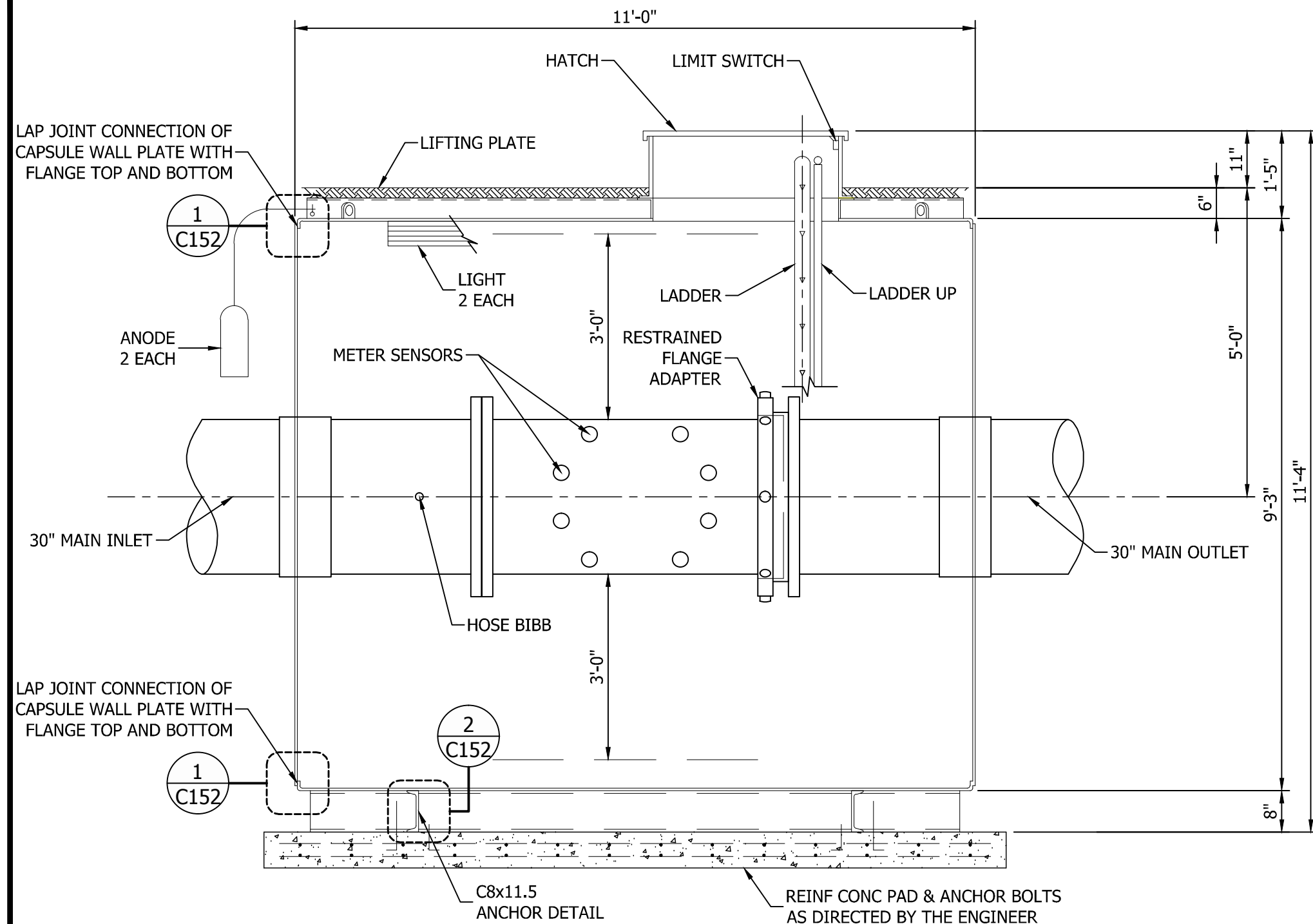
INTAKE METER VAULT INTERIOR PLAN
SCALE: 1/2"=1'-0"



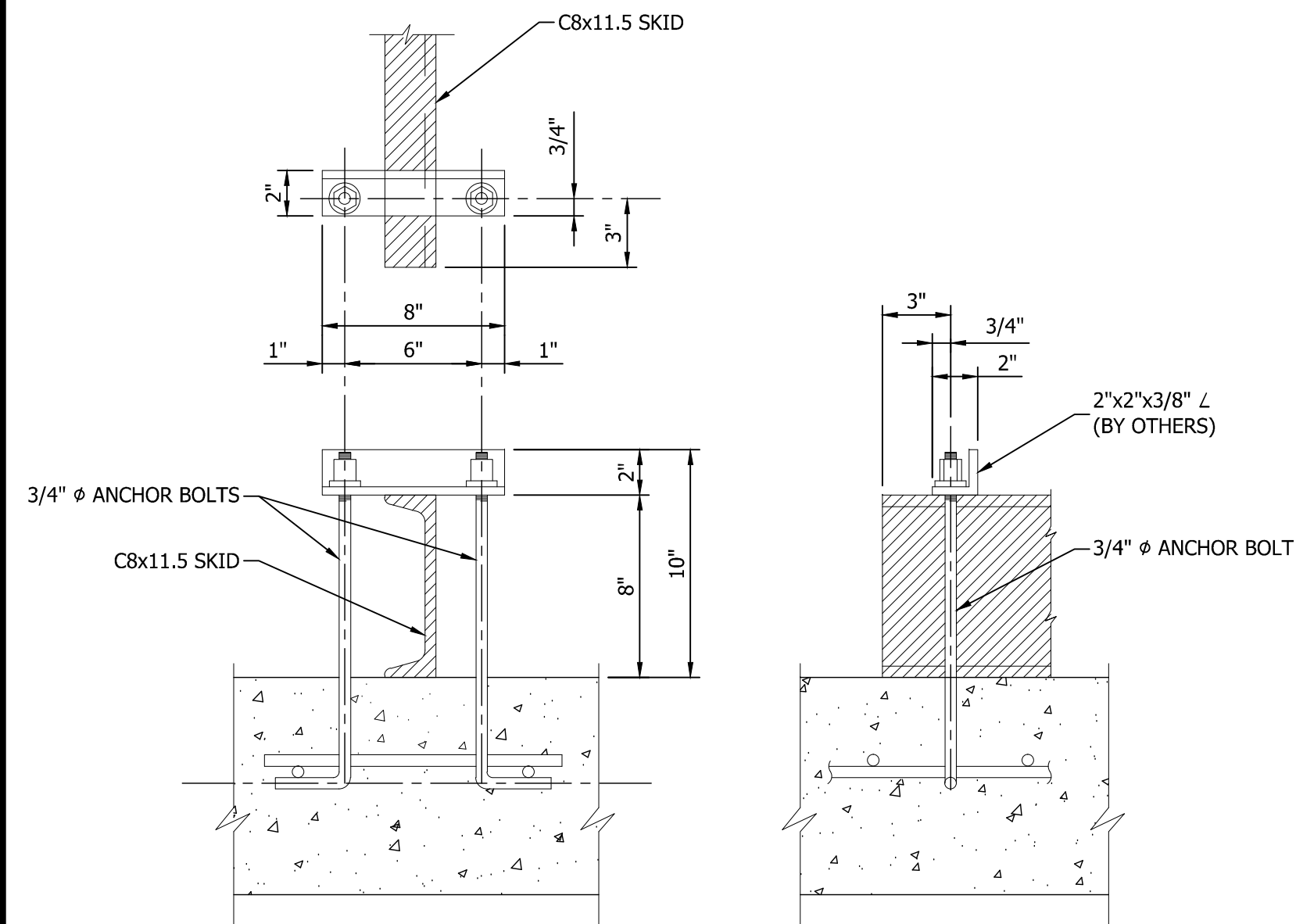
DETAIL
SCALE: 3/4" = 1'-0"



SKID PLAN
SCALE: 1/2"=1'-0"



SECTION
SCALE: 1/2"=1'-0"



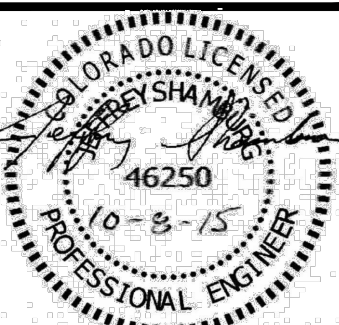
NOTE:
ANCHOR CLIPS, ANCHOR BOLTS & NUTS BY INSTALLER

TYPICAL ANCHOR DETAIL
SCALE: 3/4" = 1'-0"

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**INTAKE
METER VAULT**
RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO



DESIGNED BY:	MKA
DRAWN BY:	RJD
APPROVED BY:	JAS
DESIGN PROJ:	17865.005
CONST PROJ:	----
SCALE:	AS NOTED
DATE:	OCT 2015
DRAWING NO:	C152
SHEET NO:	60 of 114



1. YARD PIPING LAYOUT SEE SHEET C155

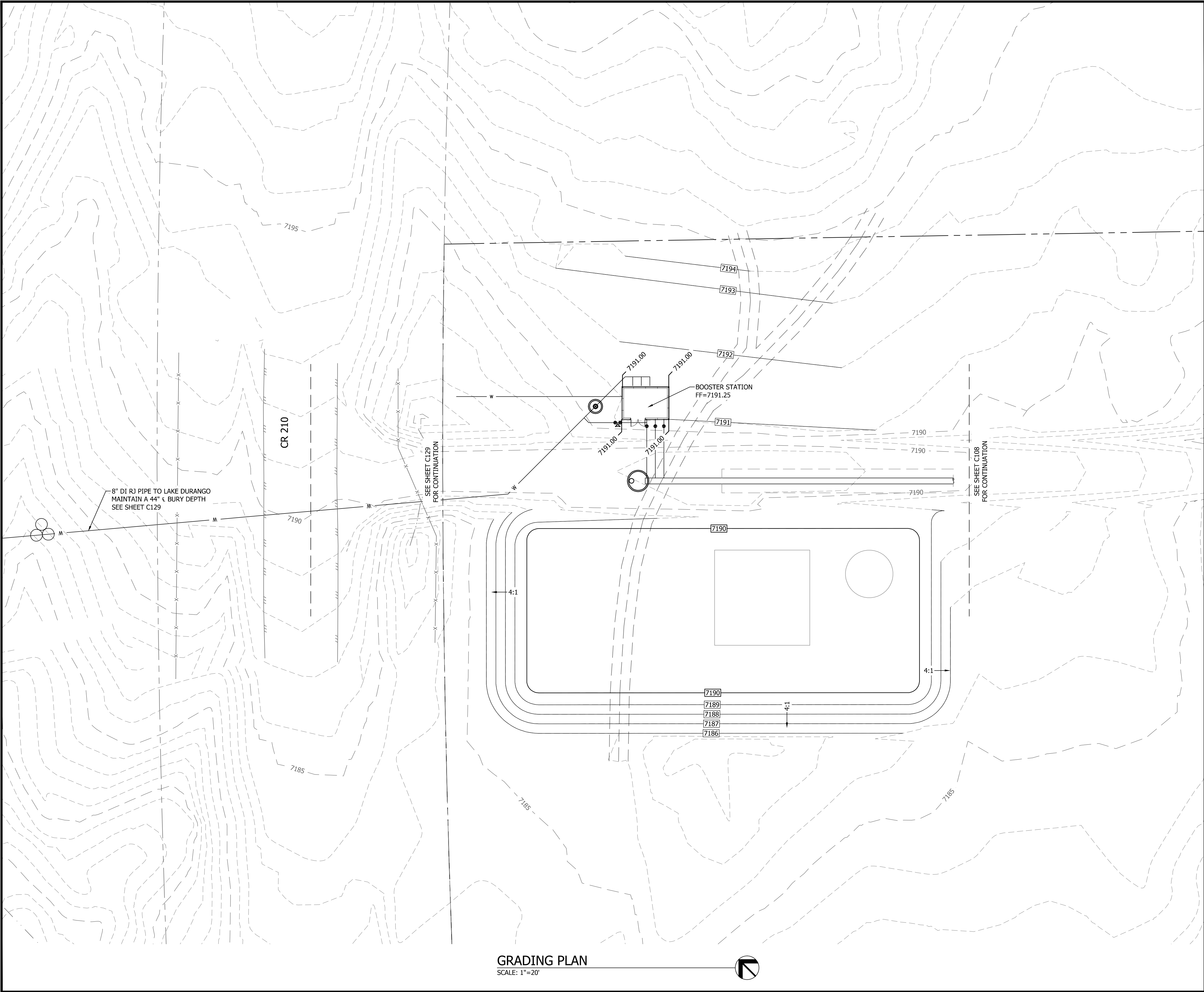
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DRAWN BY:	MKA
APPROVED BY:	JAS
DESIGN PROJ:	17865.005
CONST PROJ:	----
SCALE:	AS NOTED
DATE:	OCT 2015
DRAWING NO:	C153
SHEET NO:	

**RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO**

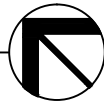
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PHONE 970.306.0924

Last edit on: 00/00/00
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 Layout Name: Booster Grading Plan
 Plotted on: 10/12/2015 9:53:15 AM



GRADING PLAN
 SCALE: 1"=20'

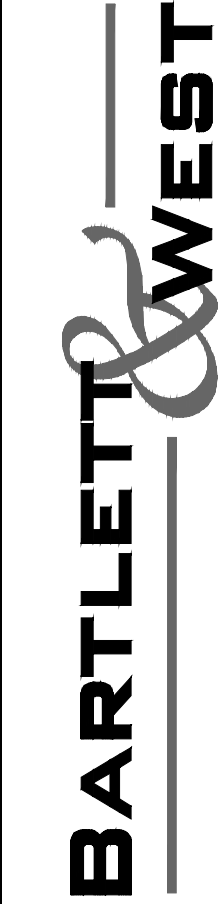


GENERAL NOTES

1. SEE SHEET C103 FOR EROSION CONTROL

SITE SUMMARY

ESTIMATE EARTHWORK	
CUT:	95 CY
FILL:	963 CY
NET FILL:	868 CY



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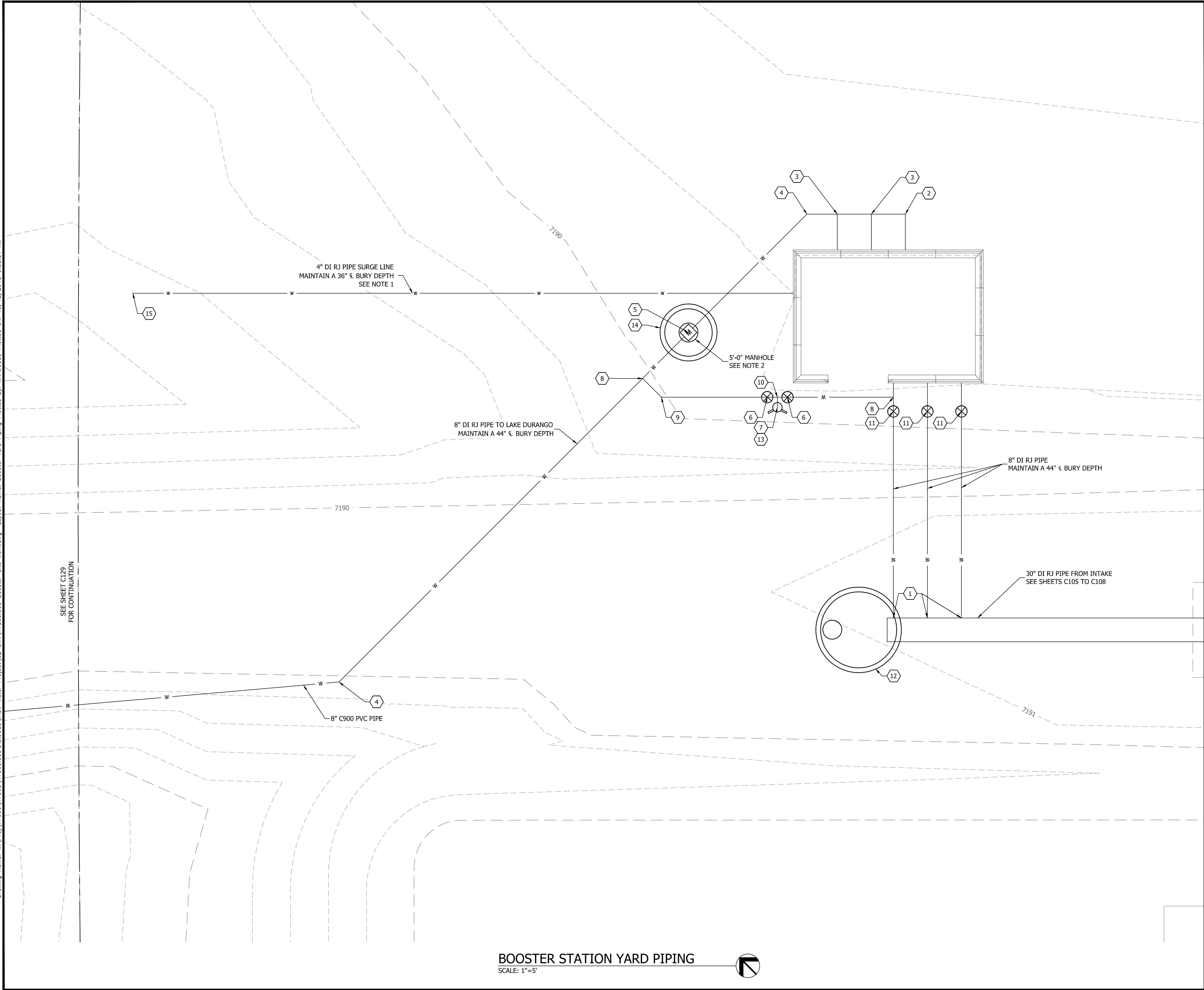
BOOSTER STATION
 GRADING PLAN
 RAW WATER PROJECT
 LA PLATA WEST WATER AUTHORITY
 LA PLATA COUNTY, COLORADO



DESIGNED BY:	MKA
DRAWN BY:	MKA
APPROVED BY:	JAS
DESIGN PROJ:	17865.005
CONST PROJ:	----
SCALE:	AS NOTED
DATE:	OCT 2015
DRAWING NO:	C154
SHEET NO:	62 of 114

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BOOSTER STATION YARD PIPING
SCALE: 1"=5'

GENERAL NOTES

1. DAYLIGHT THE 4" DI RJ SURGE LINE TO THE NORTHWEST AT ELEV 7187.0'
2. 8" MAG METER SHALL HAVE 5x THE PIPE WIDTH ON THE DOWNSTREAM & UPSTREAM SIDE

REFERENCE NOTES

- ① 30" x 30" x 8" DI RJ TEE
- ② 8"DI RJ 90° BEND
- ③ 8" x 8" x 8" DI RJ TEE
- ④ 8" DI RJ 45° BEND
- ⑤ 8" METER
- ⑥ 6" GATE VALVE, SEE DETAIL 5 ON SHEET C156
- ⑦ FIRE HYDRANT ASSEMBLY, SEE DETAIL 10 ON SHEET C158
- ⑧ 8" x 8" x 6" DI RJ TEE
- ⑨ 6" DI RJ 45° BEND
- ⑩ 6" x 6" x 6" DI RJ TEE
- ⑪ 8" GATE VALVE
- ⑫ 8'-0" PRECAST MANHOLE, SEE DETAIL 5 ON SHEET C159
- ⑬ FIRE HYDRANT WARNING SIGN, SEE DETAIL 9 ON SHEET C158
- ⑭ 5'-0" PRECAST MANHOLE, SEE DETAIL 6 ON SHEET C159
- ⑮ 4" FLAP GATE

BY

DATE

#

DESCRIPTION

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BOOSTER STATION
YARD PIPING

RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO

UNITED STATES OF AMERICA

PROFESSIONAL ENGINEER

46250

10-8-15

SHANE SHAW

DESIGNED BY:

MKA

DRAWN BY:

RJD

APPROVED BY:

JAS

DESIGN PROJ:

17865.005

CONST PROJ:

SCALE:

AS NOTED

DATE:

OCT 2015

DRAWING NO:

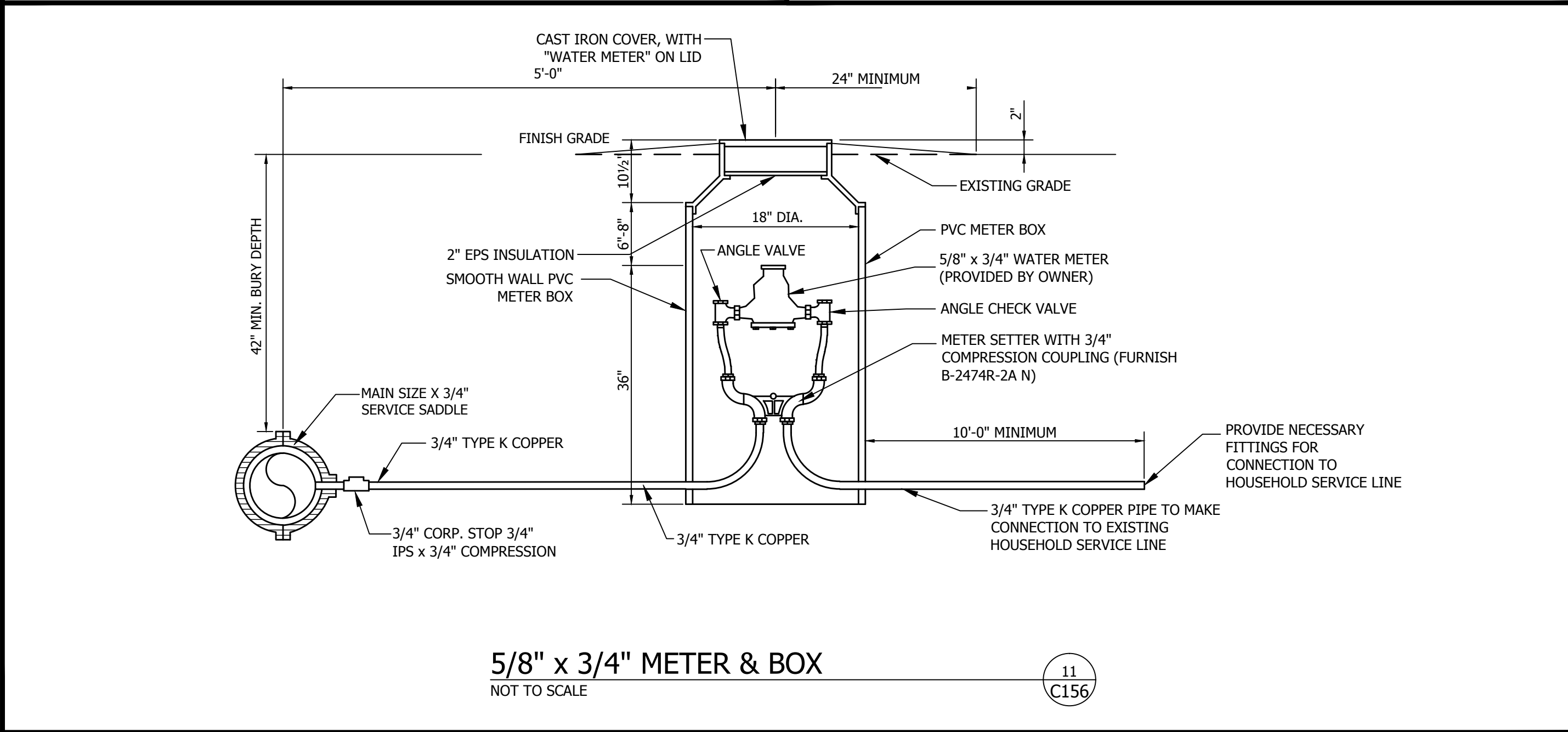
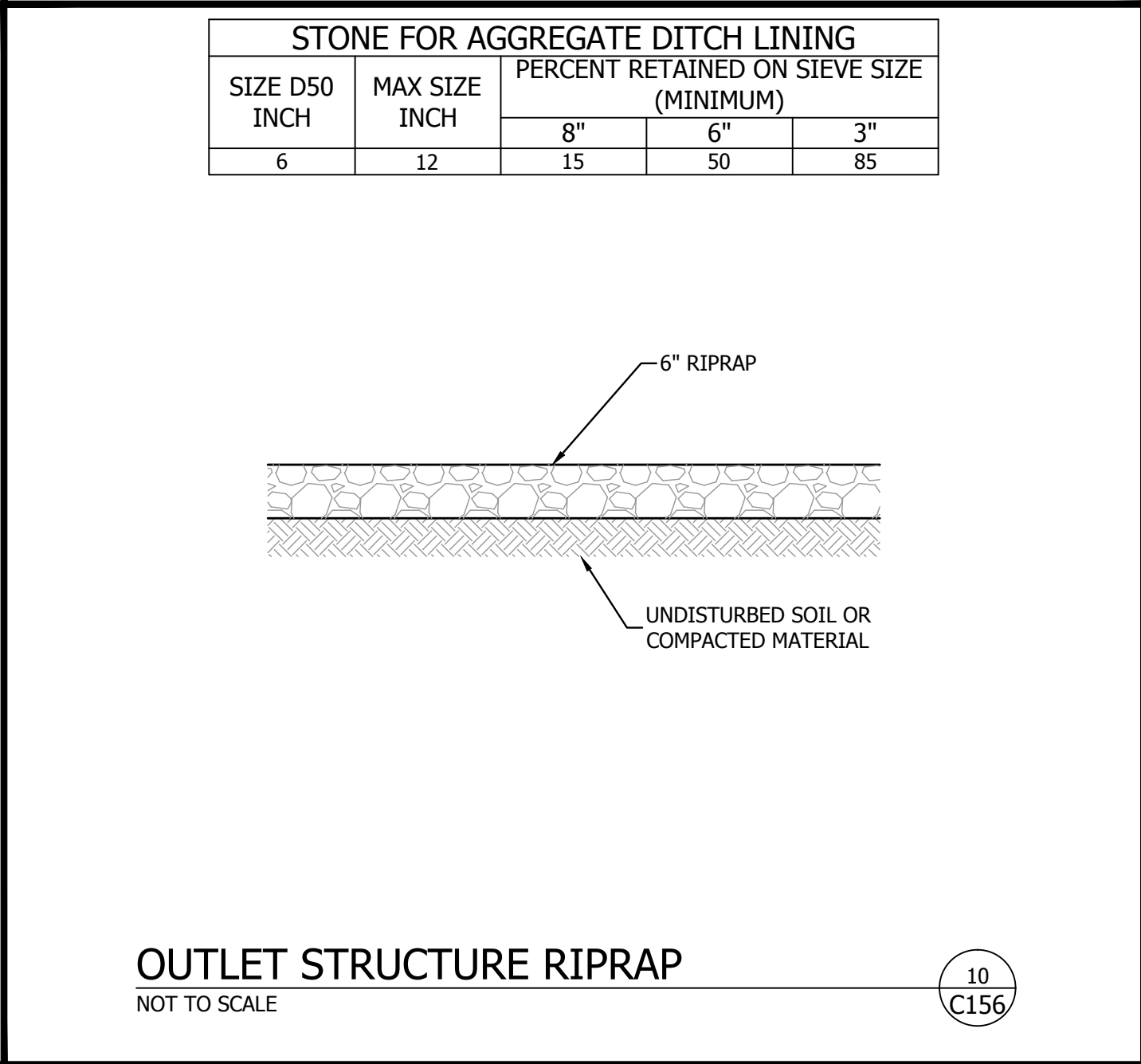
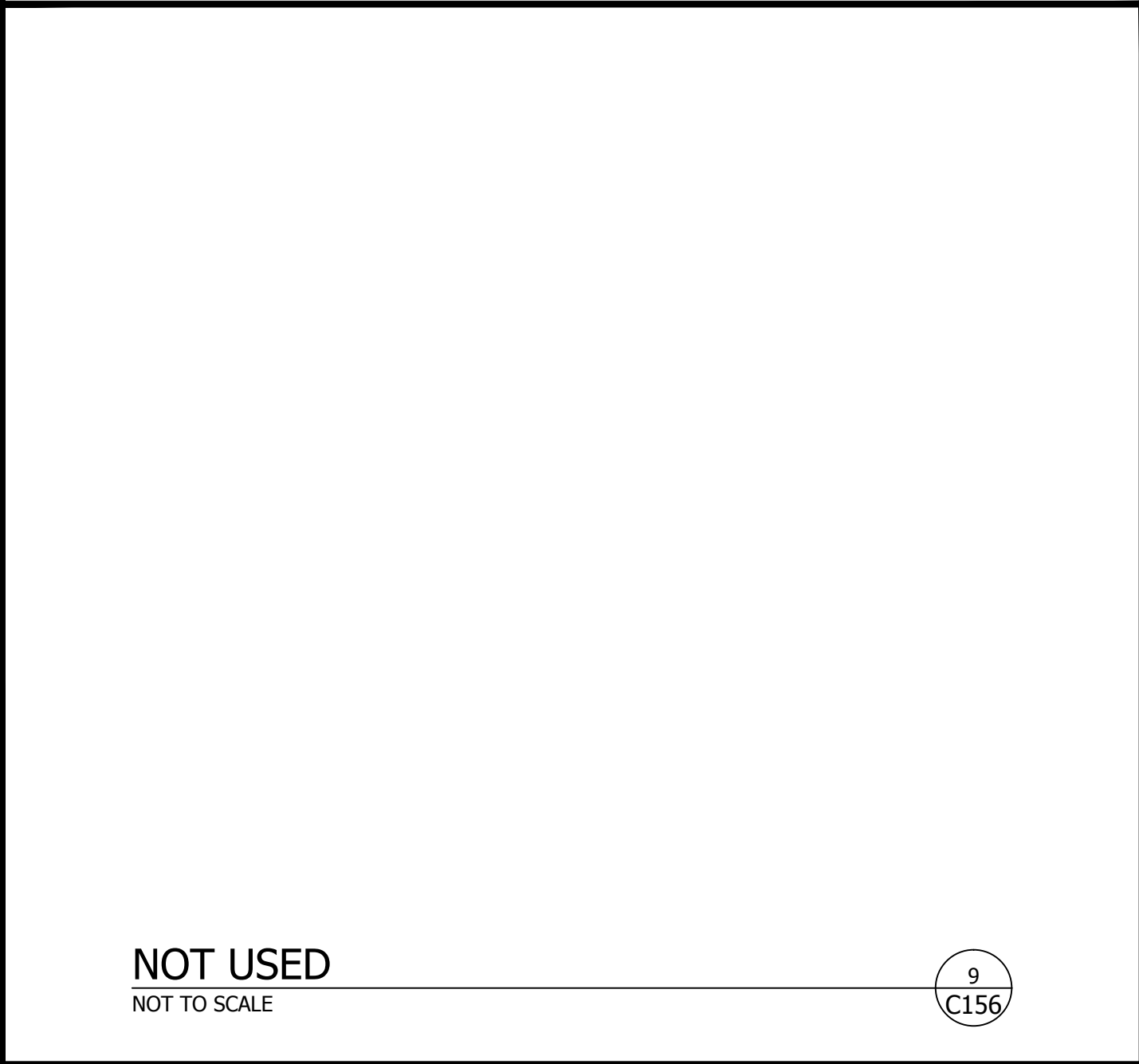
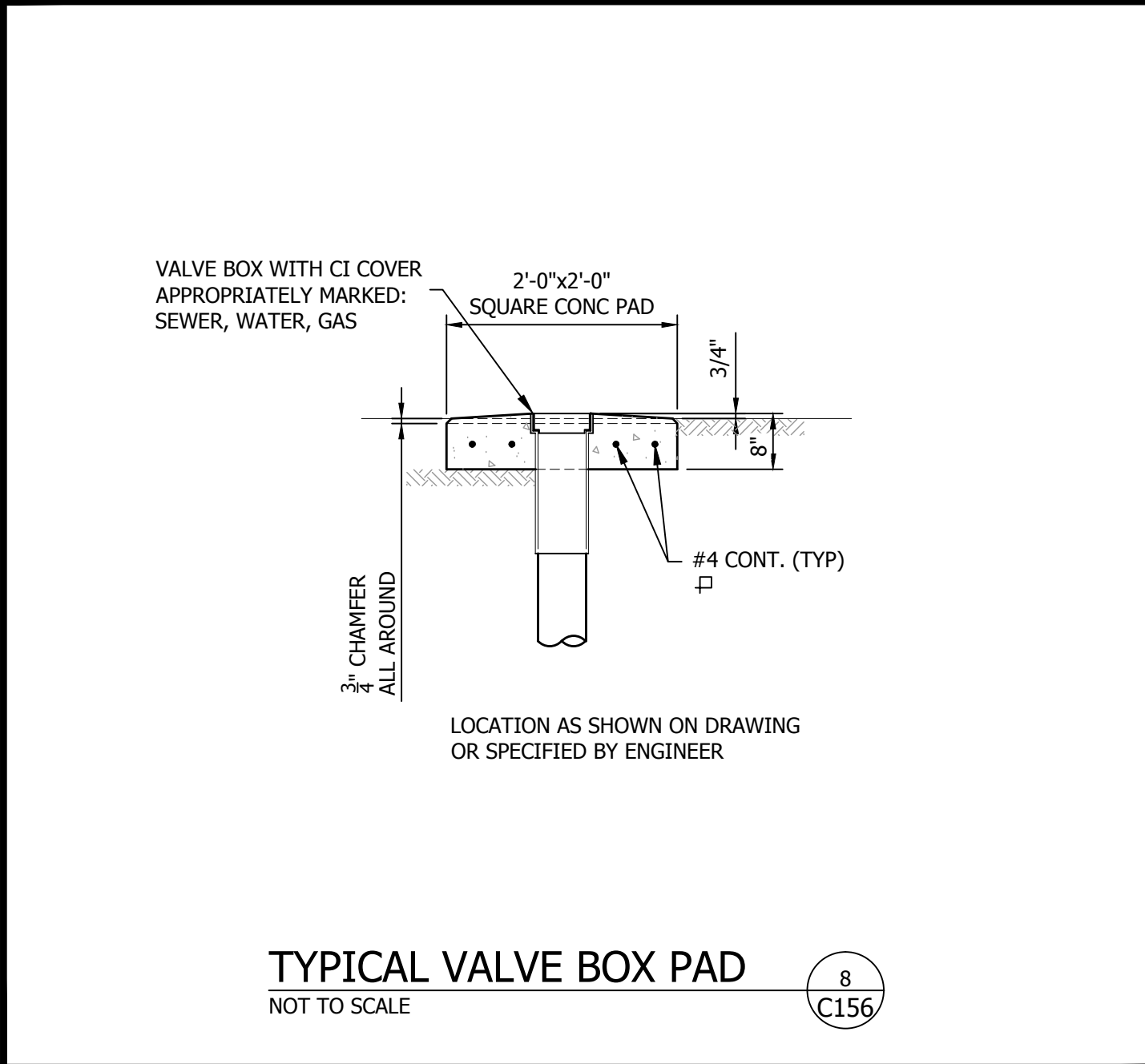
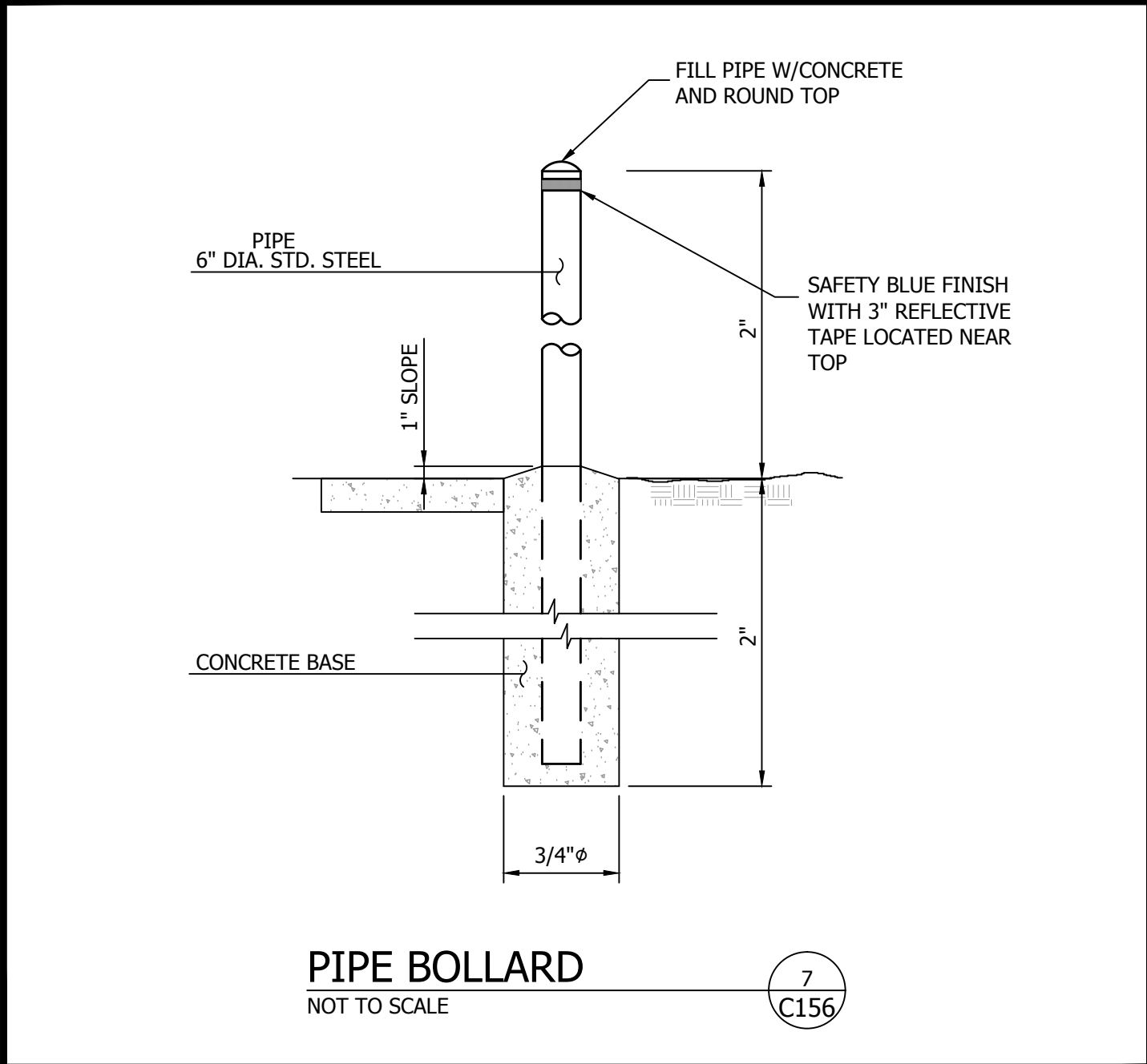
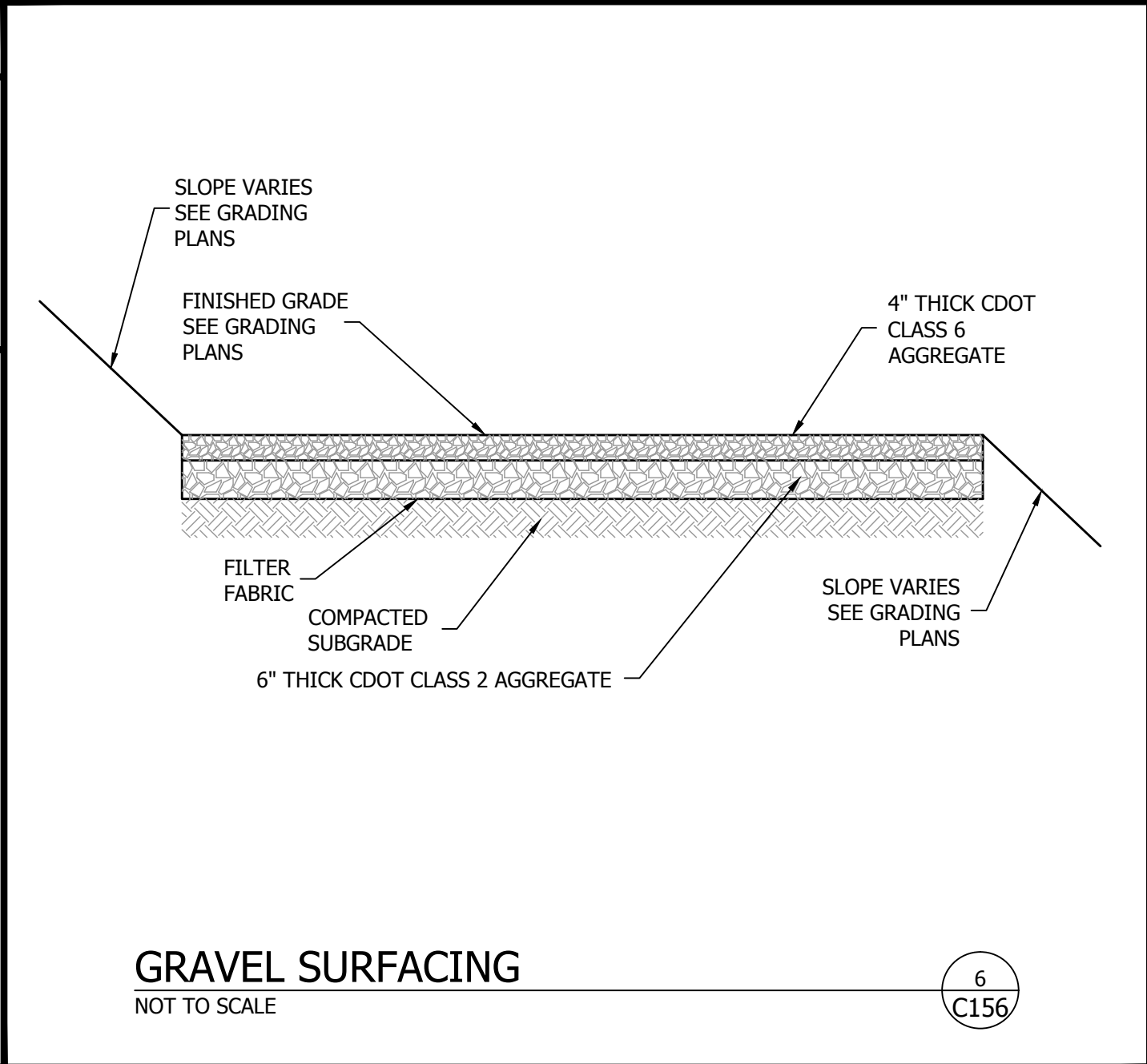
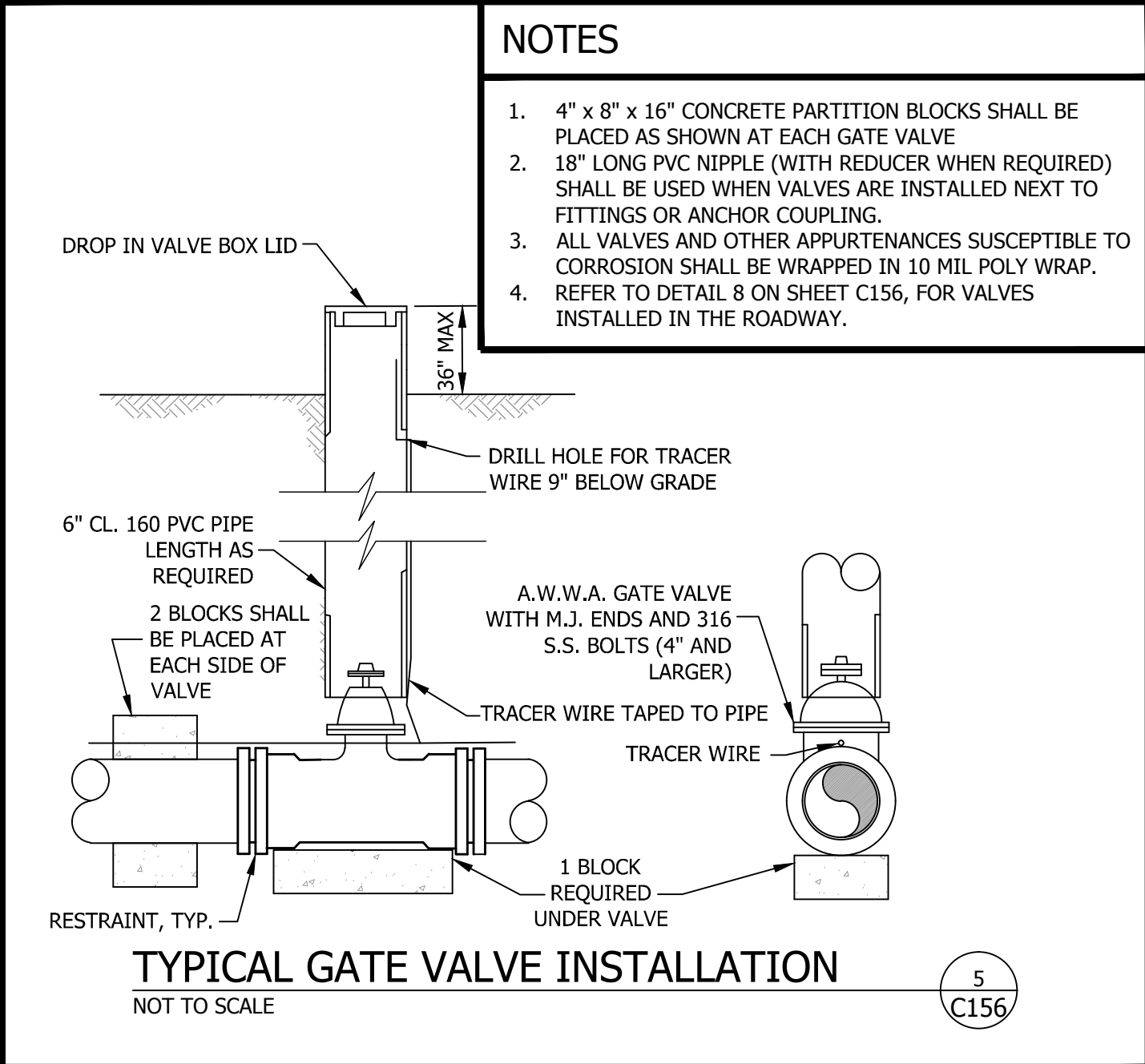
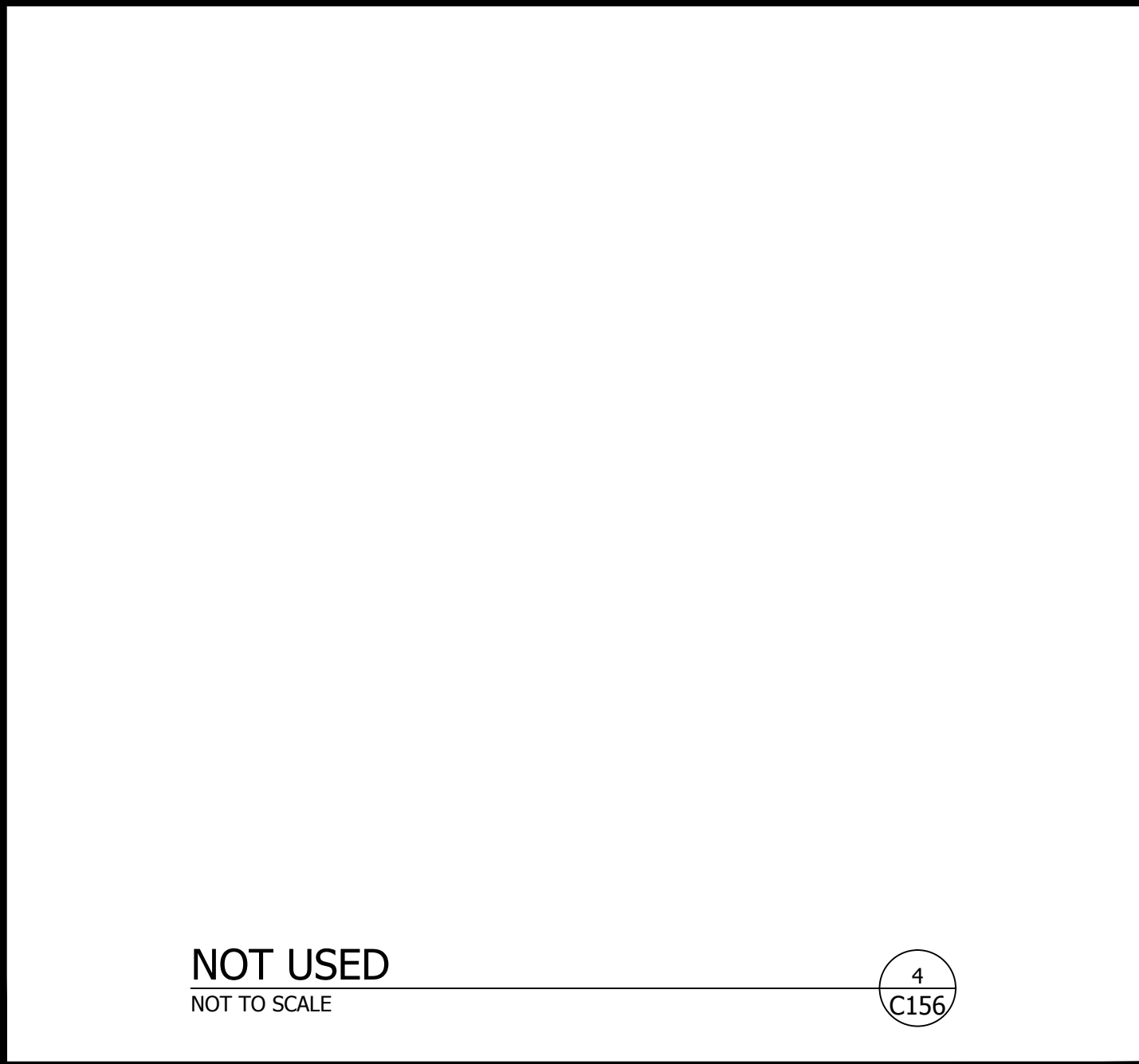
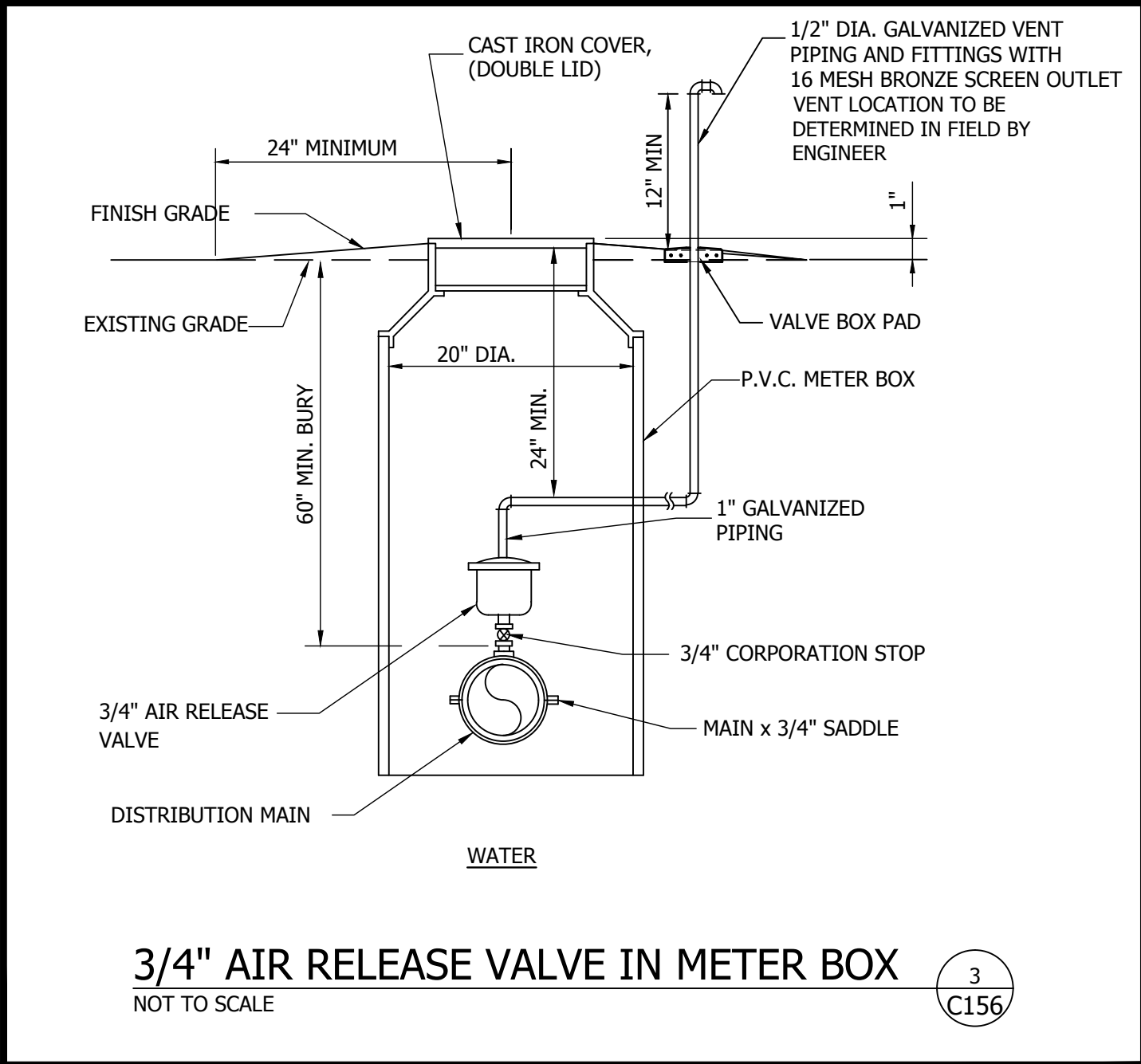
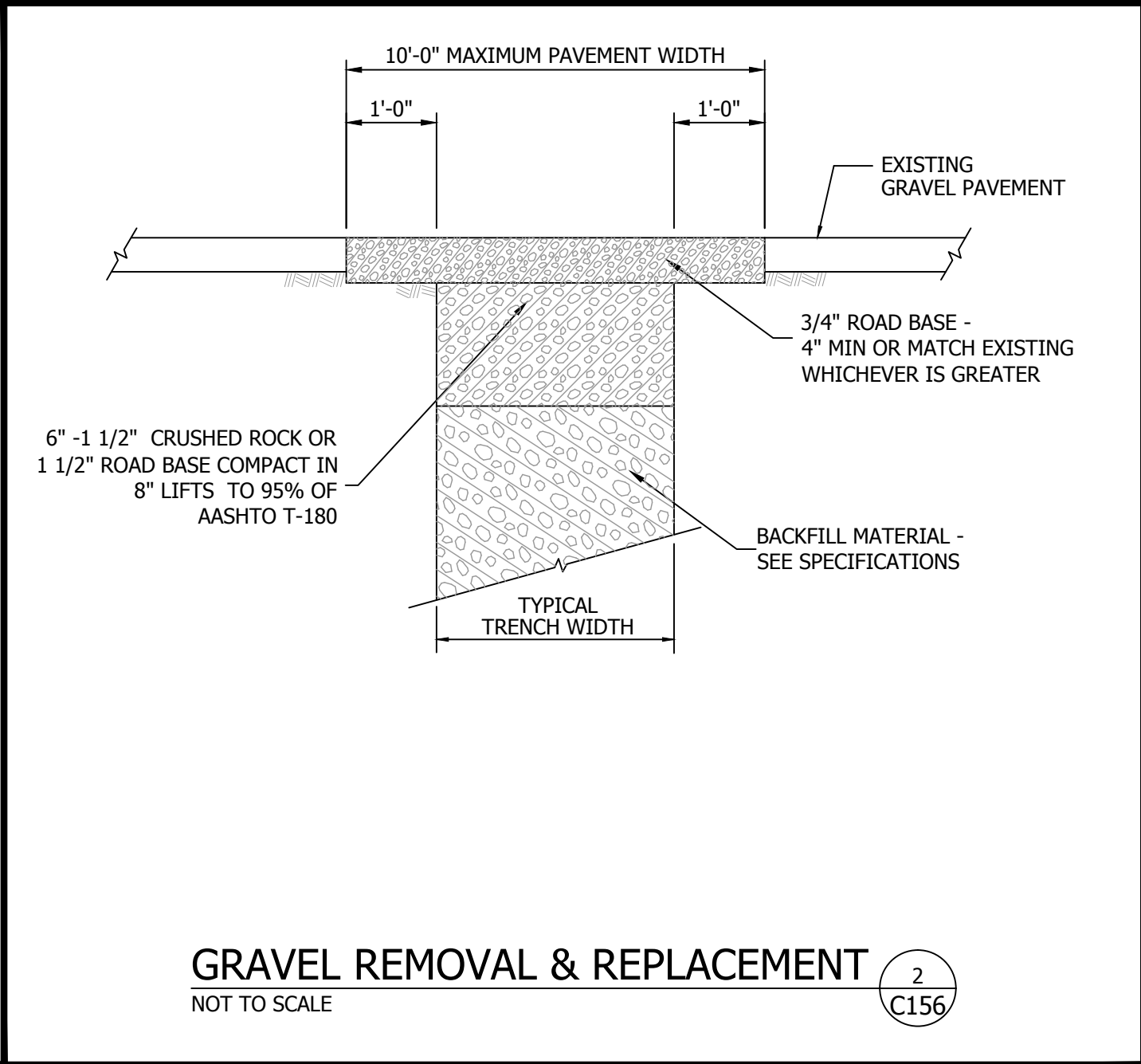
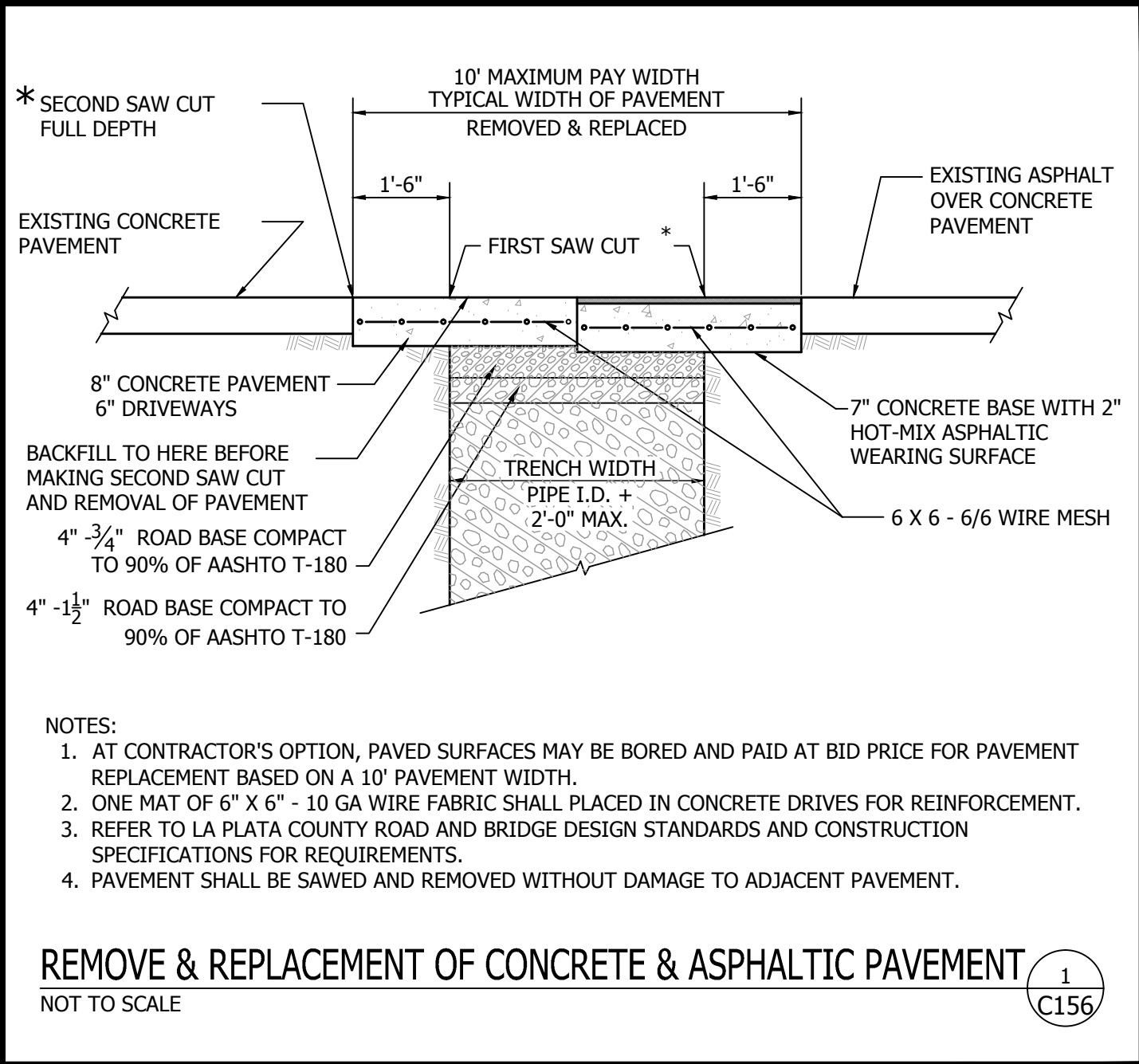
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Last edit on: 00/00/00



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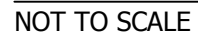
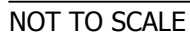
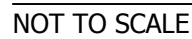
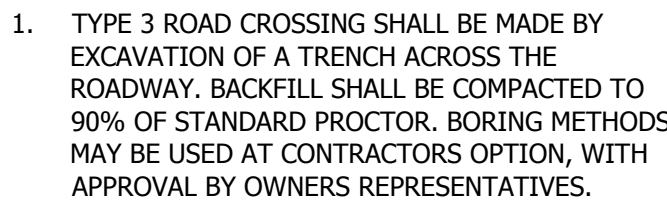
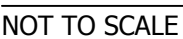
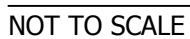
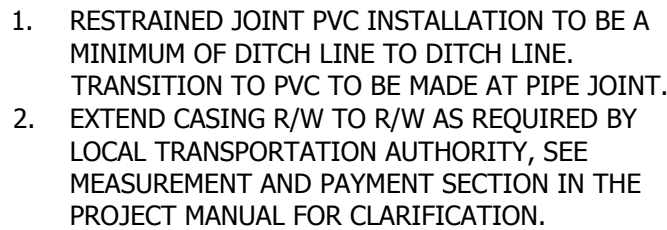
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CIVIL DETAILS
RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO

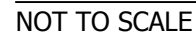
DESIGNED BY: MKA
DRAWN BY: MKA
APPROVED BY: JAS
DESIGN PROJ: 17865.005
CONST PROJ: ----
SCALE: AS NOTED
DATE: OCT 2015
DRAWING NO:
C156
SHEET NO: 64 of 114



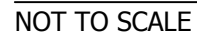
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**RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO**





1
C158



4
C158

NOT TO SCALE

5
C158

NOT TO SCALE

3
C158

NOT TO SCALE

6
C158

- (1)- 1"Ø HOOK FOR 16" AND SMALLER PIPING
- (2)- 1¼"Ø HOOKS FOR 18" AND 24" PIPING
- (4)- 1½"Ø HOOKS FOR 30" AND LARGER PIPING

NOT TO SCALE

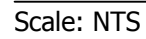


NOT TO SCALE

8
C158

NOT TO SCALE

9
C158



10
C158

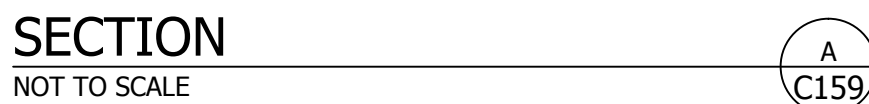


- ## TYPICAL SPACER ARRANGEMENT

PIPE SIZE	20' JOINT 'A'	40' JOIN 'A'
4"	1.77'	7.03'
8"	.93'	-
10"	.74'	-
12"	.62'	-
16"	.35"	-



- PIPELINE MARKER
NOT TO SCALE



- 190 TALISMAN DR, UNIT D-1 PAGOSA SPRINGS, CO 81147

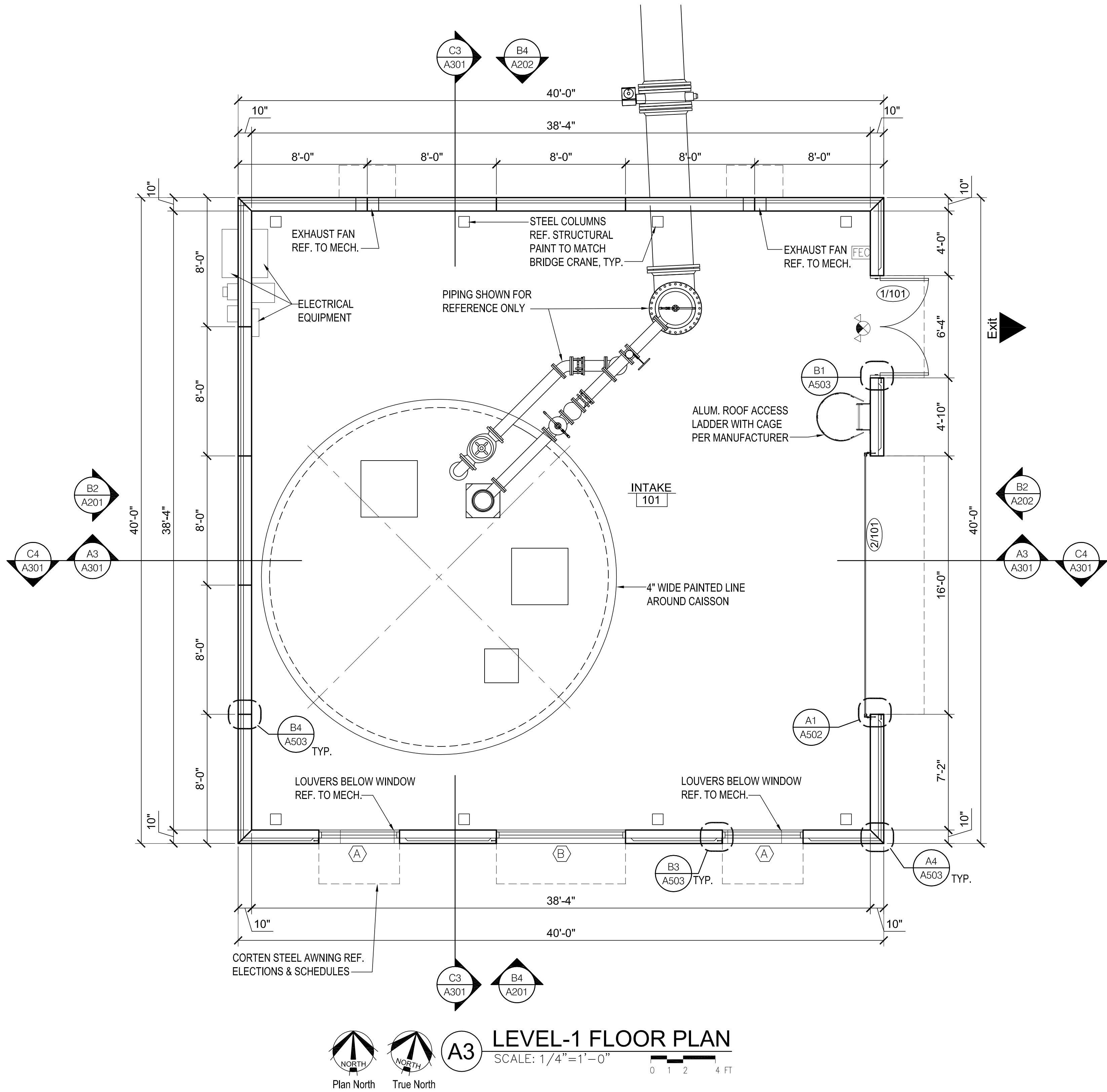
BUILDING INFORMATION:

Building Use	La Plata West Water Authority Intake Pump Building	
Location	La Plata West Water Authority Lake Nighthorse La Plata County, Colorado	
Architect	Clark Architecture & Design 902 East First Street McPherson, Kansas 67460	
Applicable Building Codes	2003 - International Building Code (IBC) 2003 - International Mechanical Code (IMC) 2003 - International Energy Conservation Code (IECC) 2001 - National Electrical Code (NEC) 2009 - International Plumbing Code (IPC) 2003 - International Fuel Gas Code (IFGC) 2003 - International Fire Code (IFC)	
Project Proposal:	New single story 1,600 sf intake pump building located along the Northern shore of Lake Nighthorse. The building is constructed of insulated precast panel with steel bar joists, insulated metal deck with metal roof panels. The site is situated over top of the existing intake caisson.	
Building Information	Occupancy Group: F-1 Factory Industrial Moderate Hazard Construction Type: Type II-B Allowable Area/ Hgt/ Stories: 15,500 sf / 55'-0" / 2 Story Area Modification: Not Required Actual Area/ Hgt/ Stories: 1,600 sf / 34'-0" / 1 Story Roof Classification: Type II-B, Class 'C' Roof Covering Classification	
Egress	Occupant Load: F-1 1600 / 100 (16) occ. Building Exits Required (Table 1018.2): 1 Exit Ground Floor Building Exits Provided: 1 Exit Ground Floor Width Required (Table 1005.1): (.2 x 16) = .32" Width Provided: 68.5" Common Path of Egress (Section 1013.3): 75 ft Exit Travel Distance (Table 1018.2): 75 ft	
Fire Prevention:	Fire Alarm - No Requirements (Section 907.2.4) Fire Extinguishers - (NFPA 10 & IFC) Class Based on Location. Automatic Sprinkler Systems: No Requirement (Section 903.2.3) Fire Truck access: All 2 sides with hose lengths not in excess of 50' from either side.	
Code Footprint:	This document is a code footprint which shows owner compliance of state law to protect occupants from dangers of fire and explosion, and is the written and graphic description of the intended life safety features in a public building. The code footprint defines minimum features of a code footprint for an objective evaluation by uniform applications of state law using minimum resources. It also makes the code footprint available to assist local fire or building officials view for new construction and changes in use and provides a building owner with life safety choices to best suit their circumstances at the outset of construction or renovations. It is a simple record, not a complete record, of the designer's life safety features, and is a fixed code target for the life of the building.	

Table 601
Fire Resistance Rating For Building Elements (Hours)

Building Element	Type II-B
Structural Frame Including Columns, Girders, Trusses	0
Bearing Walls Exterior Interior	0 0
Non-Bearing Walls and Partitions Exterior Interior	0 0
Floor Construction Including Supporting Beams and Joists	0
Roof Construction Including Supporting Beams and Joists	0
Corridors (Table 1017.1) Non-Sprinklered Building	NA 1

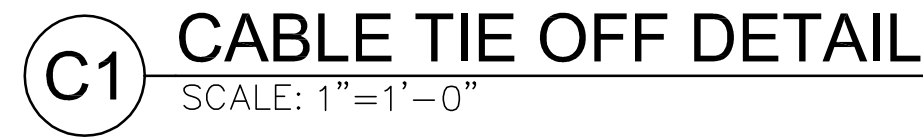
LEGEND	
	Exit
	Exit Light/Sign w/Battery Back-Up
	Fire Extinguisher
	Knox Box
	Emergency Light w/Battery back-up



LEGEND	
	DOOR TAG: REFERENCE DOOR SCHEDULE
	WINDOW TAG: REFERENCE WINDOW SCHEDULE
	ROOM TAG: REFERENCE FINISH SCHEDULE
	DETAIL TAG: DETAIL NUMBER DETAIL SHEET LOCATION



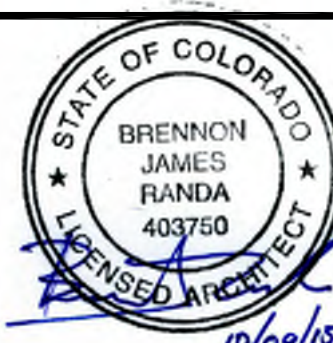
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DRAWN BY:	CJH
APPROVED BY:	CAD
DESIGN PROJ:	17865.005
CONST PROJ:	
SCALE:	AS NOTED
DATE:	OCT 2015
DRAWING NO:	A102
SHEET NO:	69 of 114



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INTAKE & BOOSTER BUILDING ROOF PLAN

**RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO**



DESIGNED BY:	CAI
DRAWN BY:	CJH
APPROVED BY:	CAI
DESIGN PROJ:	17865.000
CONST PROJ:	
SCALE:	AS NOTED
DATE:	OCT 2011
DRAWING NO:	A103
SHEET NO:	70 of 11

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BUILDING INFORMATION:

Building Use	La Plata West Water Authority Intake Pump Building	
Location	La Plata West Water Authority Lake Nighthorse La Plata County, Colorado	
Architect	Clark Architecture & Design 902 East First Street McPherson, Kansas 67460	
Applicable Building Codes	2003 - International Building Code (IBC) 2003 - International Mechanical Code (IMC) 2003 - International Energy Conservation Code (IECC) 2001 - National Electrical Code (NEC) 2009 - International Plumbing Code (IPC) 2003 - International Fuel Gas Code (IFGC) 2003 - International Fire Code (IFC)	
Project Proposal:	New single story 280 sf booster pump building located North of Lake Nighthorse along County Road 210. The building is constructed of insulated precast panel with steel bar joists, insulated metal deck with metal roof panels.	

Building Information	Occupancy Group:	F-1 Factory Industrial Moderate Hazard
	Construction Type	Type II-B
	Allowable Area/ Hgt/ Stories:	15,500 sf / 55'-0" / 2 Story
	Area Modification:	Not Required
	Actual Area/ Hgt/ Stories:	280 sf / 16'-0" / 1 Story
	Roof Classification:	Type II-B, Class 'C' Roof Covering Classification

Egress	Occupant Load:	F-1 280 / 100 (2) occ.
	Building Exits Required (Table 1018.2):	1 Exit Ground Floor

Egress	Building Exits Provided:	1 Exit Ground Floor
	Width Required (Table 1005.1):	(2 x 2) = .4"
	Width Provided:	68.5"
	Common Path of Egress (Section 1013.3):	75 ft
	Exit Travel Distance (Table 1018.2)	75 ft

Fire Prevention:	Fire Alarm - No Requirements (Section 907.2.4)
	Fire Extinguishers - (NFPA 10 & IFC) Class Based on Location.
	Automatic Sprinkler Systems: No Requirement (Section 903.2.3)
	Fire Truck access: All 2 sides with hose lengths not in excess of 50' from either side.

Code Footprint:	This document is a code footprint which shows owner compliance of state law to protect occupants from dangers of fire and explosion, and is the written and graphic description of the intended life safety features in a public building.
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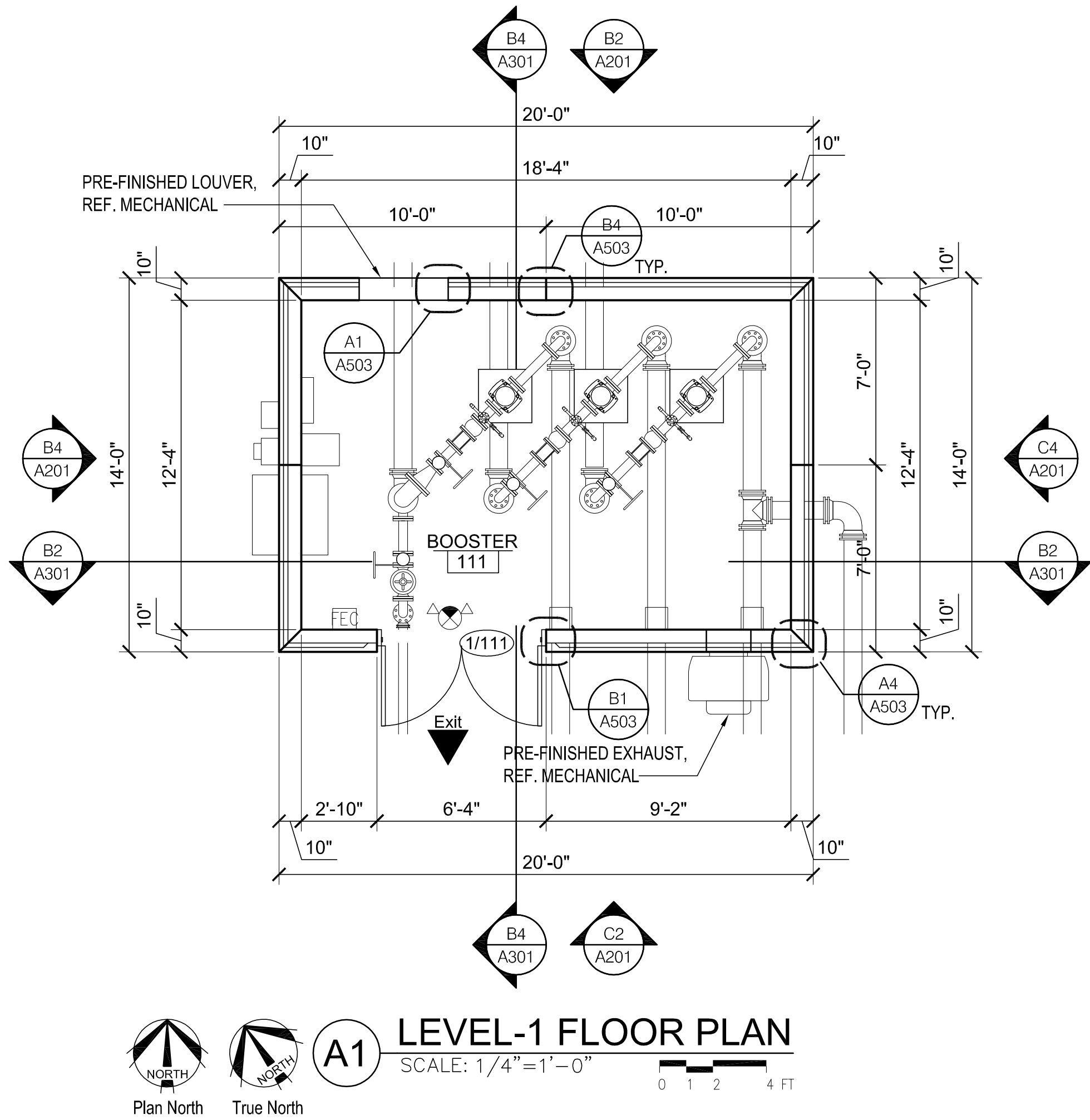
The code footprint defines minimum features of a code footprint for an objective evaluation by uniform applications of state law using minimum resources. It also makes the code footprint available to assist local fire or building officials view for new construction and changes in use and provides a building owner with life safety choices to best suit their circumstances at the outset of construction or renovations. It is a simple record, not a complete record, of the designer's life safety features, and is a fixed code target for the life of the building.

Table 601
Fire Resistance Rating For Building Elements (Hours)

Building Element	Type II-B
Structural Frame Including Columns, Girders, Trusses	0
Bearing Walls Exterior Interior	0
	0
Non-Bearing Walls and Partitions Exterior Interior	0
	0
Floor Construction Including Supporting Beams and Joists	0
Roof Construction Including Supporting Beams and Joists	0
Corridors (Table 1017.1) Non-Sprinklered Building	NA 1

LEGEND

- Exit
- Exit Light/Sign w/Battery Back-Up
- Fire Extinguisher
- Knox Box
- Emergency Light w/Battery back-up



LEGEND

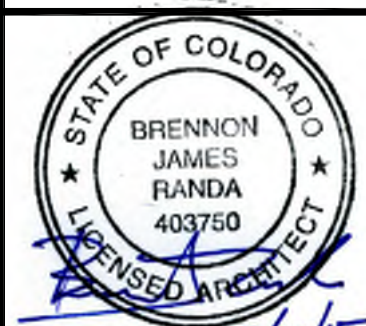
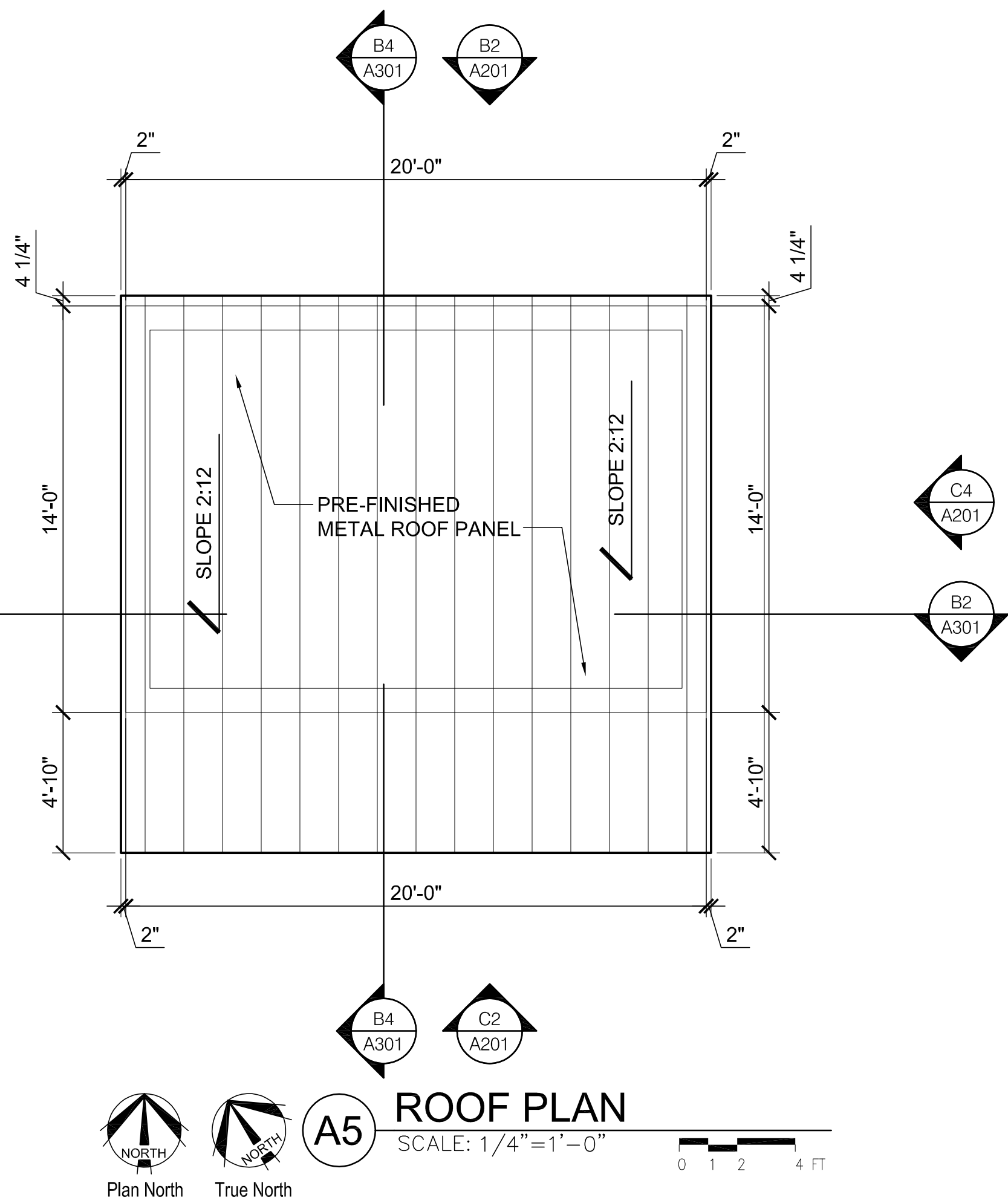
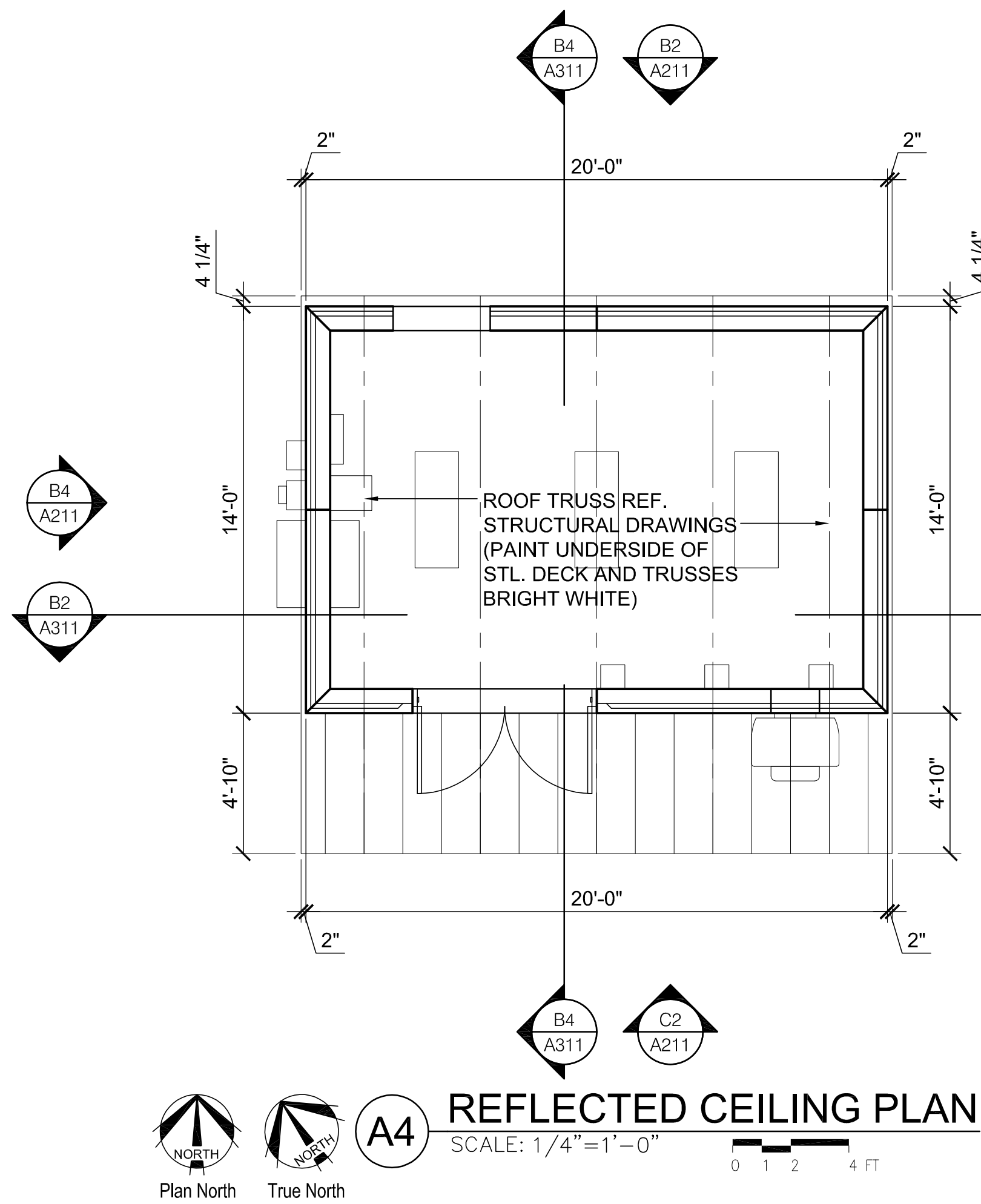
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- D WINDOW TAG: REFERENCE WINDOW SCHEDULE
- STORAGE 004 ROOM TAG: REFERENCE FINISH SCHEDULE
- D3 A403 DETAIL TAG: DETAIL NUMBER
DETAIL SHEET LOCATION

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BOOSTER BUILDING
LEVEL-1 FLOOR PLAN
RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO



DESIGNED BY:	CAD
DRAWN BY:	CJH
APPROVED BY:	CAD
DESIGN PROJ:	17865.005
CONST PROJ:	
SCALE:	AS NOTED
DATE:	OCT 2015
DRAWING NO:	A111
SHEET NO:	71 of 114



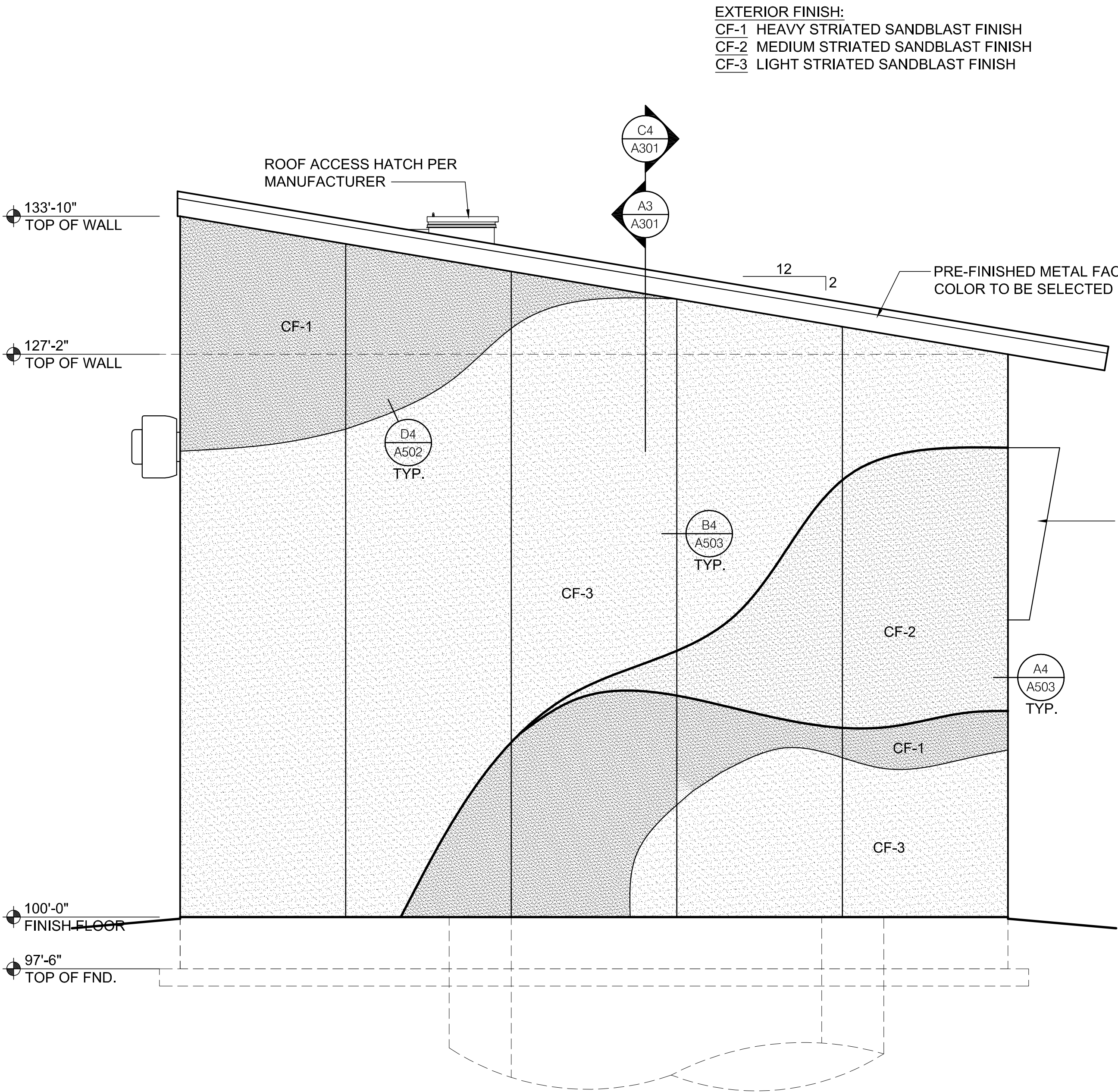
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APPROVED BY:	CAD
DESIGN PROJ:	17865.005
CONST PROJ:	
SCALE:	AS NOTED
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SHEET NO:	72 of 114

**BOOSTER BUILDING
REFLECTED CEILING & ROOF PLAN**

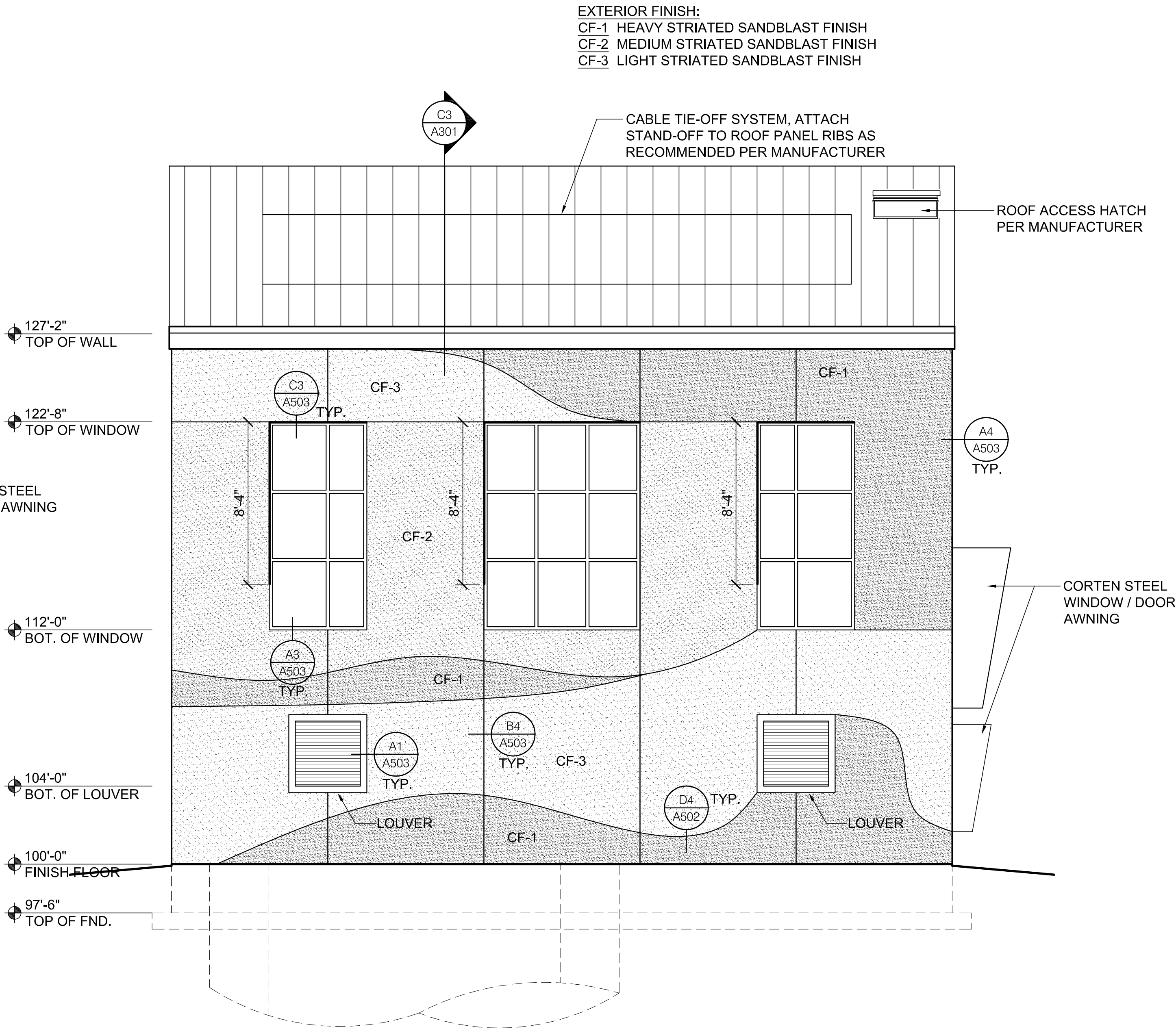
RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO

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B2 WEST ELEVATION
SCALE: 1/4"=1'-0"



B4 SOUTH ELEVATION
SCALE: 1/4"=1'-0"



**INTAKE BUILDING
EXTERIOR ELEVATION**

RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO



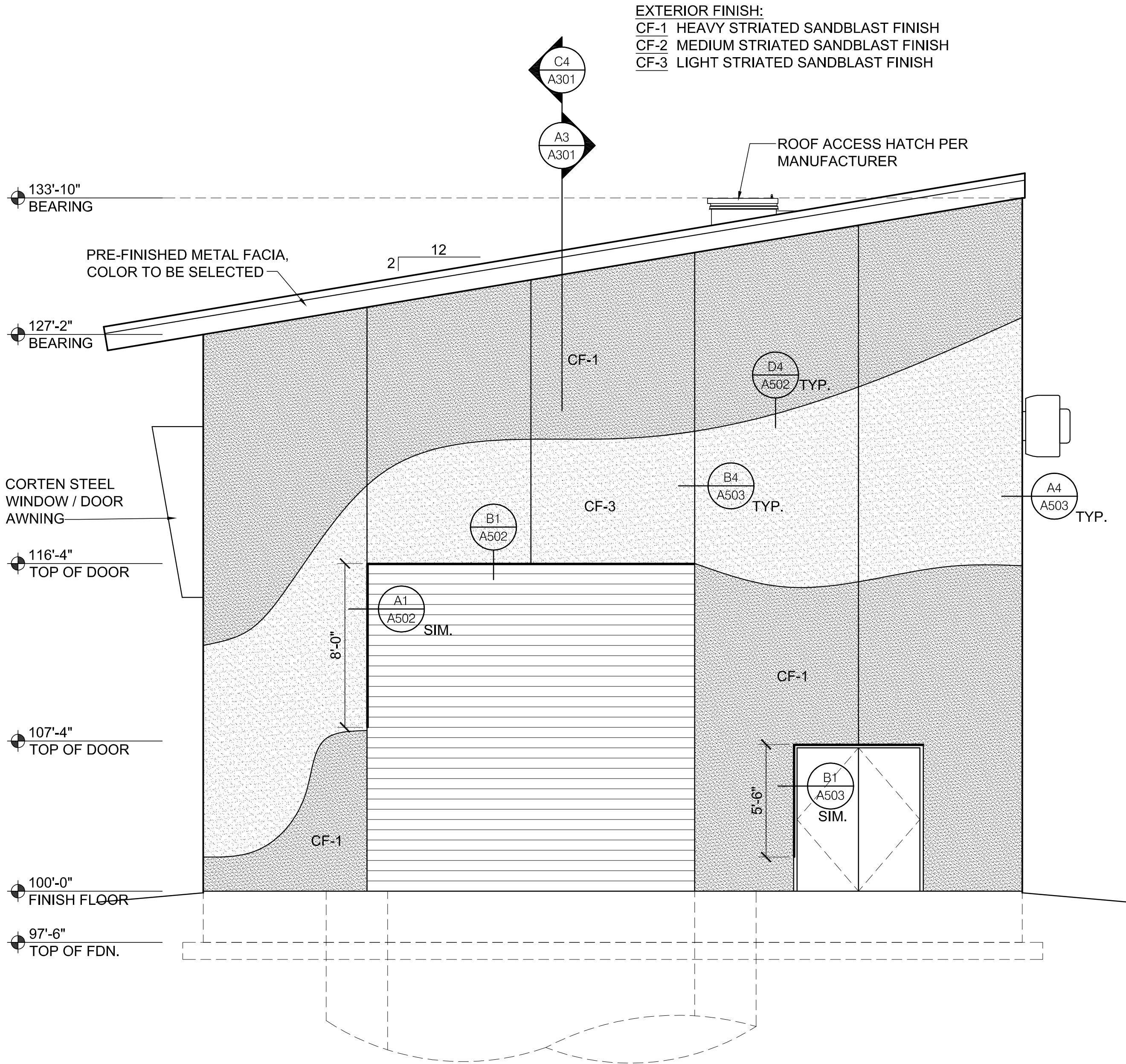
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DESIGN PROJ:	17865.005
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SCALE:	AS NOTED
DATE:	OCT 2015
DRAWING NO:	A201
SHEET NO:	73 of 114

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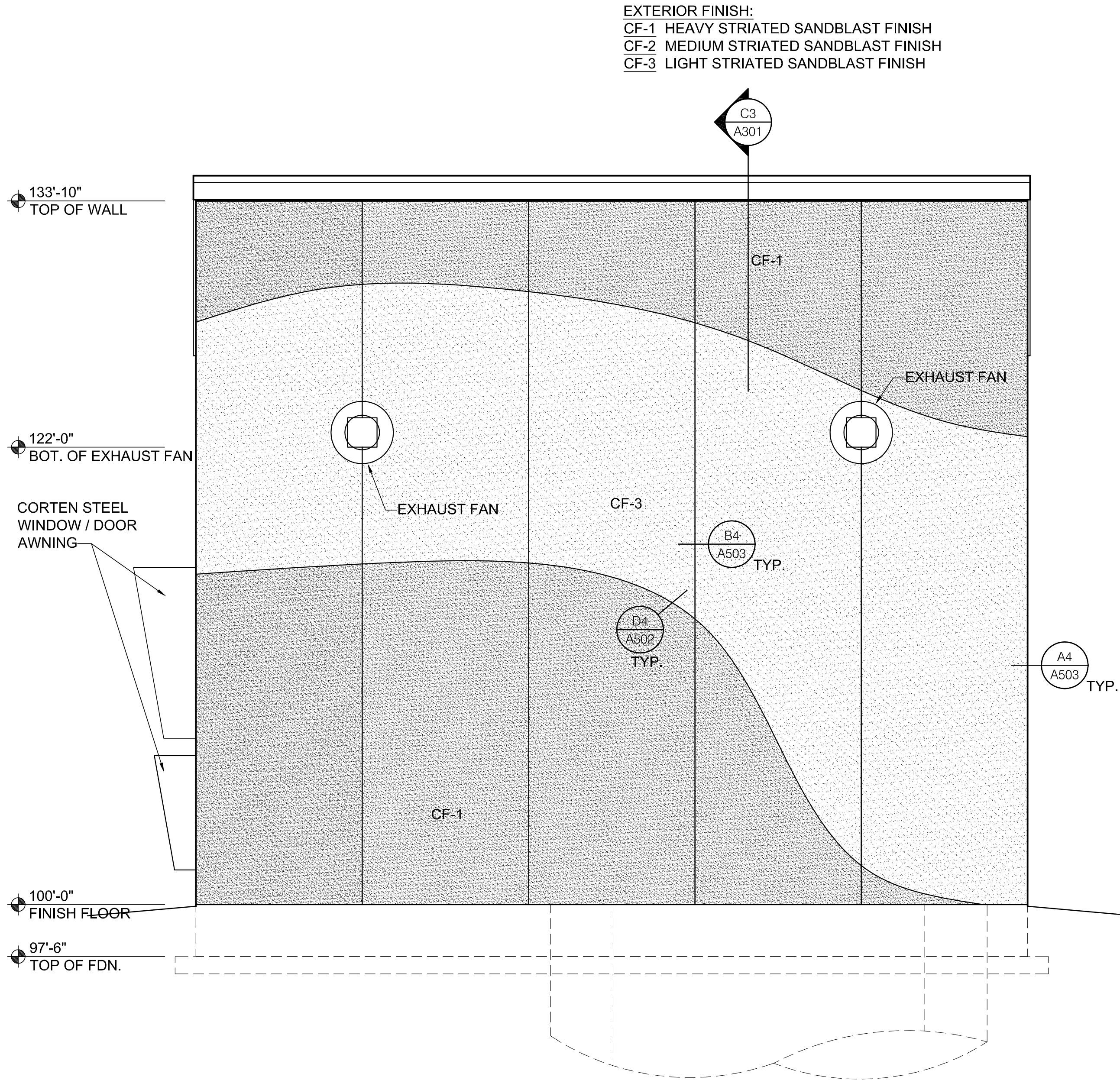
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Lost edit on: 00/00/00 Drawing Name: P:\Projects\1355 - EPWA\Drawings\AutoCAD\3D\Unlabeled Building\A202.dwg Layout Name: A202 Plotted By: CHRS Plotted on: 10/14/2015 2:47:26 PM



B2 EAST ELEVATION
SCALE: 1/4"=1'-0"
0 1 2 4 FT



B4 NORTH ELEVATION
SCALE: 1/4"=1'-0"
0 1 2 4 FT

**INTAKE BUILDING
EXTERIOR ELEVATIONS**

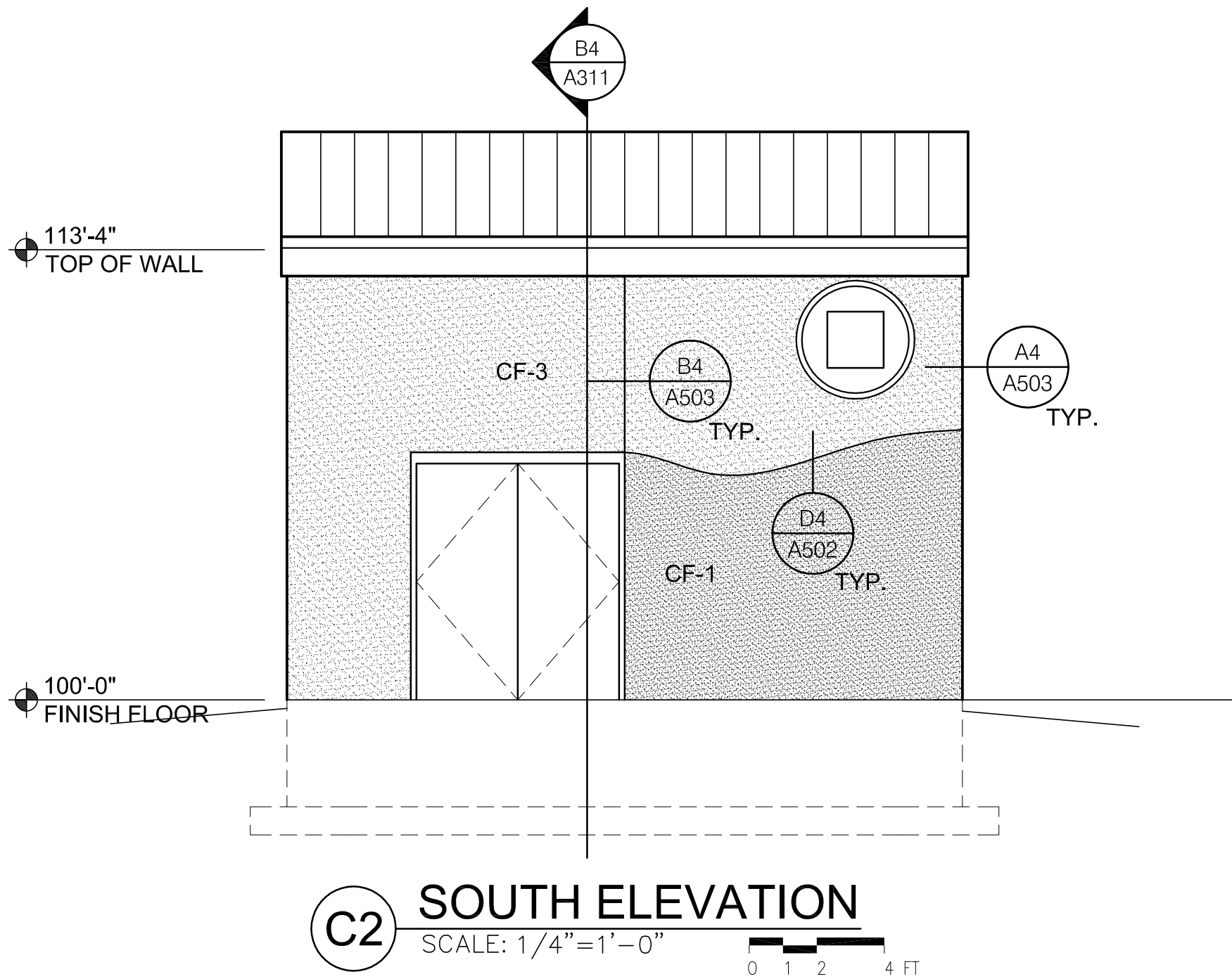
RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO

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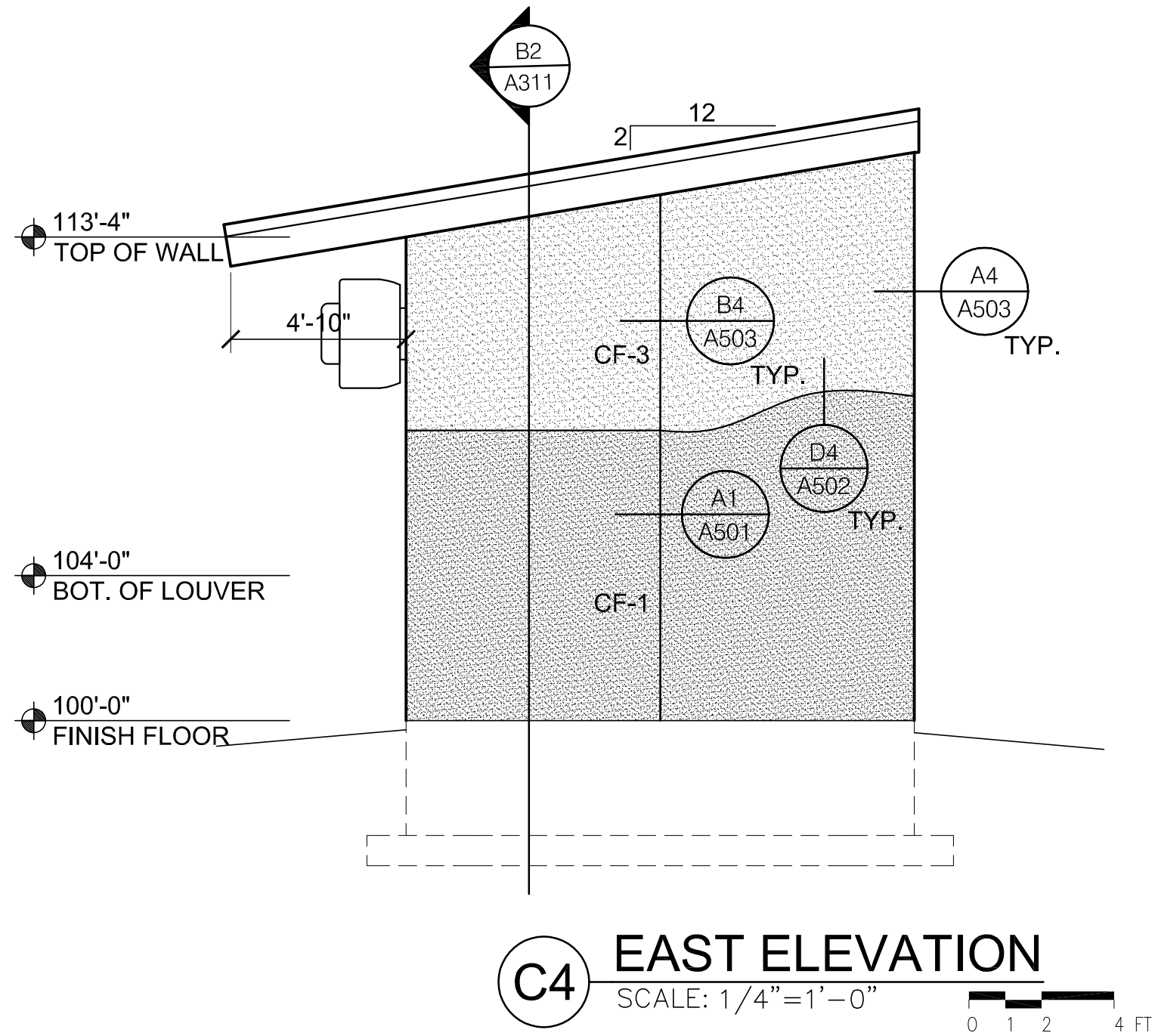


DESIGNED BY:	CAD
DRAWN BY:	CJH
APPROVED BY:	CAD
DESIGN PROJ:	17865.005
CONST PROJ:	
SCALE:	AS NOTED
DATE:	OCT 2015
DRAWING NO:	A202
SHEET NO:	74 of 114

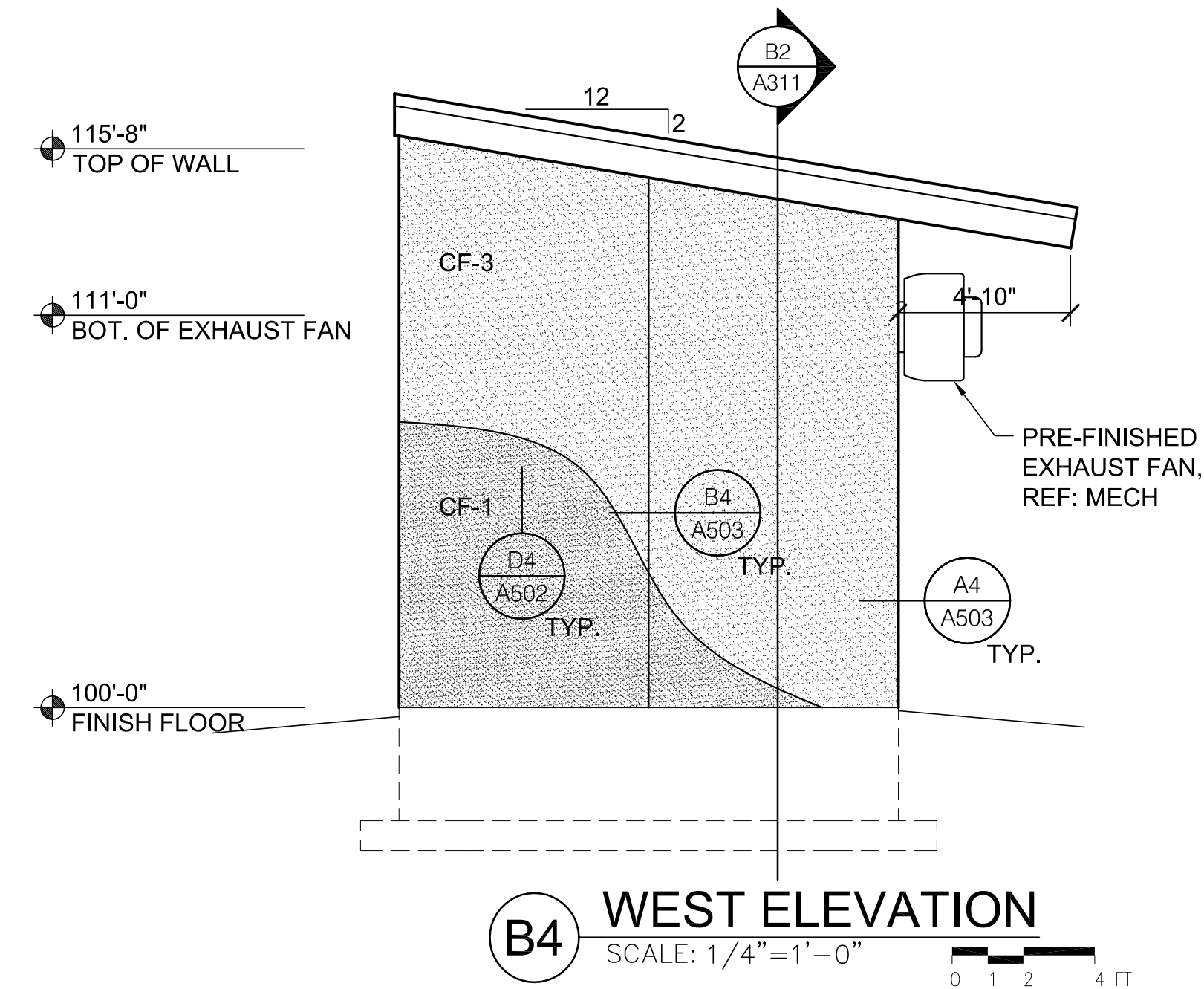
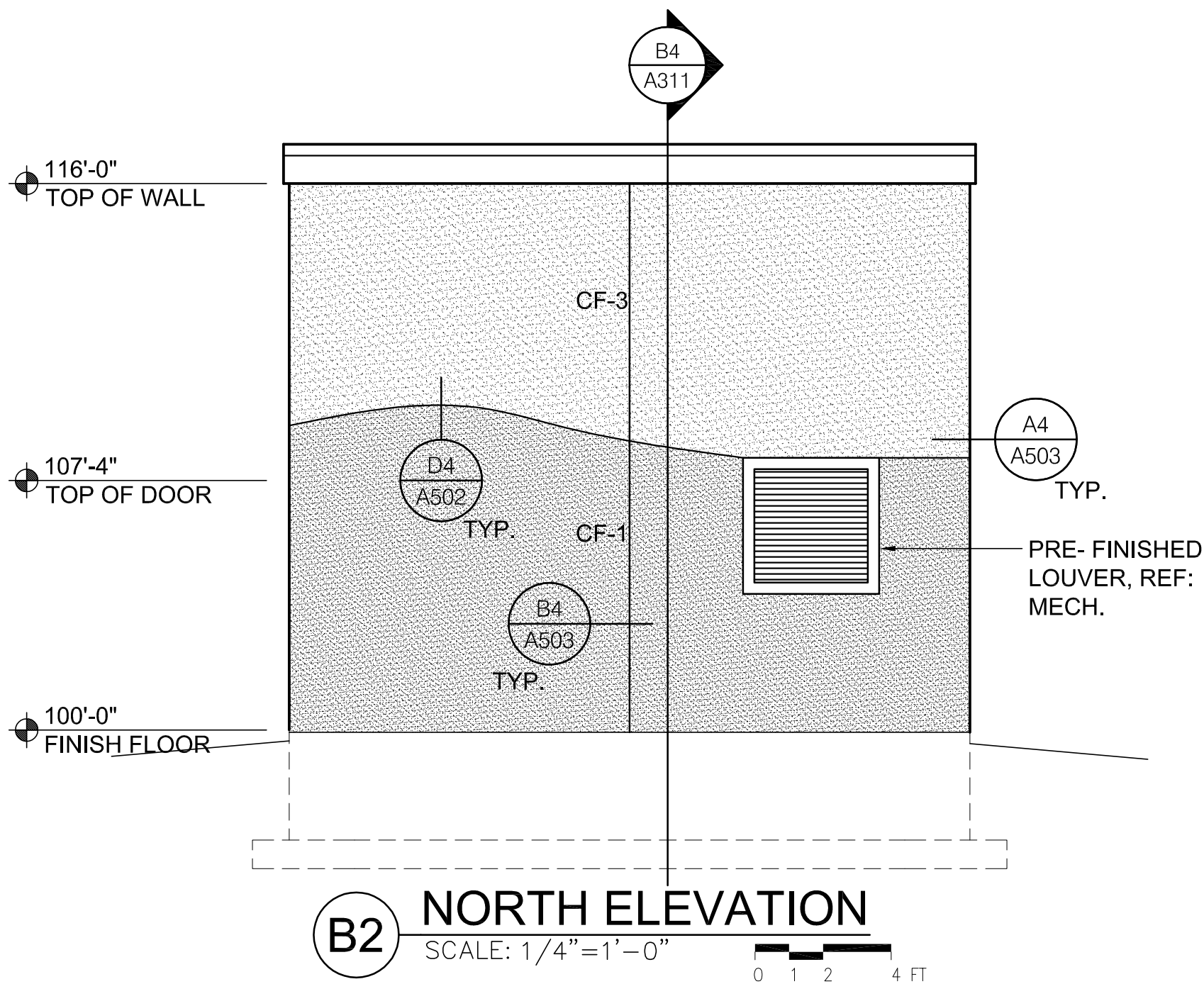
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EXTERIOR FINISH:
CF-1 HEAVY STRIATED SANDBLAST PRECAST FINISH
CF-2 MEDIUM STRIATED SANDBLAST PRECAST FINISH
CF-3 LIGHT STRIATED SANDBLAST PRECAST FINISH



EXTERIOR FINISH:
CF-1 HEAVY STRIATED SANDBLAST PRECAST FINISH
CF-2 MEDIUM STRIATED SANDBLAST PRECAST FINISH
CF-3 LIGHT STRIATED SANDBLAST PRECAST FINISH



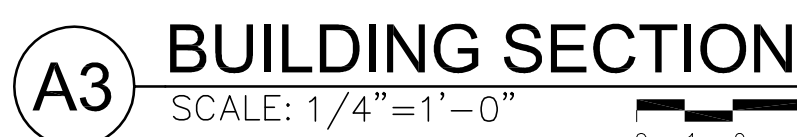
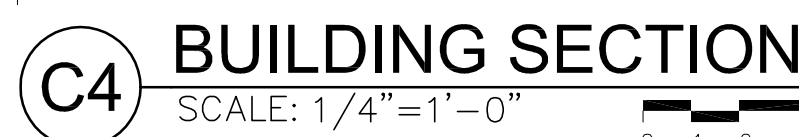
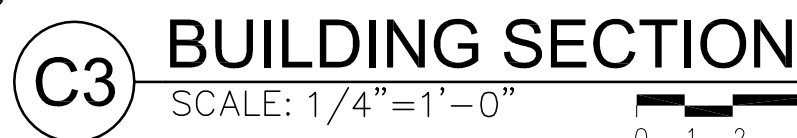
**BOOSTER BUILDING
EXTERIOR ELEVATIONS**

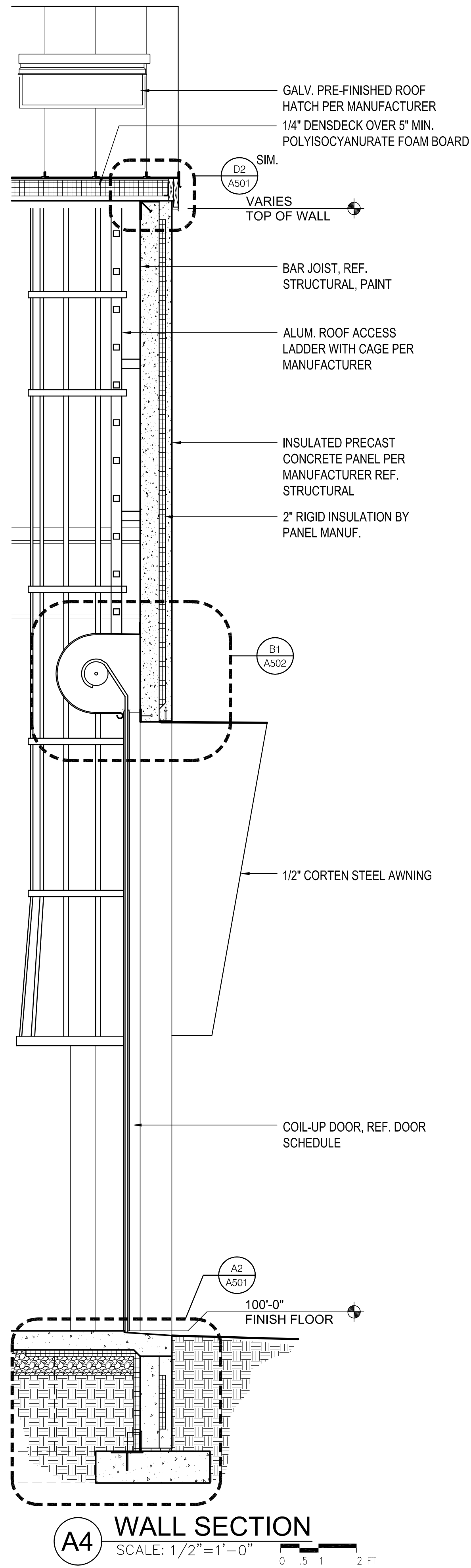
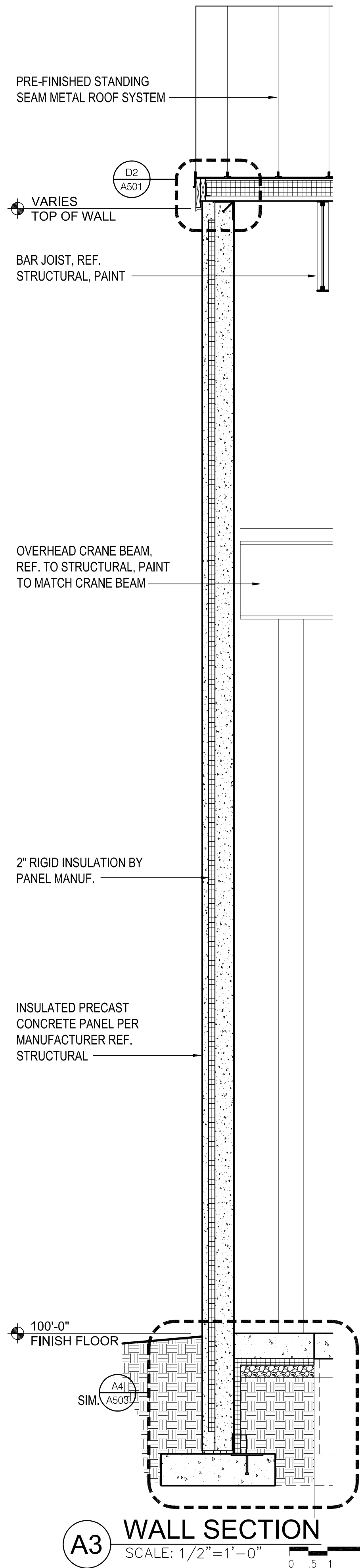
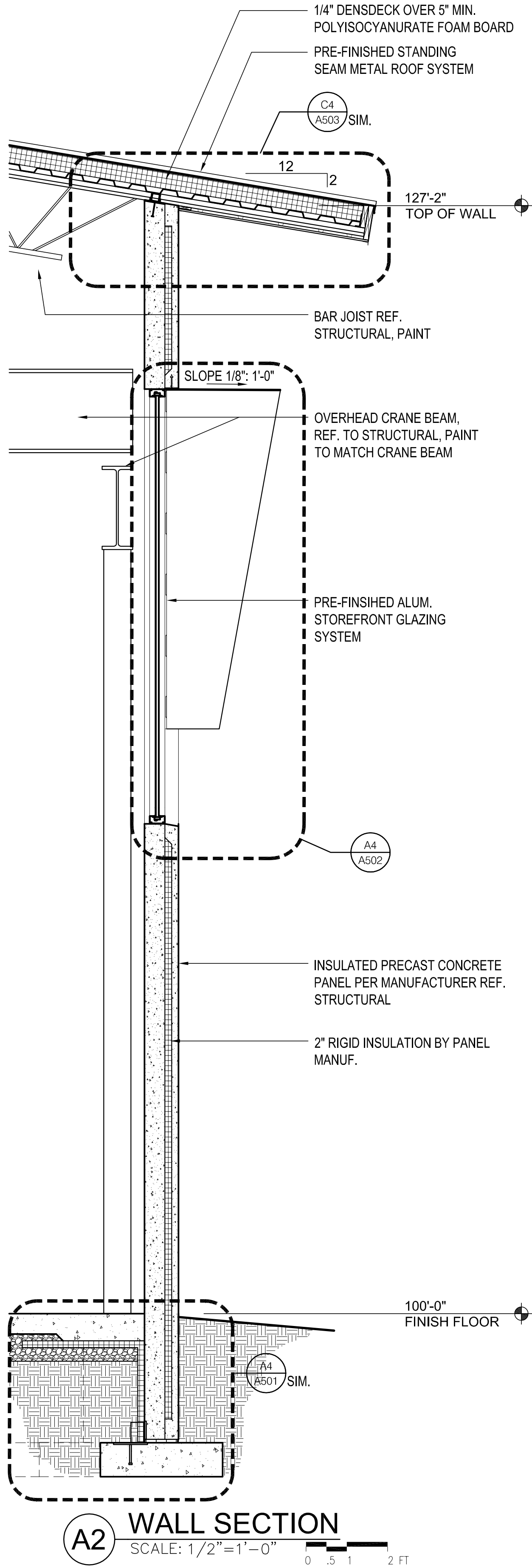
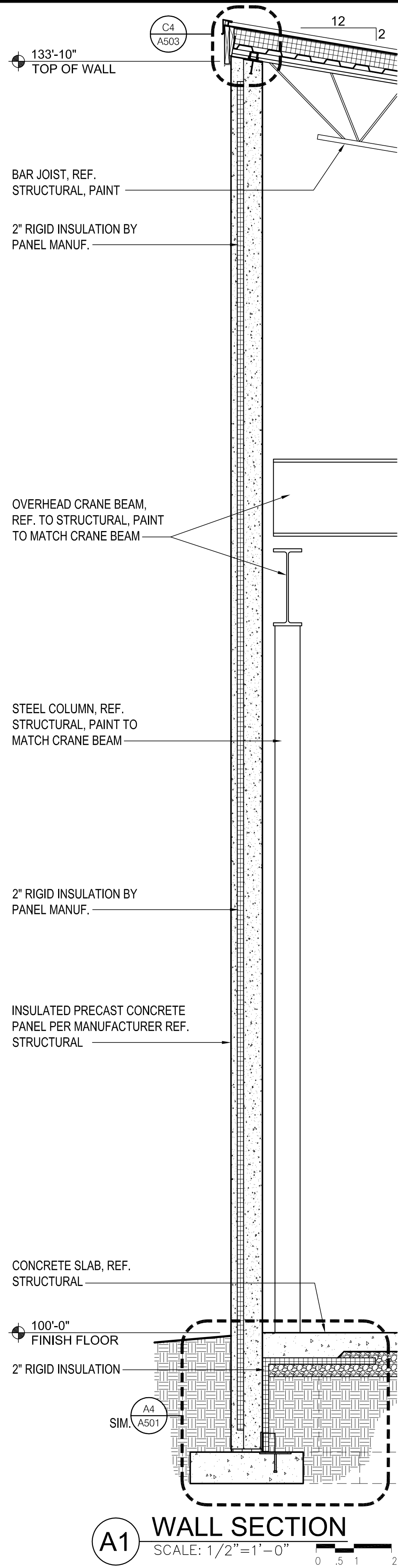
RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO

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DRAWN BY:	CJH
APPROVED BY:	CAD
DESIGN PROJ:	17865.005
CONST PROJ:	
SCALE:	AS NOTED
DATE:	OCT 2015
DRAWING NO:	A211
SHEET NO:	75 of 114

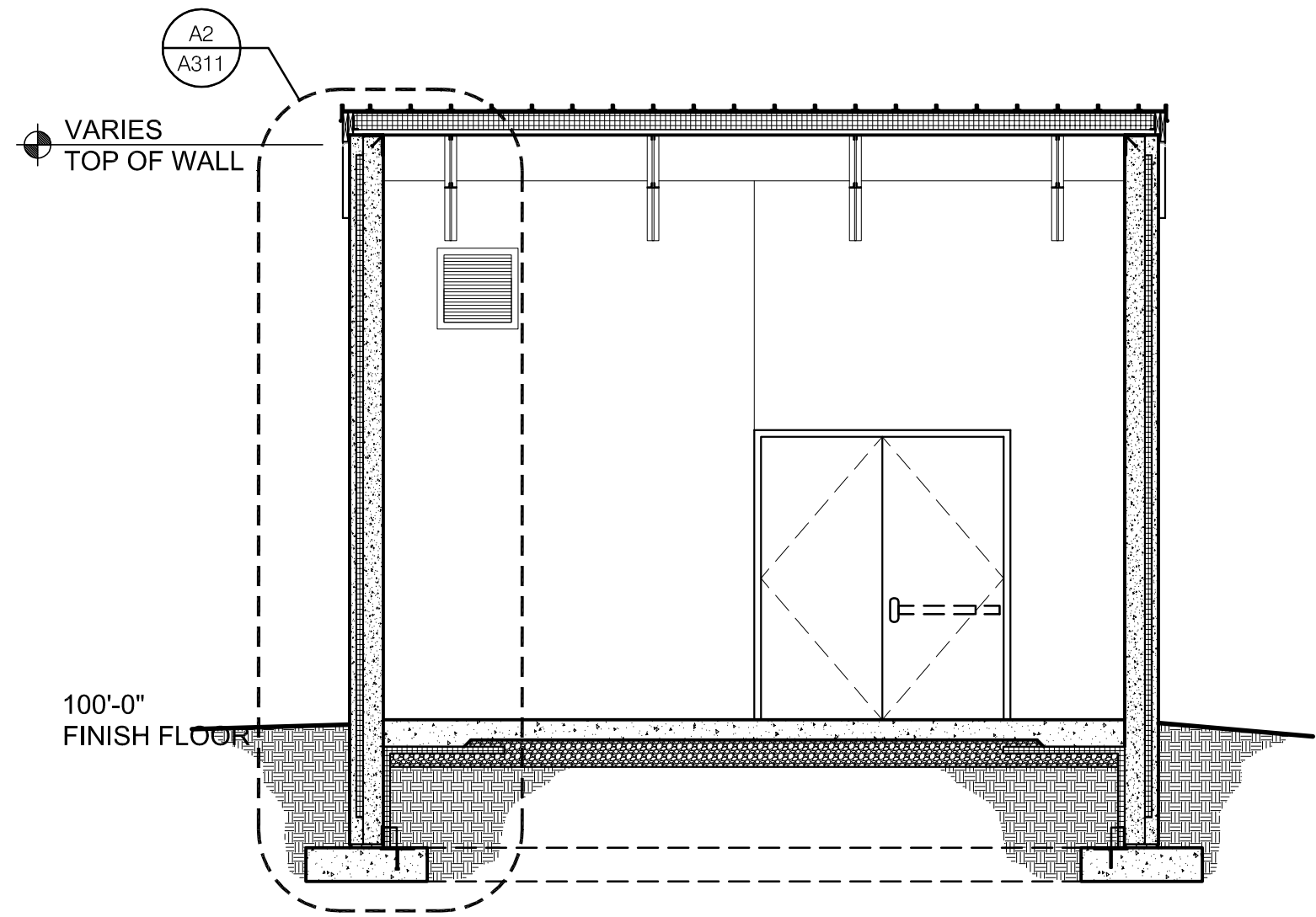
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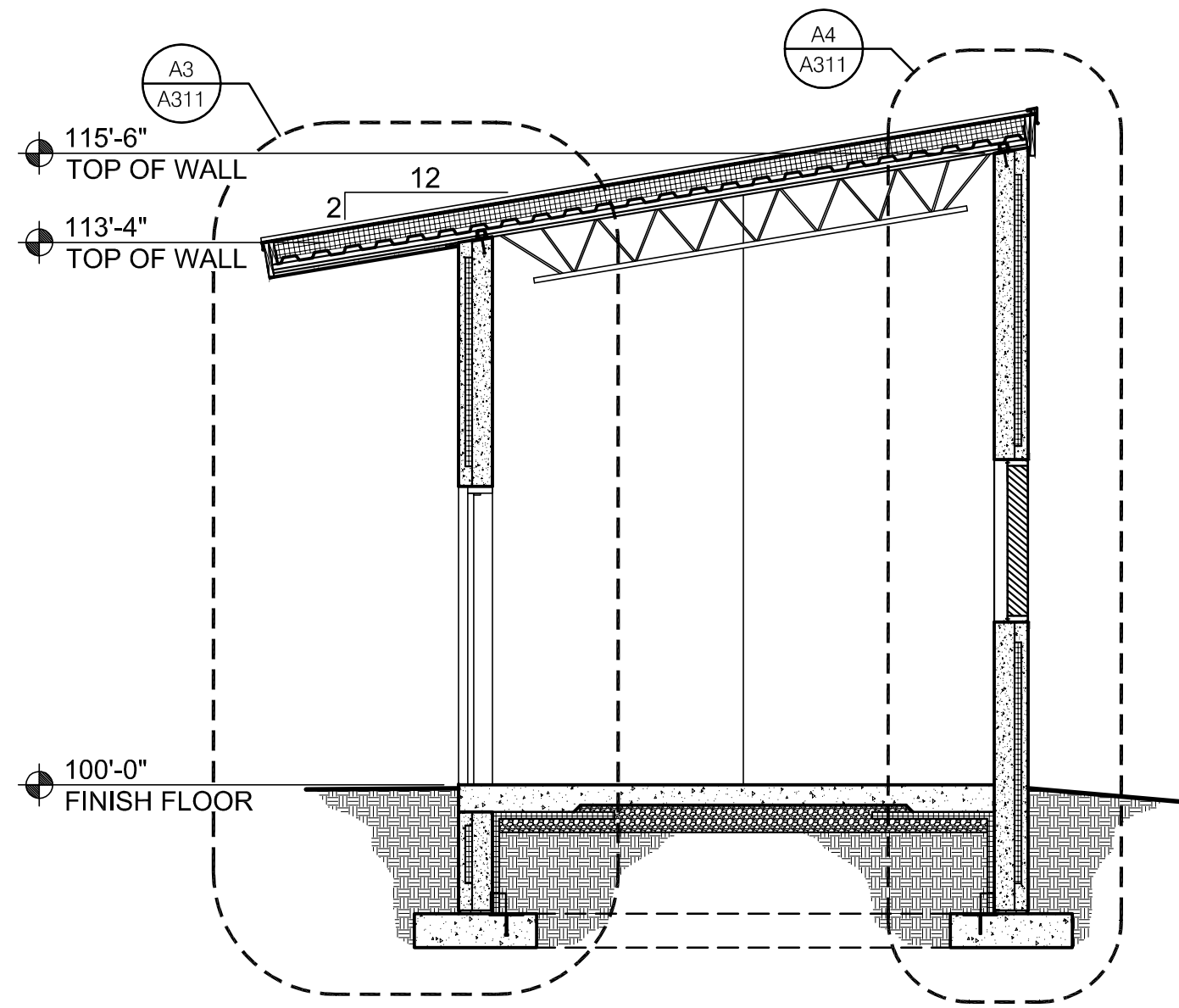
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**INTAKE BUILDING
WALL SECTIONS**
RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO

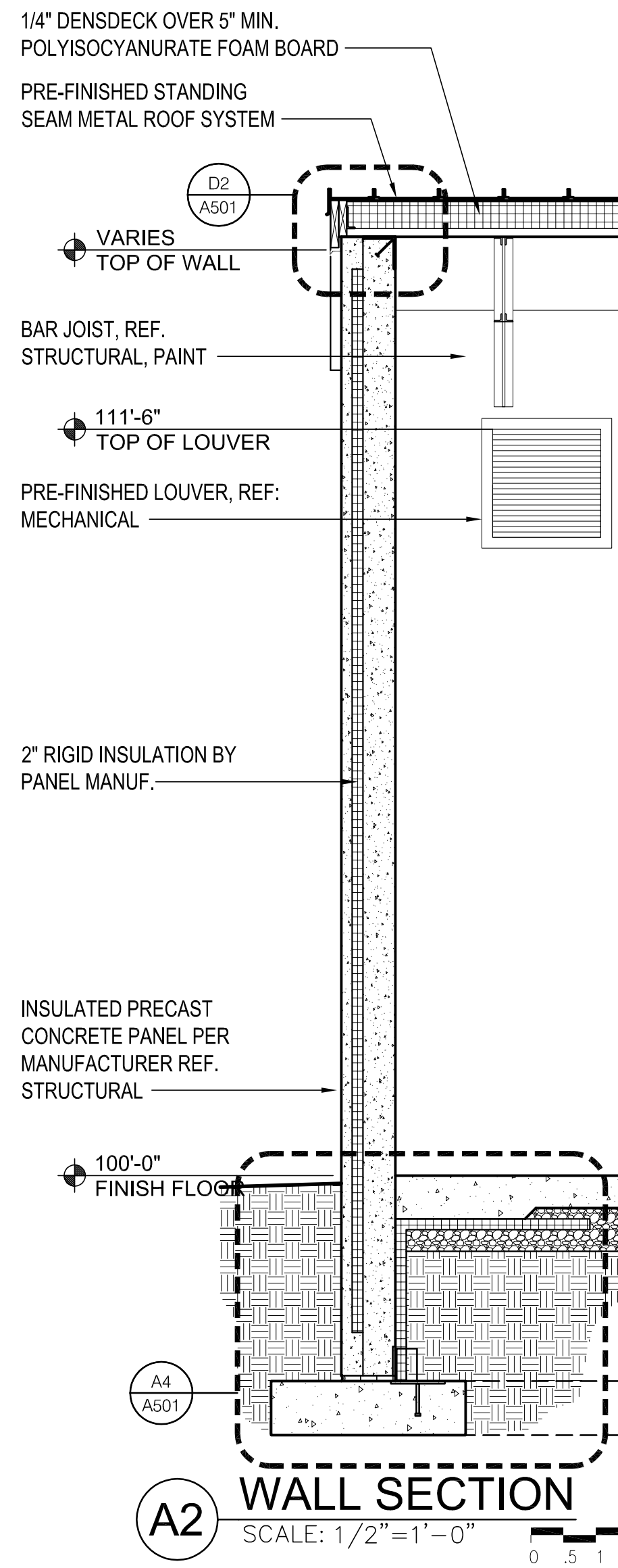
DESIGNED BY: CAD
DRAWN BY: CJH
APPROVED BY: CAD
DESIGN PROJ: 17865.005
CONST PROJ:
SCALE: AS NOTED
DATE: OCT 2015
DRAWING NO: **A302**
SHEET NO: 77 of 114



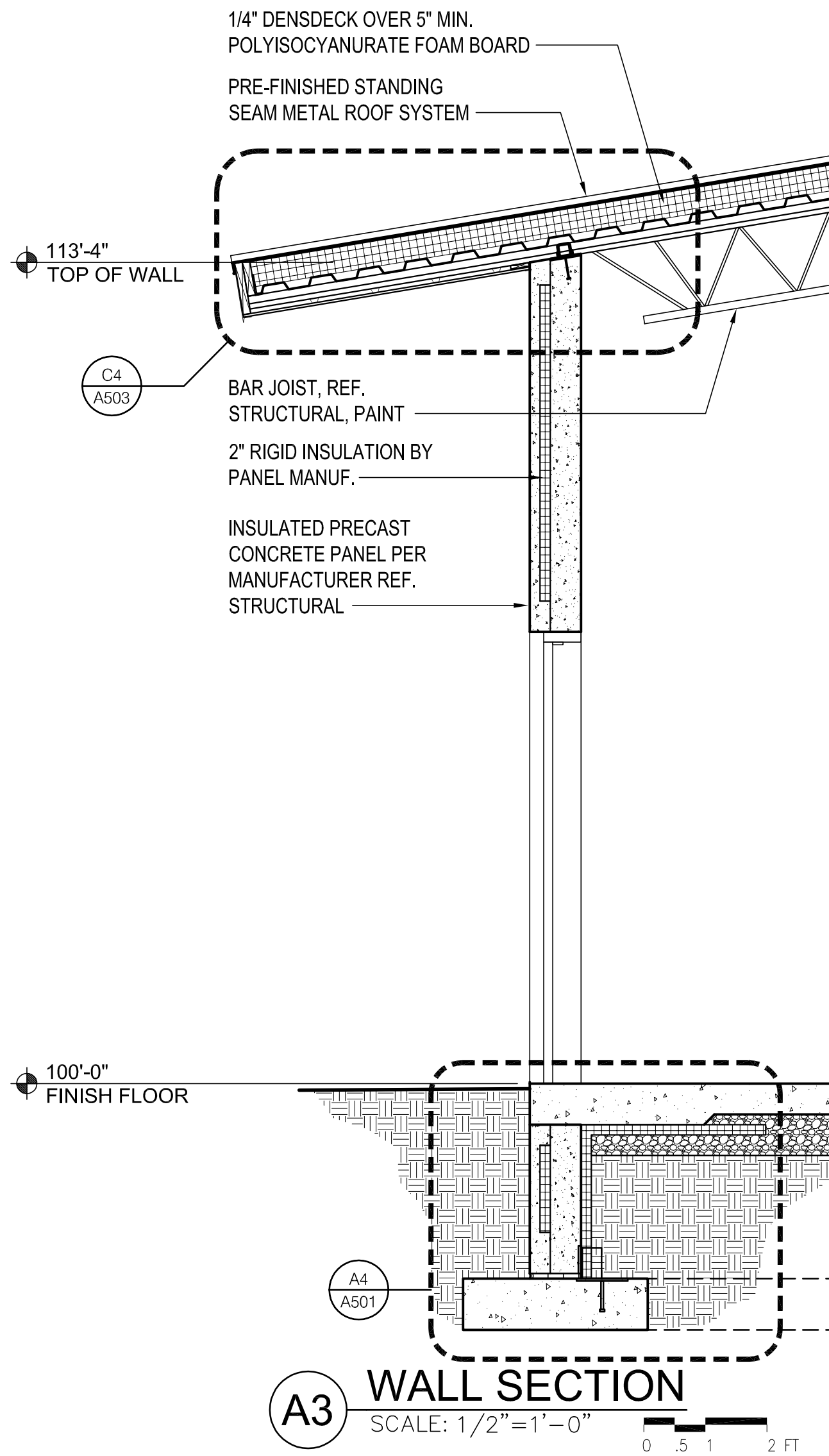
B2 BUILDING SECTION
SCALE: 1/4"=1'-0"



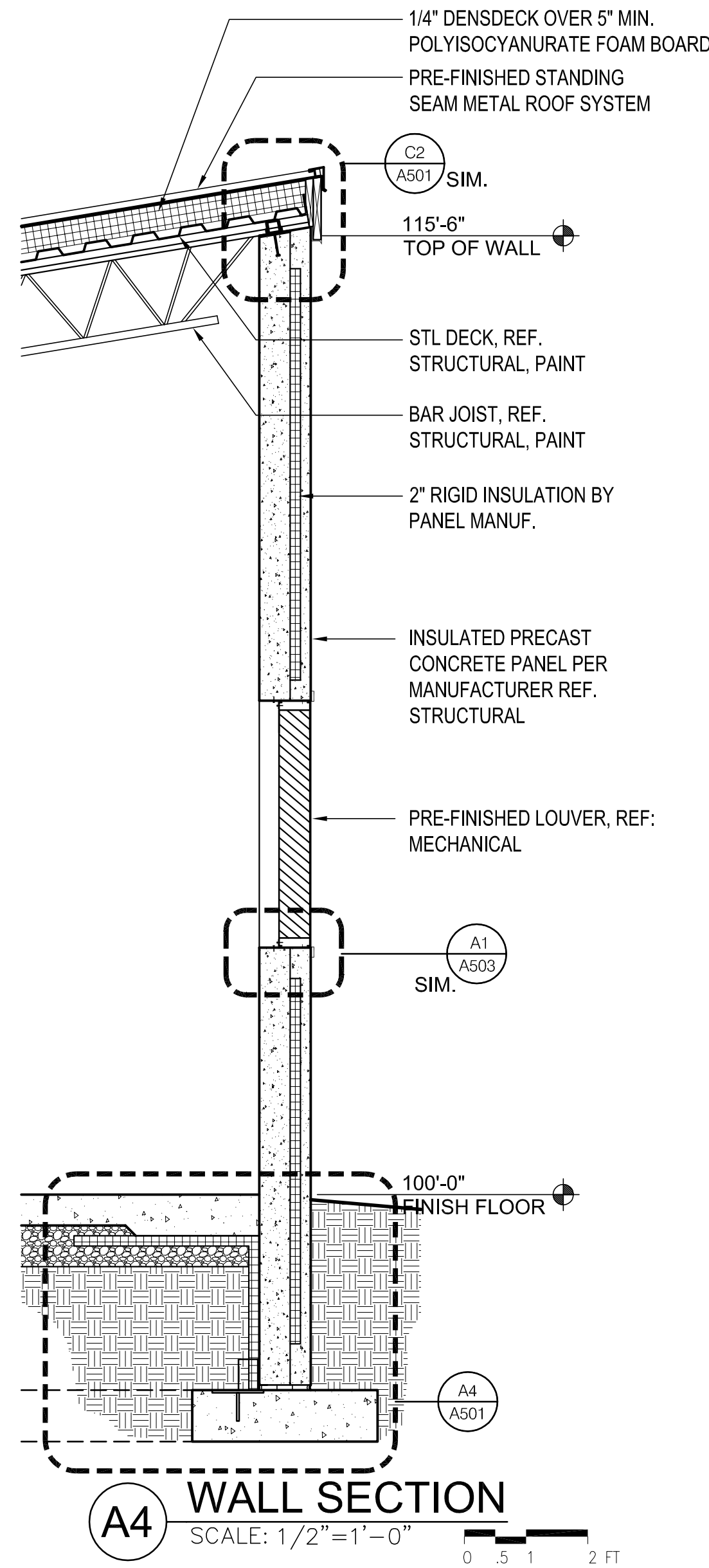
B4 BUILDING SECTION
SCALE: 1/4"=1'-0"



A2 WALL SECTION
SCALE: 1/2"=1'-0"



A3 WALL SECTION
SCALE: 1/2"=1'-0"



A4 WALL SECTION
SCALE: 1/2"=1'-0"

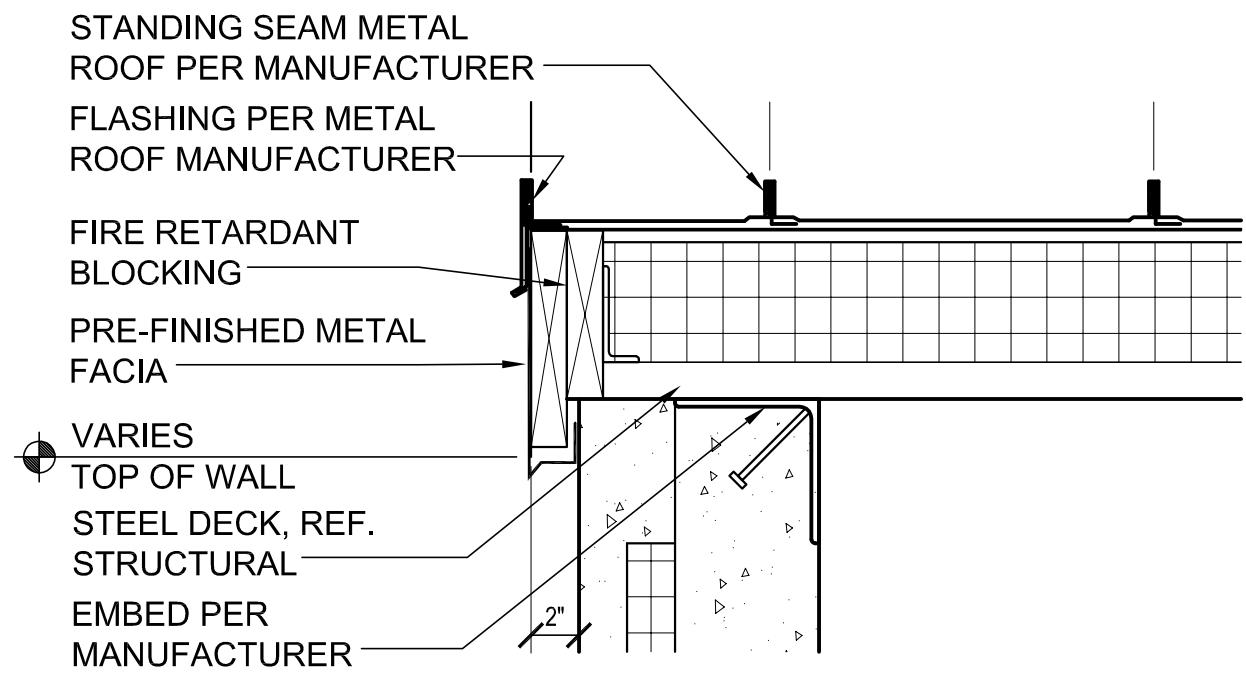
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**BOOSTER BUILDING
BUILDING SECTIONS**
RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO

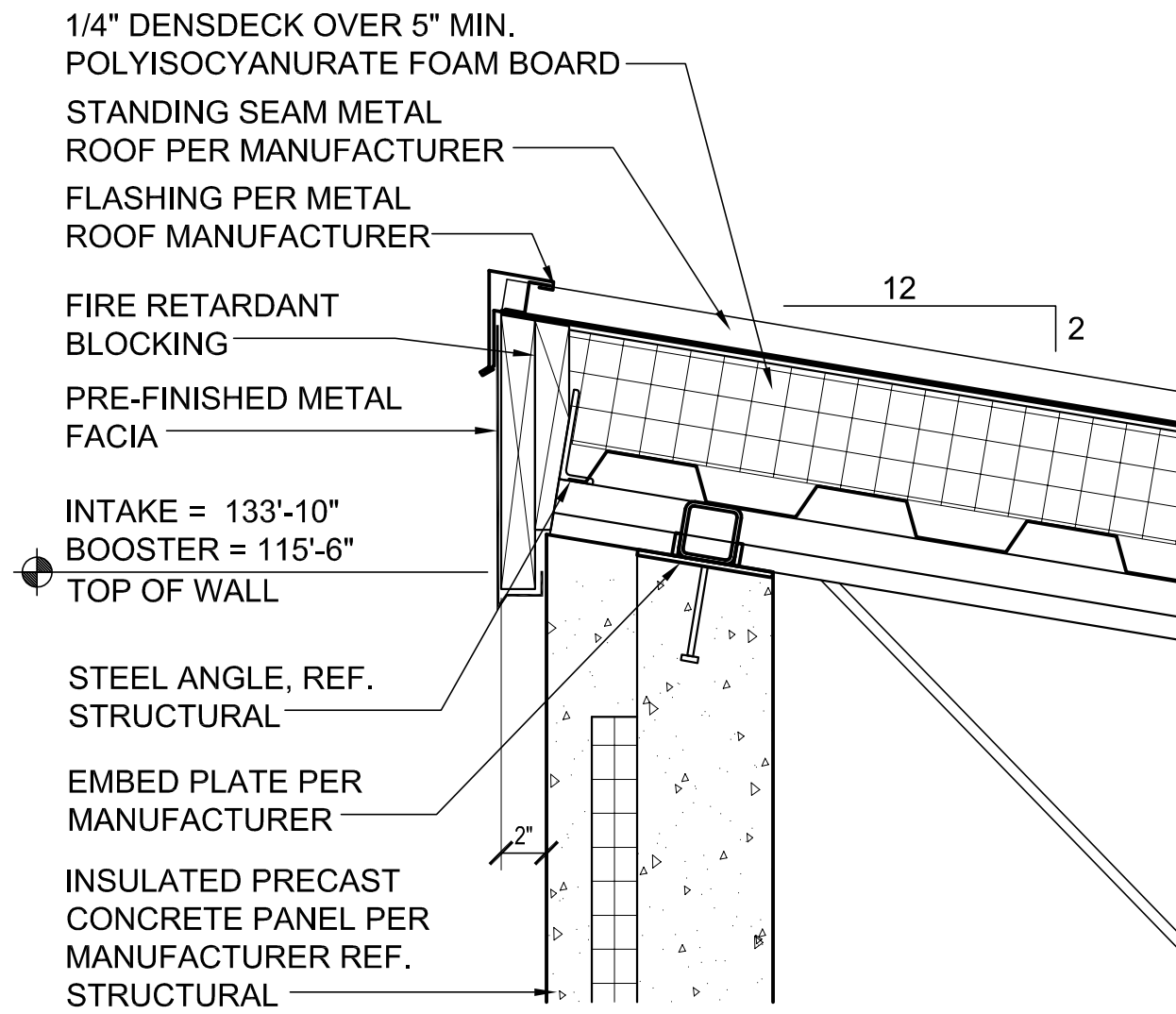


DESIGNED BY:	CAD
DRAWN BY:	CJH
APPROVED BY:	CAD
DESIGN PROJ:	17865.005
CONST PROJ:	AS NOTED
DATE:	OCT 2015
DRAWING NO:	A311
SHEET NO:	78 of 114

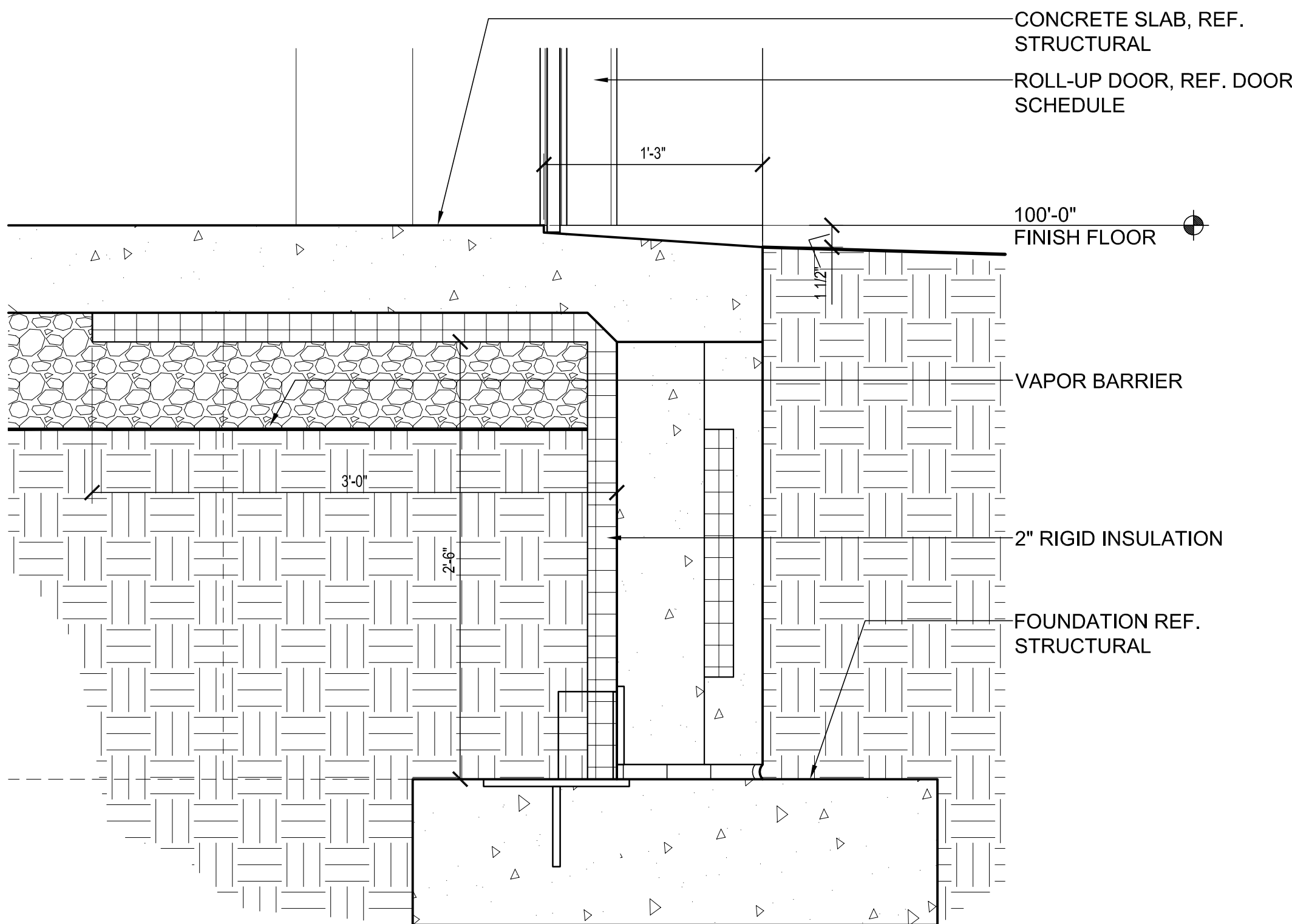
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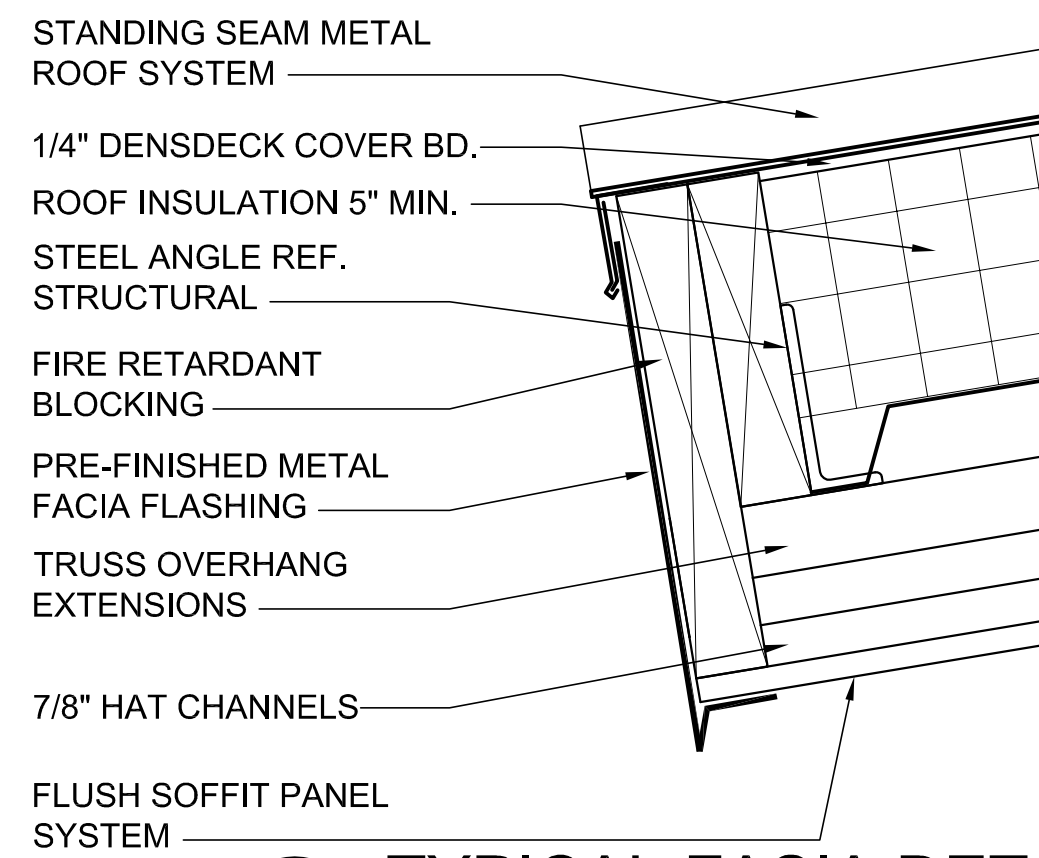
D2 TYPICAL OVERHANG DETAIL
SCALE: 1 1/2"=1'-0"



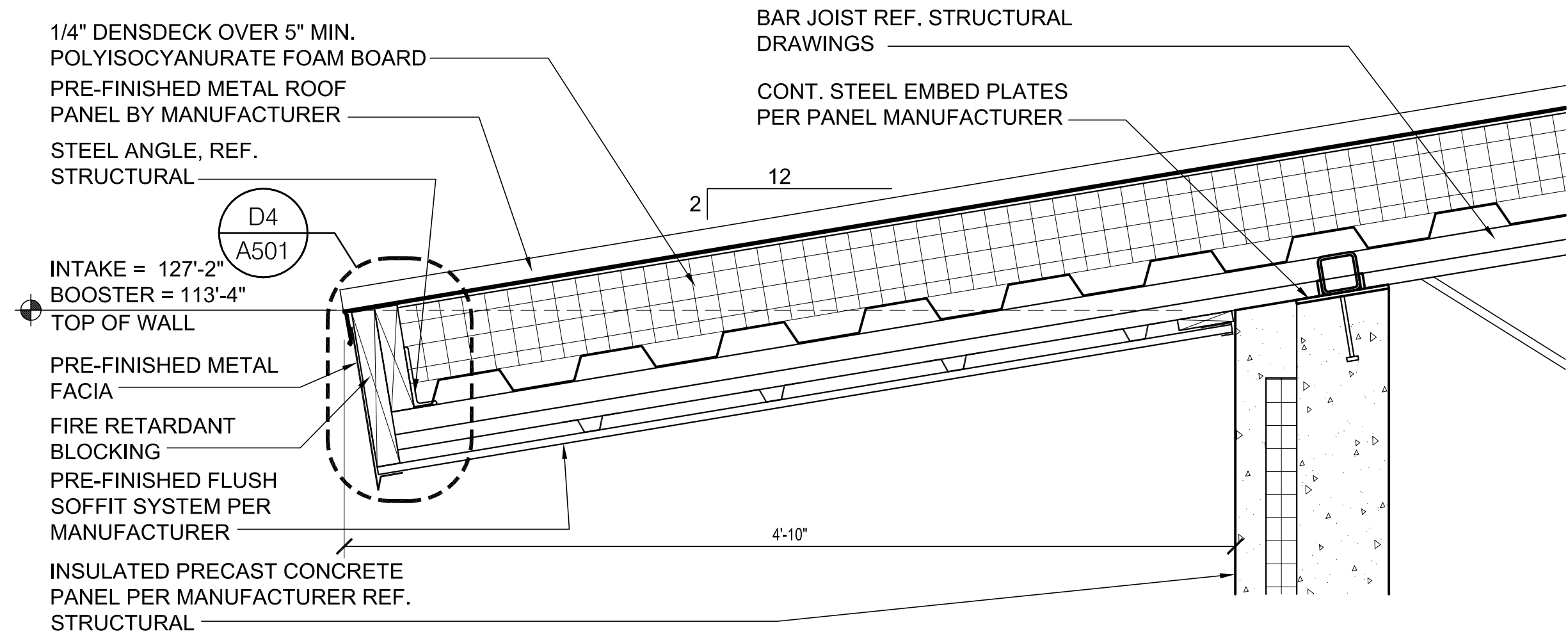
C2 TYPICAL OVERHANG DETAIL
SCALE: 1 1/2"=1'-0"



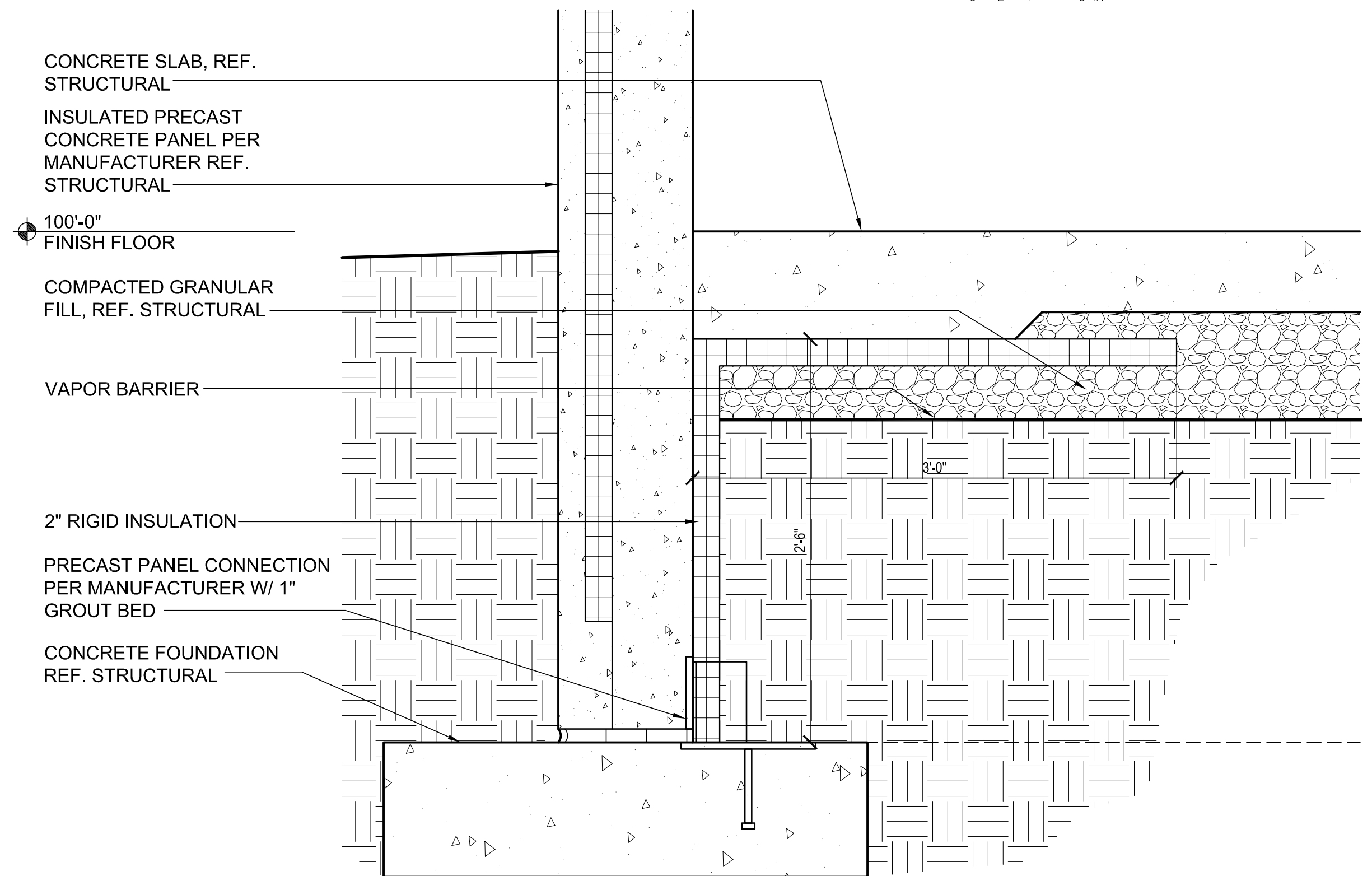
A2 TYPICAL SILL DETAIL
SCALE: 1 1/2"=1'-0"



D4 TYPICAL FASIA DETAIL
SCALE: 3"=1'-0"



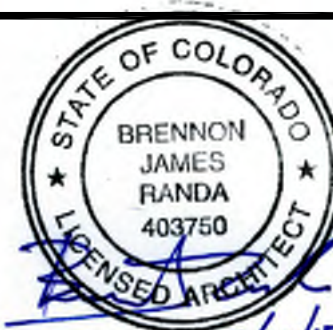
C4 TYPICAL OVERHANG DETAIL
SCALE: 1 1/2"=1'-0"



A4 TYPICAL SILL DETAIL
SCALE: 1 1/2"=1'-0"

INTAKE & BOOSTER BUILDING
ENLARGED DETAILS

RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO



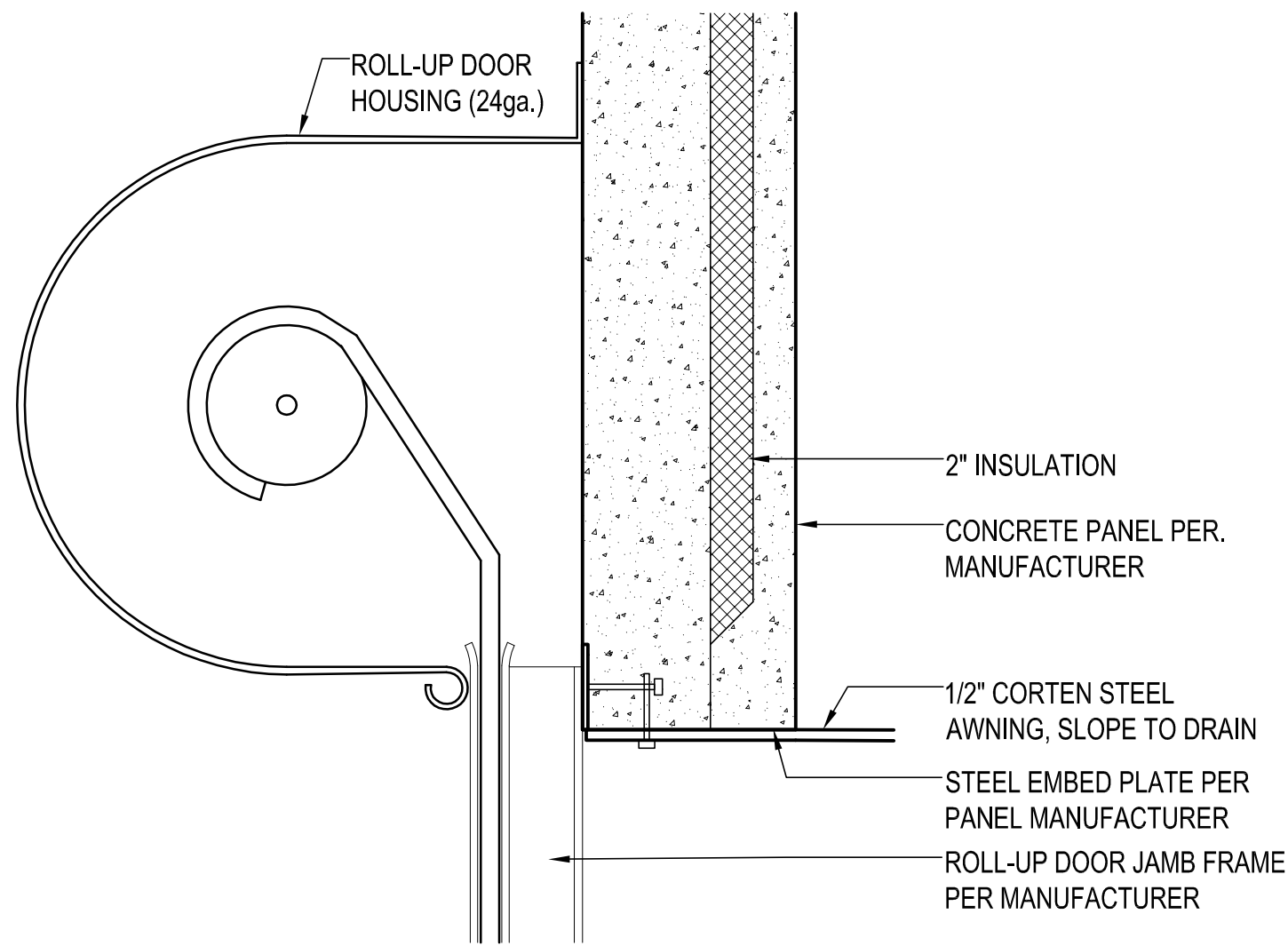
DESIGNED BY:	CAD
DRAWN BY:	CJH
APPROVED BY:	CAD
DESIGN PROJ:	17865.005
CONST PROJ:	
SCALE:	AS NOTED
DATE:	OCT 2015
DRAWING NO:	A501
SHEET NO:	79 of 114

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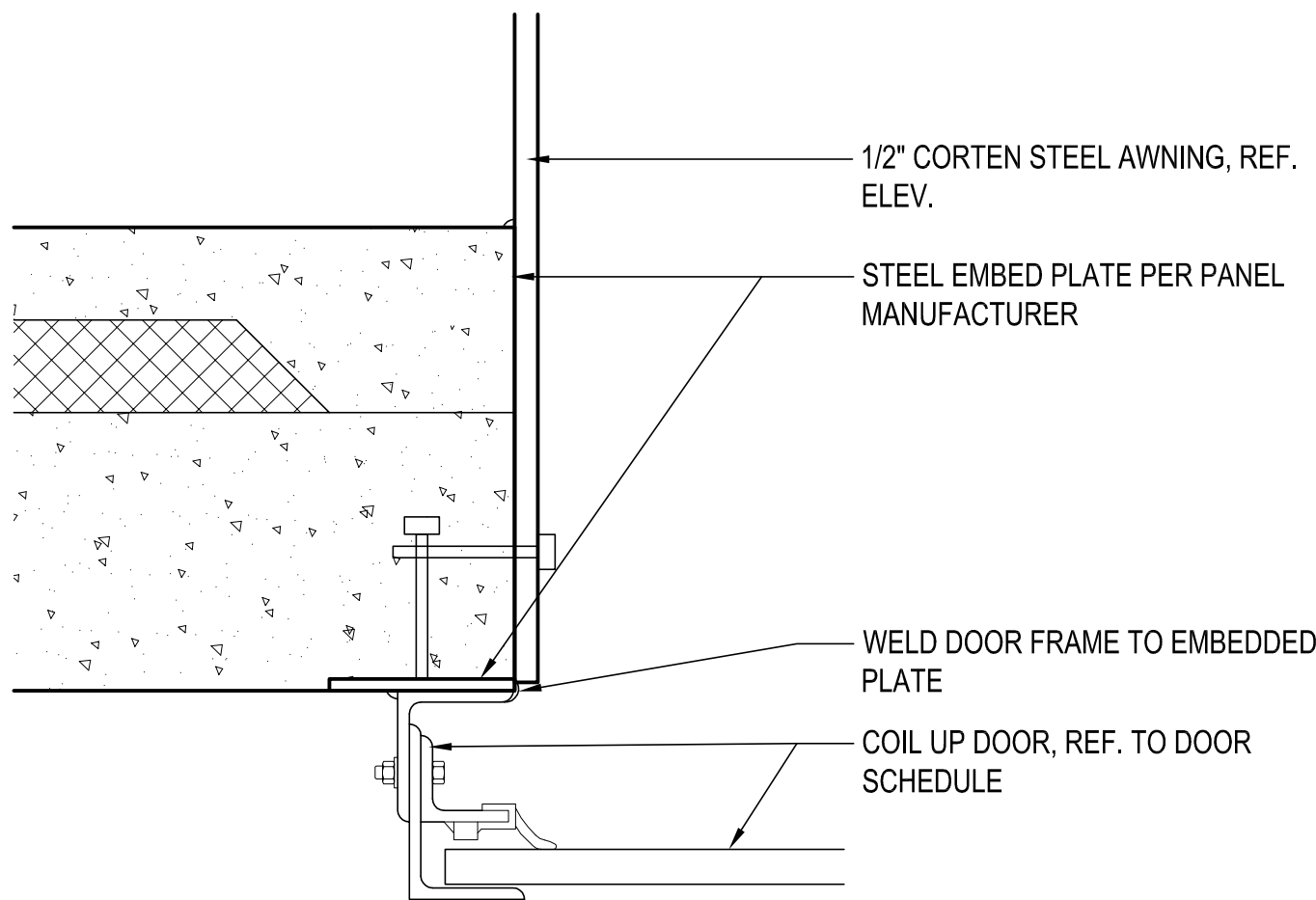
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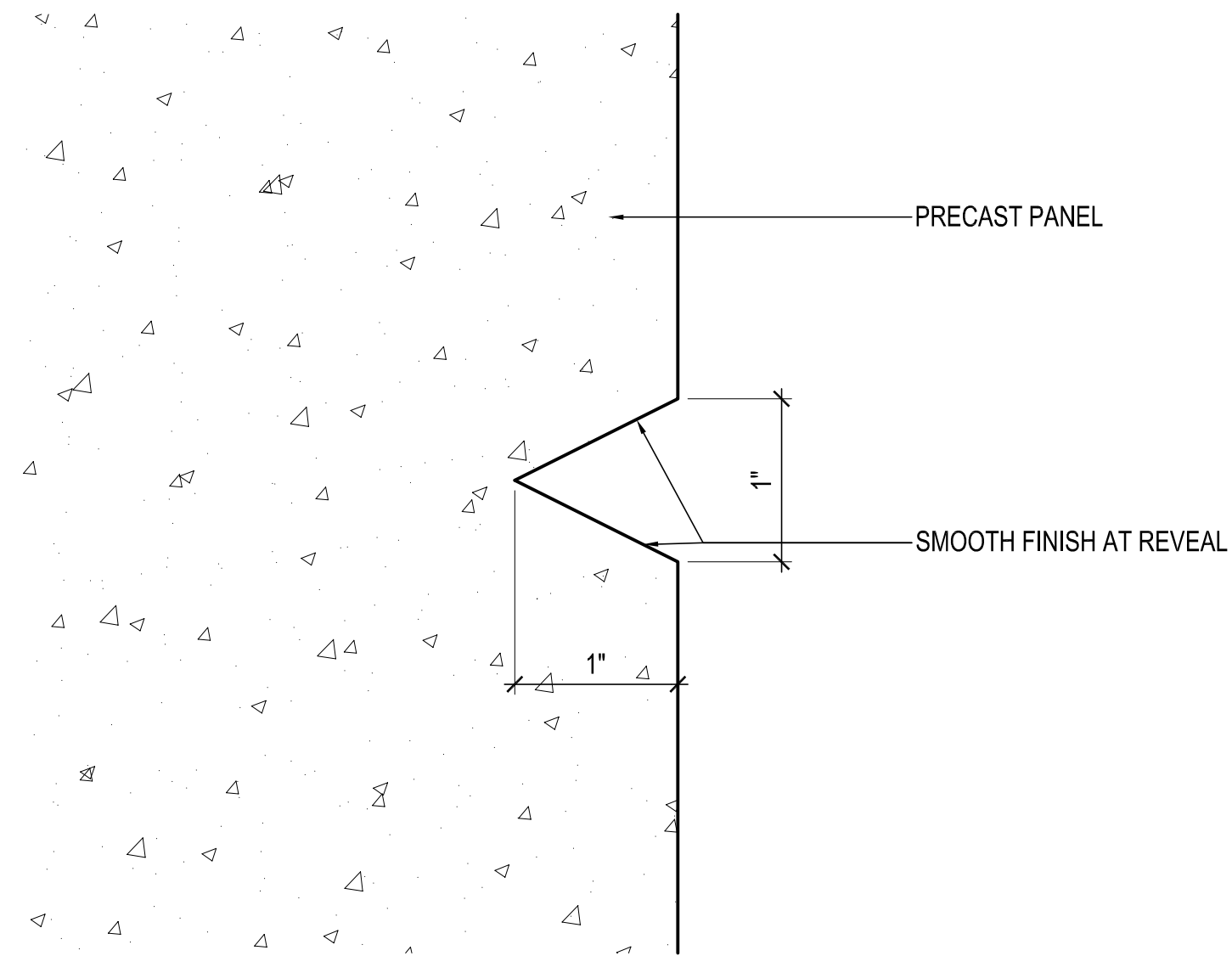
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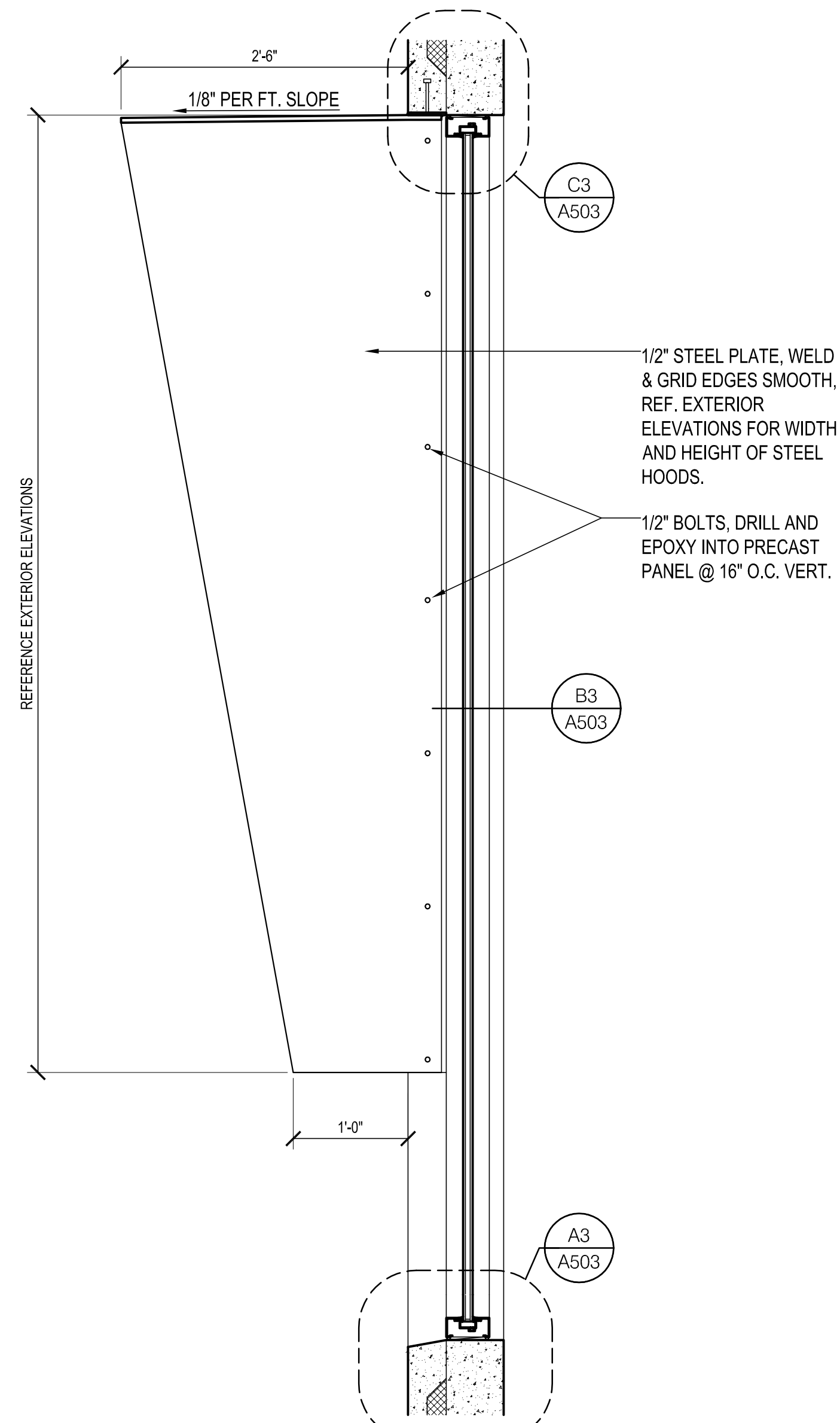
B1 TYPICAL COIL UP DOOR JAMB DETAIL
SCALE: 1 1/2"=1'-0"



A1 TYPICAL COIL UP DOOR JAMB DETAIL
SCALE: 3"=1'-0"



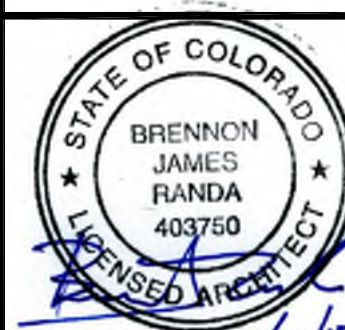
D4 TYPICAL PRECAST REVEL
SCALE: FULL



A4 TYPICAL AWNING DETIAL
SCALE: 1"=1'-0"

INTAKE & BOOSTER BUILDING
ENLARGED DETAILS

RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO

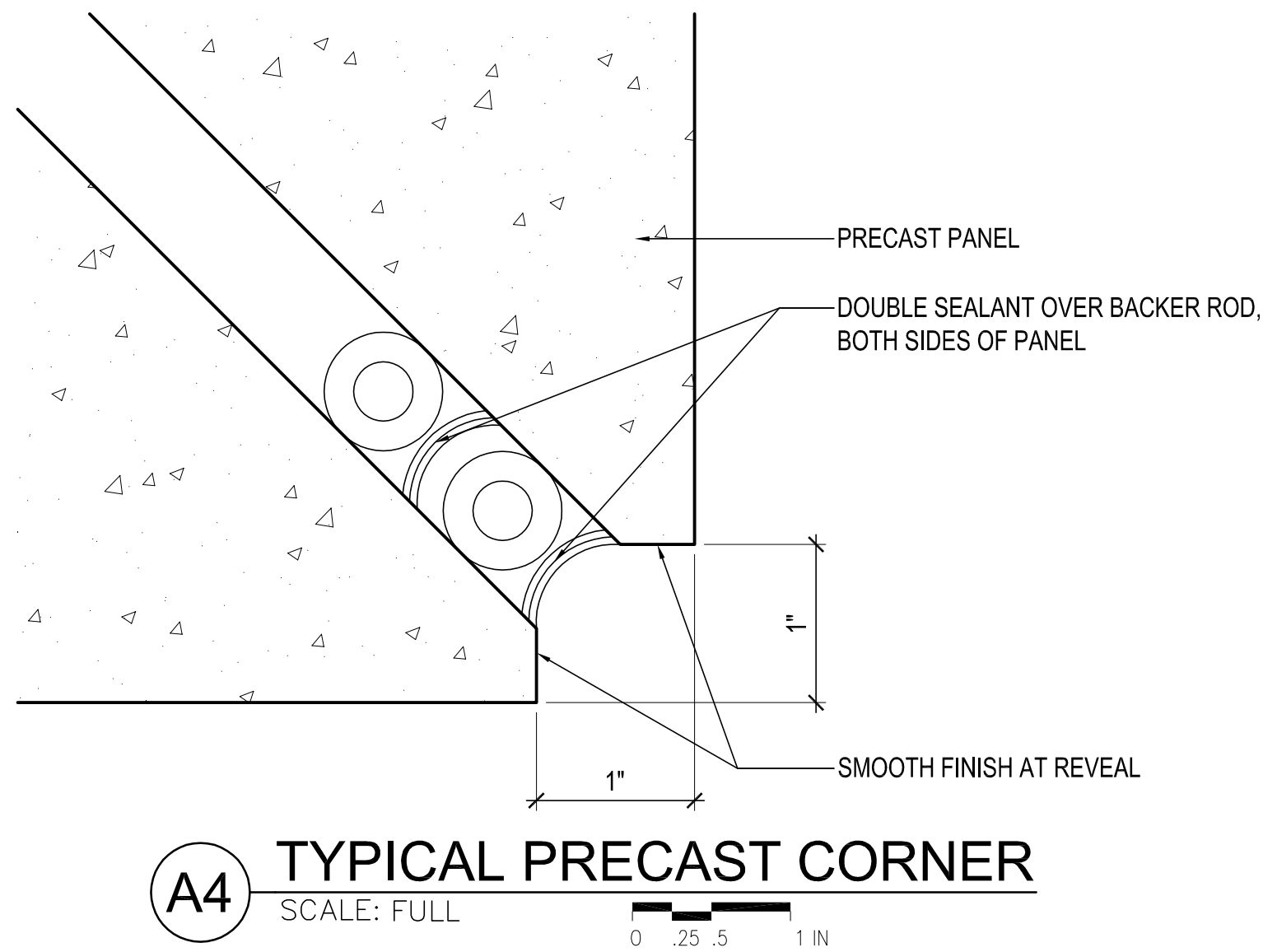
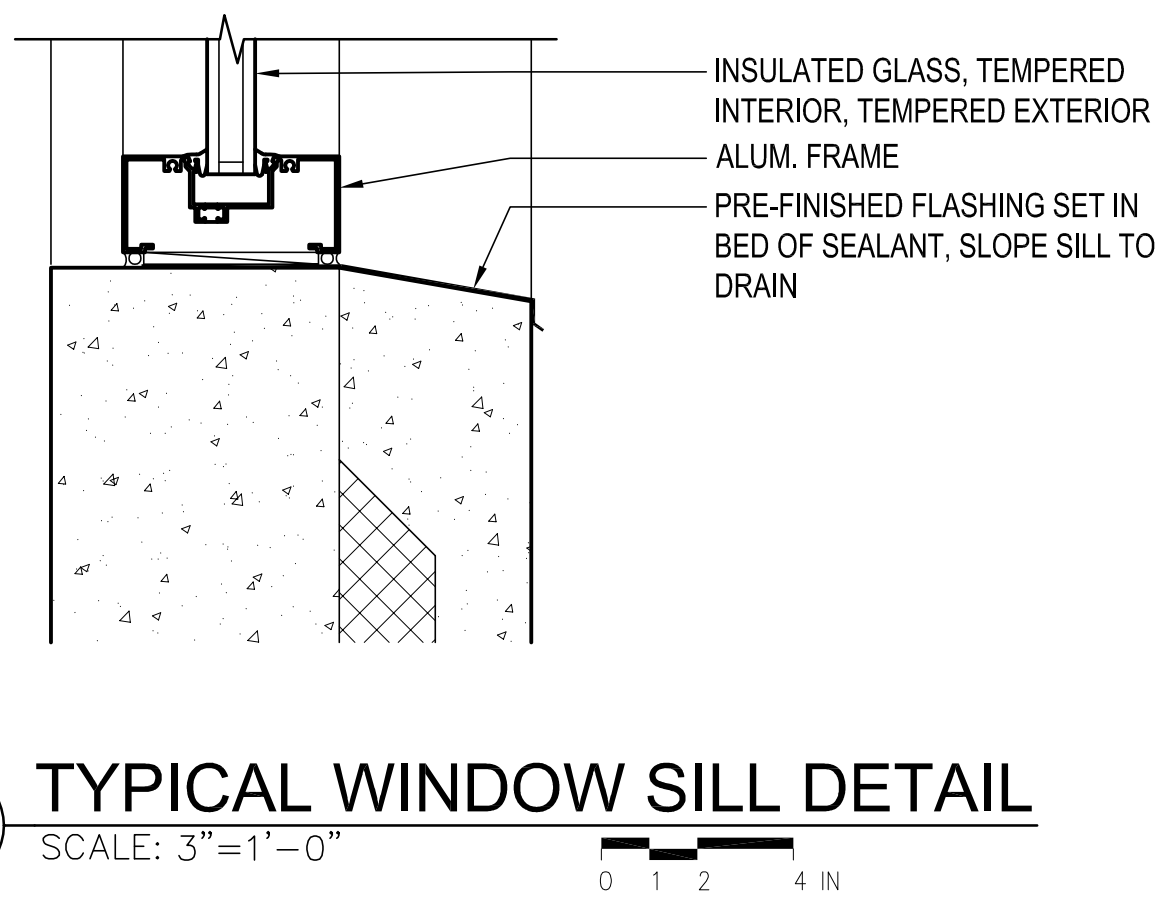
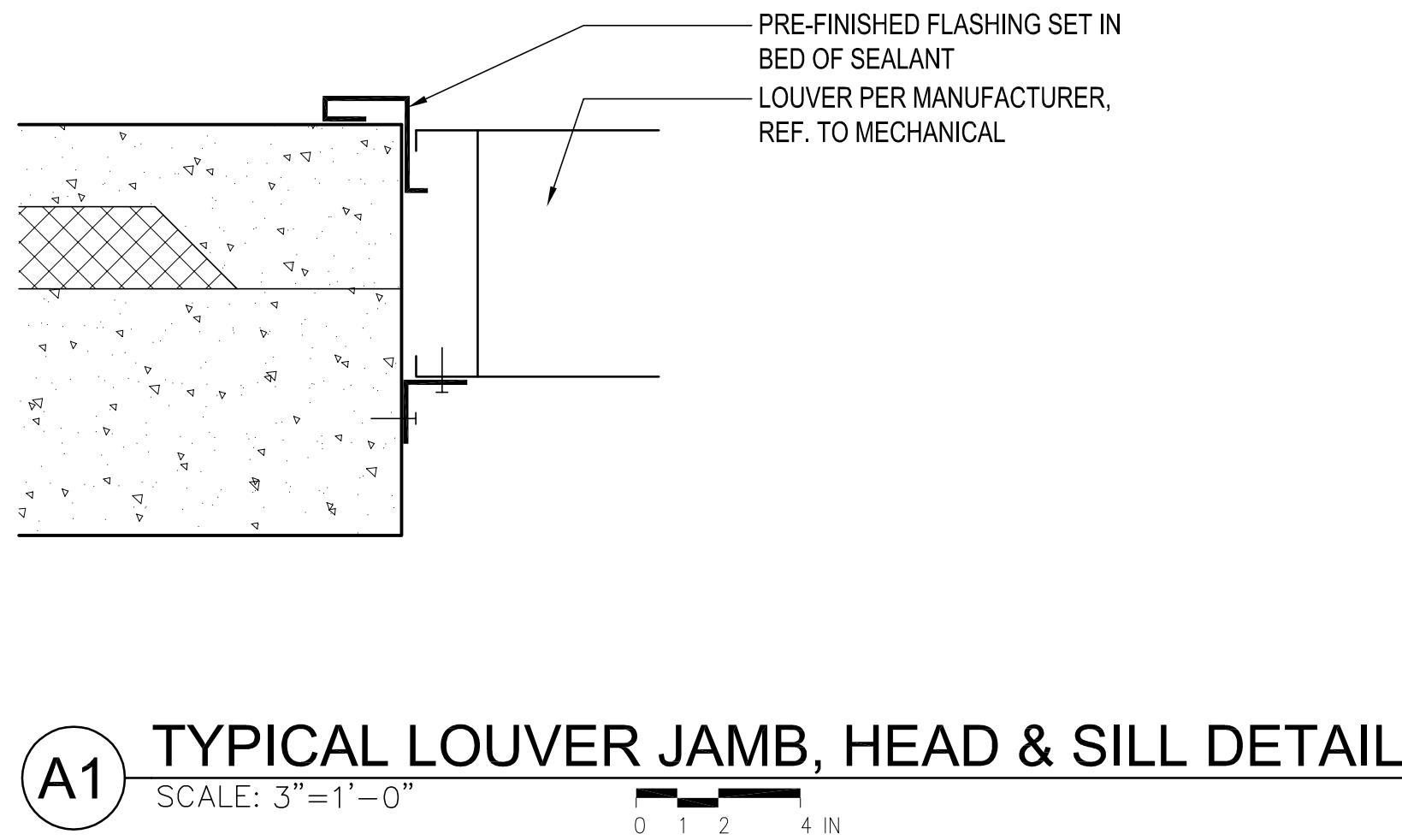
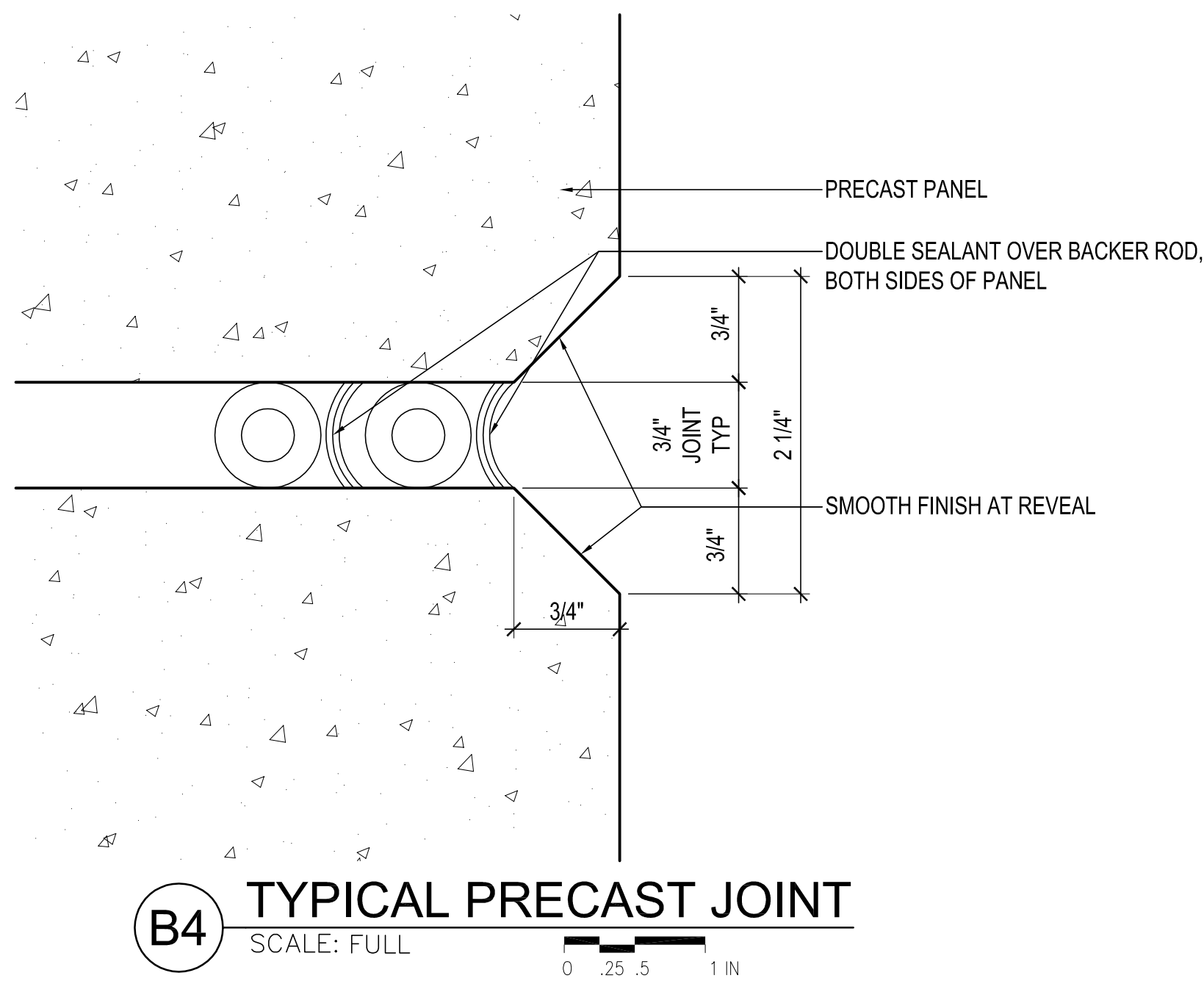
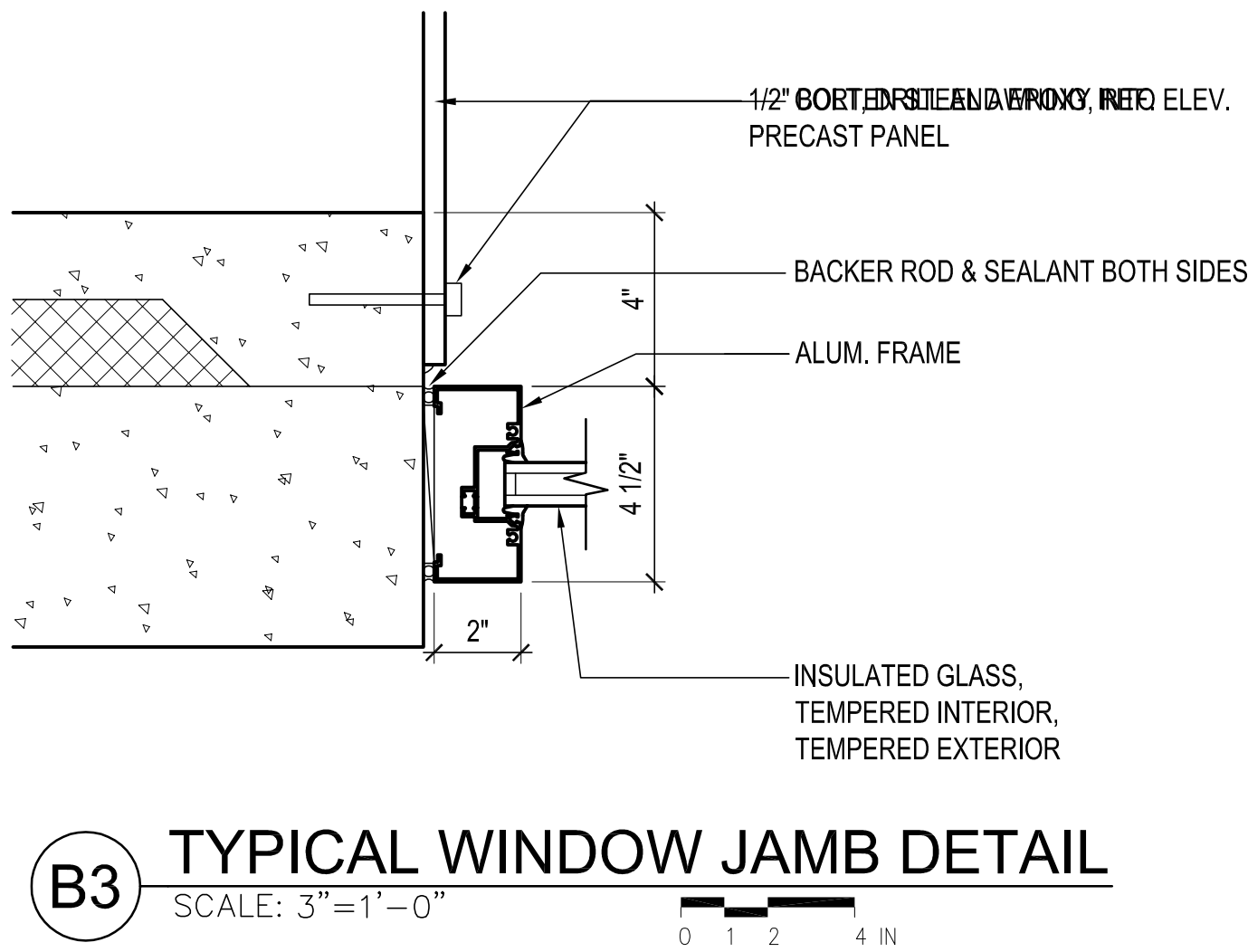
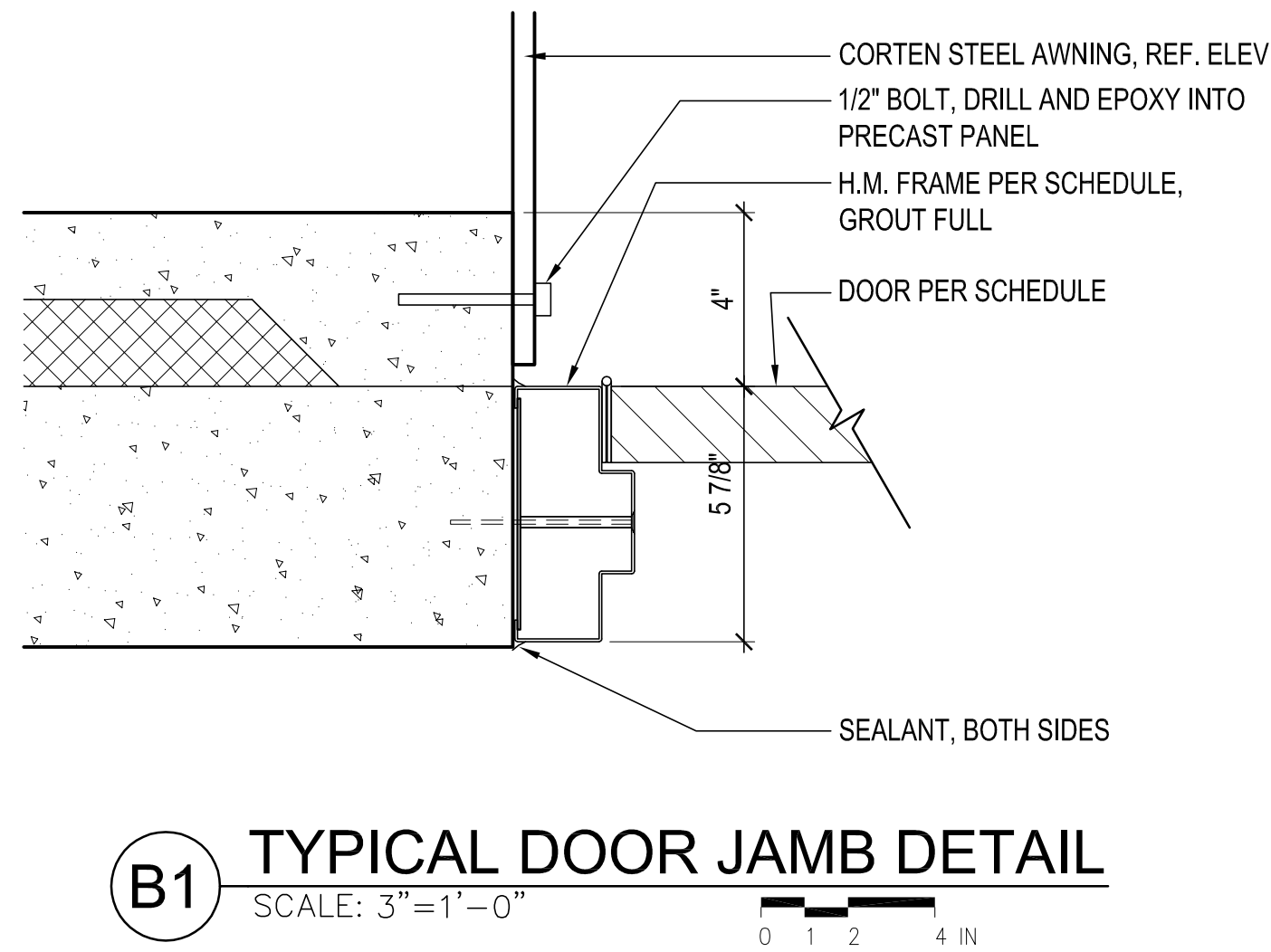
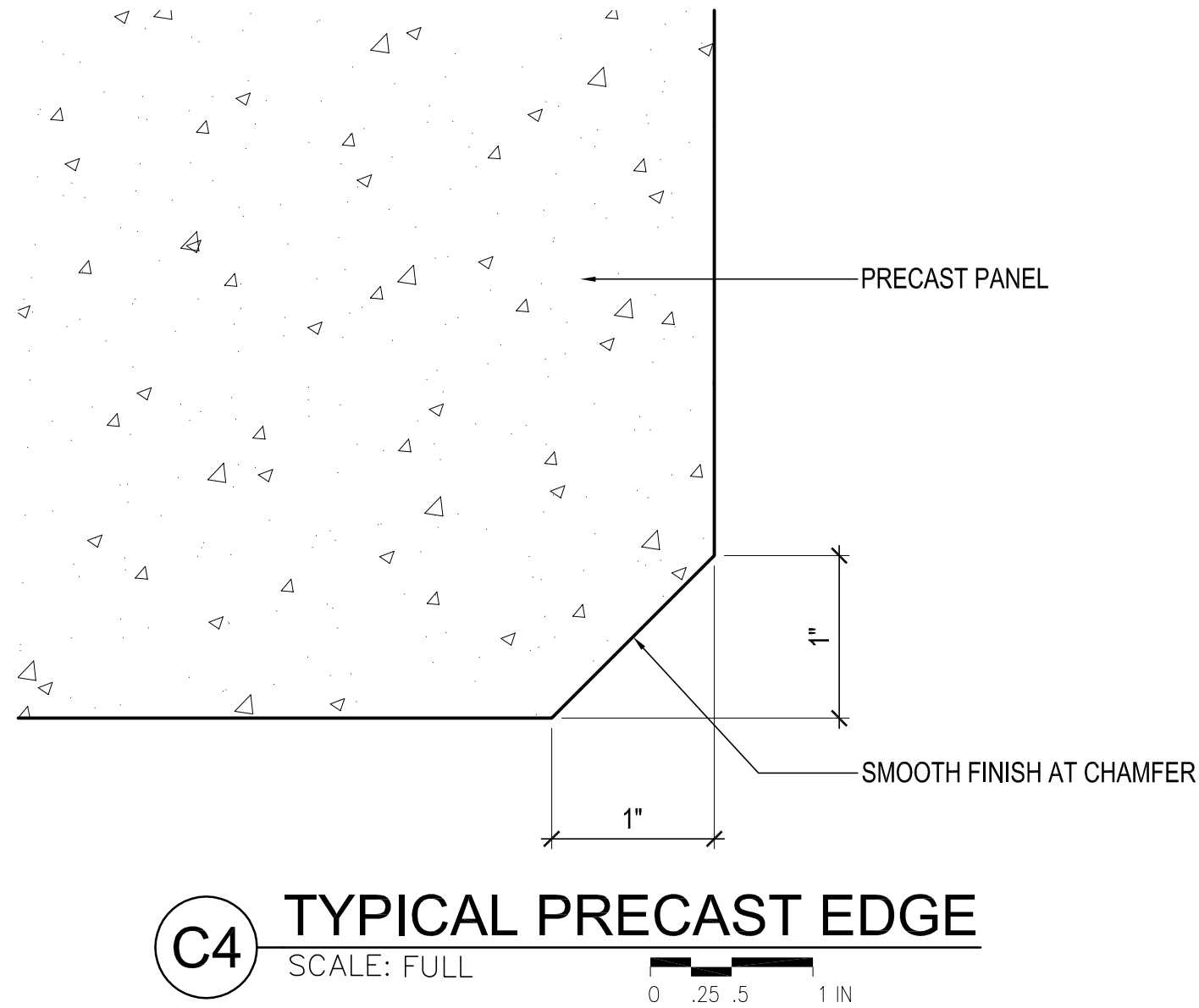
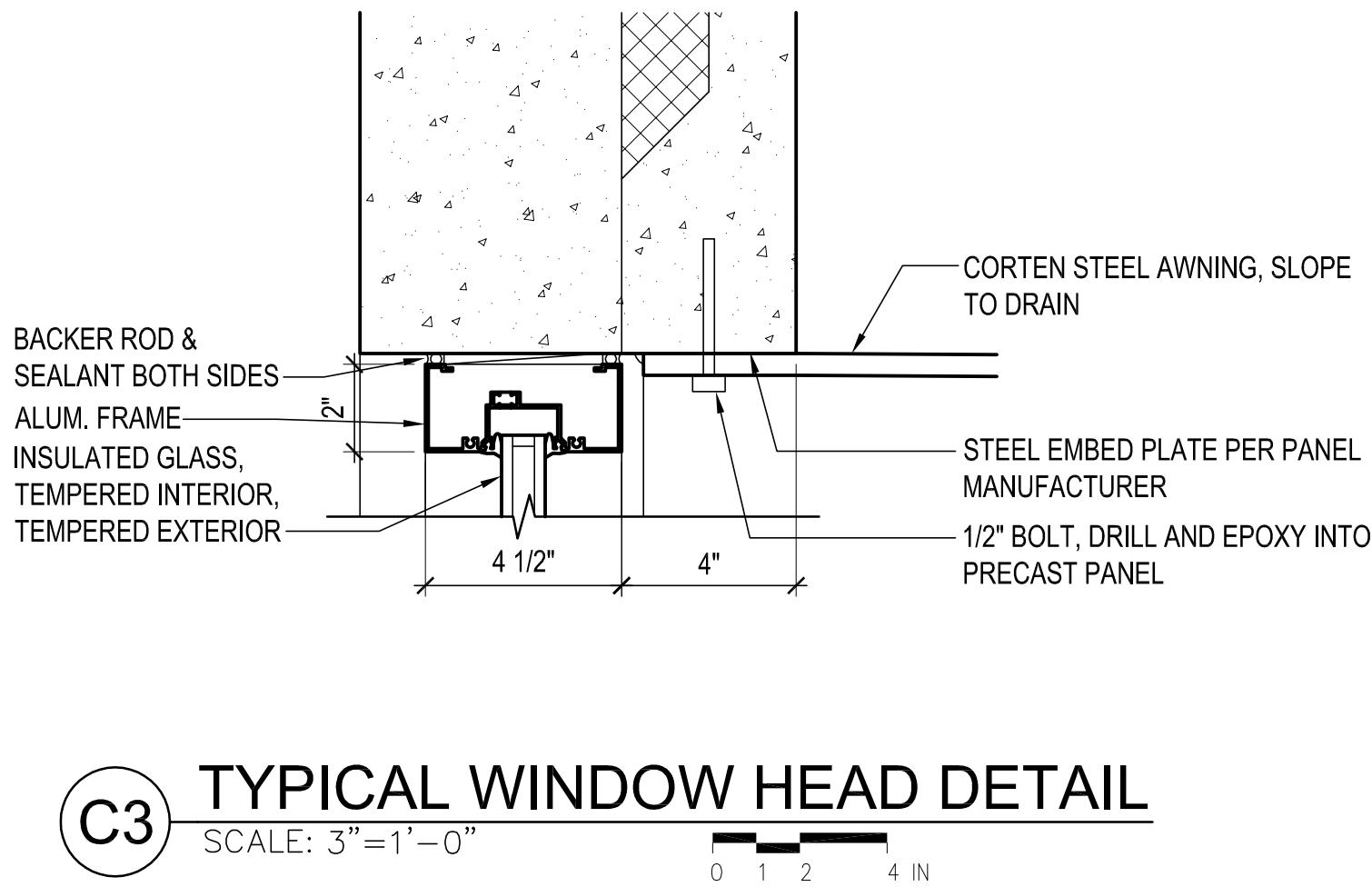
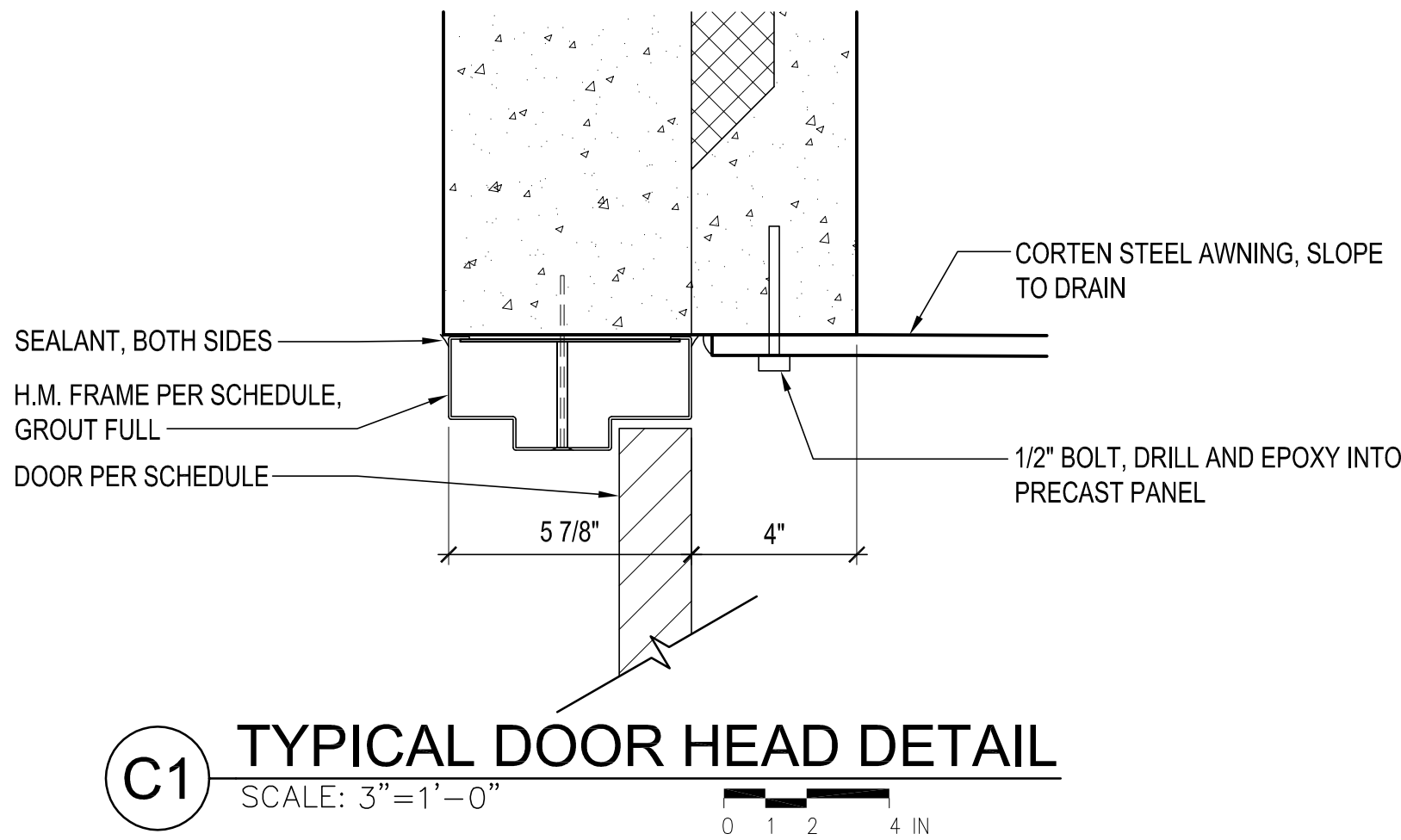


DESIGNED BY:	CAD
DRAWN BY:	CJH
APPROVED BY:	CAD
DESIGN PROJ:	17865.005
CONST PROJ:	
SCALE:	AS NOTED
DATE:	OCT 2015
DRAWING NO:	A502
SHEET NO:	80 of 114

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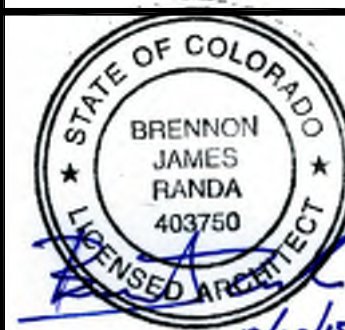
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**INTAKE & BOOSTER BUILDING
ENLARGED DETAILS**
RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO



DESIGNED BY: CAD
DRAWN BY: CJH
APPROVED BY: CAD
DESIGN PROJ: 17865.005
CONST PROJ:
SCALE: AS NOTED
DATE: OCT 2015
DRAWING NO: **A503**
SHEET NO: 81 of 114

AB	ANCHOR BOLT	MAX	MAXIMUM																																																																																																																																																																																																																																				
ACI	AMERICAN CONCRETE INSTITUTE	MB	MACHINE BOLT																																																																																																																																																																																																																																				
ADOL	ADDITIONAL	WC	MISCELLANEOUS CHANNEL																																																																																																																																																																																																																																				
ADJ	ADJACENT	MECH	MECHANICAL																																																																																																																																																																																																																																				
AGGR	AGGREGATE	MEP	MECHANICAL/ ELECTRICAL/ PLUMBING																																																																																																																																																																																																																																				
ASCE	AMERICAN INSTITUTE OF STEEL CONSTRUCTION	MF	MOMENT FRAME																																																																																																																																																																																																																																				
ALT	ALTERNATE	MFB	MOMENT FRAME BEAM																																																																																																																																																																																																																																				
ALUM	ALUMINUM	MFC	MOMENT FRAME COLUMN																																																																																																																																																																																																																																				
ANSI	AMERICAN NATIONAL STANDARDS INSTITUTE	MFR	MANUFACTURE;																																																																																																																																																																																																																																				
	AMERICAN PLYWOOD	MANUFACTURER																																																																																																																																																																																																																																					
APA	ASSOCIATION	MFRG	MANUFACTURING																																																																																																																																																																																																																																				
APPROX	APPROXIMATE	MIN	MINIMUM																																																																																																																																																																																																																																				
AR	ANCHOR ROD	MISC	MISCELLANEOUS																																																																																																																																																																																																																																				
ARCH	ARCHITECTURAL; ARCHITECT	MS	MATCH LINE																																																																																																																																																																																																																																				
ASSEMBLY	ASSEMBLY	MS	MECHANICAL SPLICE																																																																																																																																																																																																																																				
ASTM	AMERICAN SOCIETY FOR P&P TESTING AND MATERIALS	NT	NEAR FACE																																																																																																																																																																																																																																				
AWS	AMERICAN WELDING SOCIETY	NFPA	NATIONAL FOREST PRODUCTS ASSOCIATION																																																																																																																																																																																																																																				
		NIC	NOT IN CONTRACT																																																																																																																																																																																																																																				
		NS	NEAR SIDE																																																																																																																																																																																																																																				
		NTS	NOT TO SCALE																																																																																																																																																																																																																																				
BD	BOARD	OC	ON CENTER																																																																																																																																																																																																																																				
BF	BRACED FRAME	OD	OUTSIDE DIAMETER																																																																																																																																																																																																																																				
BLDG	BUILDING	OP	OPENING																																																																																																																																																																																																																																				
BLK	BLOCK; BLOCKING	OPP	OPPOSITE (HAND)																																																																																																																																																																																																																																				
BM	BEAM	OPT	OPTION; OPTIONAL																																																																																																																																																																																																																																				
BOS	BOTTOM OF STEEL; BOSOM	OVS	OVERSIZED (HOLES)																																																																																																																																																																																																																																				
(WELD)		OWJ	OPEN WEB JOIST																																																																																																																																																																																																																																				
BOT	BOTTOM																																																																																																																																																																																																																																						
BRG	BRAKING	P	PIPE																																																																																																																																																																																																																																				
BRG	BEARING	PAF	POWER ACTUATED FASTENER																																																																																																																																																																																																																																				
BRKT	BRACKET	PC	PRECAST																																																																																																																																																																																																																																				
BTWN	BETWEEN	PCF	POUNDS PER CUBIC FOOT																																																																																																																																																																																																																																				
BU	BUILT-UP	PCP	PRECAST CONCRETE PANEL																																																																																																																																																																																																																																				
		PEN	PENETRATION																																																																																																																																																																																																																																				
c	CAMBER	PERP	PERPENDICULAR																																																																																																																																																																																																																																				
CANT	CANTILEVER	PL	PLATE																																																																																																																																																																																																																																				
CC	CENTER TO CENTER	PLF	POUNDS PER LINEAL FOOT																																																																																																																																																																																																																																				
CC	CENTER OF GRAVITY	PLYMD	PLYWOOD																																																																																																																																																																																																																																				
CP	CAST-IN-PLACE	PP	PARTIAL PENETRATION																																																																																																																																																																																																																																				
CJ	CONSTRUCTION JOINT	PREFAB	PREFABRICATED																																																																																																																																																																																																																																				
CL	CENTERLINE	PS	PRESTRESSED																																																																																																																																																																																																																																				
CLR	CLEARANCE; CLEAR	PSF	POUNDS PER SQUARE FOOT																																																																																																																																																																																																																																				
CMU	CONCRETE MASONRY UNIT	PSI	POUNDS PER SQUARE INCH																																																																																																																																																																																																																																				
COL	COLUMN	PT	POST-TENSION																																																																																																																																																																																																																																				
COMP	COMPRESSION																																																																																																																																																																																																																																						
CONC	CONCRETE	R	RADIUS																																																																																																																																																																																																																																				
CONN	CONNECTION; CONNECT	RB	RISER BAR																																																																																																																																																																																																																																				
CONST	CONSTRUCTION	RCMD	RECOMMEND																																																																																																																																																																																																																																				
CONT	CONTINUE; CONTINUOUS	REF	REFERENCE																																																																																																																																																																																																																																				
CONTR	CONTRACTOR	REIN	REINFORCE; REINFORCING																																																																																																																																																																																																																																				
COORD	COORDINATE; COORDINATION	REINFR	REINFORCEMENT																																																																																																																																																																																																																																				
CORR	CORRODED	REQD	REQUIRED																																																																																																																																																																																																																																				
CP	COMPLETE PENETRATION																																																																																																																																																																																																																																						
CTR	WELD-ULTRASONIC TEST	S1S	SURFACED ONE SIDE																																																																																																																																																																																																																																				
CTSK	CENTER	S2S	SURFACED TWO SIDES																																																																																																																																																																																																																																				
OU	COUNTERSINK; COUNTERSUNK	S4S	SURFACED FOUR SIDES																																																																																																																																																																																																																																				
	CUBIC	S	AMERICAN STANDARD SHAPE; SOUTH																																																																																																																																																																																																																																				
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DIAPH	DIAPHRAGM	SIM	SIMILAR																																																																																																																																																																																																																																				
DIM	DIMENSION	SLBB	SHORT LEGS BACK-TO-BACK																																																																																																																																																																																																																																				
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DO	DITTO	SPC	SPACING																																																																																																																																																																																																																																				
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EQUIP	EQUIPMENT	TAG	TONGUE AND GROOVE																																																																																																																																																																																																																																				
ES	EACH SIDE	TAG	TEMPERATURE; TEMPORARY																																																																																																																																																																																																																																				
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EXT	EXTERIOR	TOF	TOP OF FOOTING																																																																																																																																																																																																																																				
EXTD	EXTEND; EXTENDED	TOS	TOP OF STEEL																																																																																																																																																																																																																																				
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FD	FLOOR DRAIN	TRANS	TRANSVERSE </tr <tr><td>FDN</td><td>FOUNDATION</td><td>TYP</td><td>TYPICAL</td></tr> <tr><td>FF</td><td>FAR FACE</td><td></td><td></td></tr> <tr><td>FIN</td><td>FINISH</td><td>UBC</td><td>UNIFORM BUILDING CODE</td></tr> <tr><td>FLG</td><td>FLOOR; FLOOR LINE</td><td>UL</td><td>UNDERWRITERS LABORATORY; INCORPORATED</td></tr> <tr><td>FLS</td><td>FLANGE</td><td>UNO</td><td>UNLESS NOTED OTHERWISE</td></tr> <tr><td>FOS</td><td>FACE OF STUD</td><td>UT</td><td>ULTRASONIC TEST</td></tr> <tr><td>FP</td><td>FIREPROOF</td><td></td><td></td></tr> <tr><td>FRMG</td><td>FRAMING</td><td>V. VERT</td><td>VERTICAL</td></tr> <tr><td>FS</td><td>FULL SIZE; FAR SIDE</td><td>VE</td><td>VERTICAL EACH FACE</td></tr> <tr><td>FT</td><td>FOOT; FEET</td><td>VG</td><td>VERTICAL GRAIN</td></tr> <tr><td>FTG</td><td>FOOTING</td><td>VF</td><td>VERTICAL INSIDE FACE</td></tr> <tr><td></td><td></td><td>VOF</td><td>VERTICAL OUTSIDE FACE</td></tr> <tr><td>GA</td><td>GAGE; GAUGE</td><td>WD</td><td>WIDE FLANGE; WIDE, WEST</td></tr> <tr><td>CALV</td><td>GALVANIZED</td><td>WF</td><td>WIDE FLANGE</td></tr> <tr><td>GB</td><td>GRADE BEAM</td><td>WH</td><td>WEEP HOLE</td></tr> <tr><td>GL</td><td>GLUE LAMINATED (BEAM)</td><td>WL</td><td>WORK LINE</td></tr> <tr><td>GRND</td><td>GROUND</td><td>WP</td><td>WORK POINT</td></tr> <tr><td>GSN</td><td>GENERAL STRUCTURAL NOTES</td><td>WPJ</td><td>WEAKENED PLANE JOINT</td></tr> <tr><td></td><td></td><td>WT</td><td>WEIGHT; STRUCTURAL TEE</td></tr> <tr><td>H</td><td>HORIZONTAL</td><td>WWF</td><td>WELDED WIRE FABRIC</td></tr> <tr><td>HEF</td><td>HORIZONTAL EACH FACE</td><td>YD</td><td>YARD</td></tr> <tr><td>HGR</td><td>HANGER</td><td></td><td></td></tr> <tr><td>HIF</td><td>HORIZONTAL INSIDE FACE</td><td></td><td></td></tr> <tr><td>HOF</td><td>HORIZONTAL OUTSIDE FACE</td><td></td><td></td></tr> <tr><td>HORIZ</td><td>HORIZONTAL</td><td></td><td></td></tr> <tr><td>HP</td><td>HP SHAPES; HIGH POINT</td><td></td><td></td></tr> <tr><td>HS</td><td>HIGH STRENGTH</td><td></td><td></td></tr> <tr><td>HSS</td><td>HOLLOW STEEL SHAPE</td><td></td><td></td></tr> <tr><td>HT</td><td>HEIGHT</td><td></td><td></td></tr> <tr><td>ICBO</td><td>INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS</td><td></td><td></td></tr> <tr><td>ID</td><td>INSIDE DIAMETER</td><td></td><td></td></tr> <tr><td>IN</td><td>INCH</td><td></td><td></td></tr> <tr><td>INCL</td><td>INCLUDE</td><td></td><td></td></tr> <tr><td>INFO</td><td>INFORMATION</td><td></td><td></td></tr> <tr><td>INSUL</td><td>INSULATION</td><td></td><td></td></tr> <tr><td>INT</td><td>INTERIOR</td><td></td><td></td></tr> <tr><td>JST</td><td>JOIST</td><td></td><td></td></tr> <tr><td>JT</td><td>JOINT</td><td></td><td></td></tr> <tr><td>K</td><td>KIP (1,000 POUNDS)</td><td></td><td></td></tr> <tr><td>KO</td><td>KNOCK-OUT</td><td></td><td></td></tr> <tr><td>KSI</td><td>KIPS PER SQUARE INCH</td><td></td><td></td></tr> <tr><td>L</td><td>ANGLE</td><td></td><td></td></tr> <tr><td>LAB</td><td>LABORATORY</td><td></td><td></td></tr> <tr><td>LB</td><td>LINEAL FOOT</td><td></td><td></td></tr> <tr><td>LF</td><td>LINEAL; LINEAR</td><td></td><td></td></tr> <tr><td>LN</td><td>LINE; LINEAR</td><td></td><td></td></tr> <tr><td>LH</td><td>LONG LEGS HORIZONTAL</td><td></td><td></td></tr> <tr><td>LLV</td><td>LONG LEGS VERTICAL</td><td></td><td></td></tr> <tr><td>LLBB</td><td>LONG LEGS BACK-TO-BACK</td><td></td><td></td></tr> <tr><td>LOC</td><td>LOCATION; LOCATE</td><td></td><td></td></tr> <tr><td>LONGIT</td><td>LONGITUDINAL</td><td></td><td></td></tr> <tr><td>LP</td><td>LOW POINT</td><td></td><td></td></tr> <tr><td>LSL</td><td>LONG SLOTTED (HOLES)</td><td></td><td></td></tr> <tr><td>LWT</td><td>LIGHT WEIGHT</td><td></td><td></td></tr> <tr><td>LVL</td><td>LEVEL</td><td></td><td></td></tr> <tr><td>MAS</td><td>MASONRY</td><td></td><td></td></tr> <tr><td>MATL</td><td>MATERIAL</td><td></td><td></td></tr>	FDN	FOUNDATION	TYP	TYPICAL	FF	FAR FACE			FIN	FINISH	UBC	UNIFORM BUILDING CODE	FLG	FLOOR; FLOOR LINE	UL	UNDERWRITERS LABORATORY; INCORPORATED	FLS	FLANGE	UNO	UNLESS NOTED OTHERWISE	FOS	FACE OF STUD	UT	ULTRASONIC TEST	FP	FIREPROOF			FRMG	FRAMING	V. VERT	VERTICAL	FS	FULL SIZE; FAR SIDE	VE	VERTICAL EACH FACE	FT	FOOT; FEET	VG	VERTICAL GRAIN	FTG	FOOTING	VF	VERTICAL INSIDE FACE			VOF	VERTICAL OUTSIDE FACE	GA	GAGE; GAUGE	WD	WIDE FLANGE; WIDE, WEST	CALV	GALVANIZED	WF	WIDE FLANGE	GB	GRADE BEAM	WH	WEEP HOLE	GL	GLUE LAMINATED (BEAM)	WL	WORK LINE	GRND	GROUND	WP	WORK POINT	GSN	GENERAL STRUCTURAL NOTES	WPJ	WEAKENED PLANE JOINT			WT	WEIGHT; STRUCTURAL TEE	H	HORIZONTAL	WWF	WELDED WIRE FABRIC	HEF	HORIZONTAL EACH FACE	YD	YARD	HGR	HANGER			HIF	HORIZONTAL INSIDE FACE			HOF	HORIZONTAL OUTSIDE FACE			HORIZ	HORIZONTAL			HP	HP SHAPES; HIGH POINT			HS	HIGH STRENGTH			HSS	HOLLOW STEEL SHAPE			HT	HEIGHT			ICBO	INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS			ID	INSIDE DIAMETER			IN	INCH			INCL	INCLUDE			INFO	INFORMATION			INSUL	INSULATION			INT	INTERIOR			JST	JOIST			JT	JOINT			K	KIP (1,000 POUNDS)			KO	KNOCK-OUT			KSI	KIPS PER SQUARE INCH			L	ANGLE			LAB	LABORATORY			LB	LINEAL FOOT			LF	LINEAL; LINEAR			LN	LINE; LINEAR			LH	LONG LEGS HORIZONTAL			LLV	LONG LEGS VERTICAL			LLBB	LONG LEGS BACK-TO-BACK			LOC	LOCATION; LOCATE			LONGIT	LONGITUDINAL			LP	LOW POINT			LSL	LONG SLOTTED (HOLES)			LWT	LIGHT WEIGHT			LVL	LEVEL			MAS	MASONRY			MATL	MATERIAL		
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NOTES:

- NOTATIONS:
db : NOMINAL BAR DIAMETER (INCHES)
LD : TENSION DEVELOPMENT LENGTH (INCHES) FOR REINFORCEMENT SATISFYING THE FOLLOWING REQUIREMENTS:
SLABS AND WALLS: CLEAR SPACING > 2db, AND CONCRETE CLEAR COVER > db
BEAMS AND COLUMNS: CLEAR SPACING > db, AND CONCRETE CLEAR COVER > db
DEVELOPMENT LENGTH OF TOP BARS IN TENSION = 1.3 x LD (INCHES)
DEVELOPMENT LENGTH OF BARS OR DOWELS IN COMPRESSION = 19 x db (INCHES)
TIED COLUMN LAP IN COMPRESSION = 30 x db (INCHES)
LCS : SPIRAL LAP SPLICE IN COMPRESSION = 22.5 x LD (INCHES)
LSB : TENSION LAP SPLICE LENGTH FOR OTHER THAN TOP BARS = 1.3 x LD (INCHES)
LSBT : TENSION LAP SPLICE LENGTH OF TOP BARS = 1.69 x LD (INCHES)
LT : MULTIPLY VALUES IN THE TABLE BY 1.5 IF CLEAR SPACING OR CONCRETE COVER DO NOT MEET THE REQUIREMENTS FOR LD IN NOTE 1.
TOP BARS: HORIZONTAL BEAM REINFORCING WITH MORE THAN 12 INCHES OF CONCRETE CAST BELOW.
THE DEVELOPMENT AND SPLICE LENGTHS ARE BASED REINFORCEMENT STRENGTH Fy = 60 KSI.

F'c=3000 psi					
BAR SIZE	LD	LT	LSB	LSBT	
#3	17	23	23	30	
#4	22	29	29	38	
#5	28	37	37	49	
#6	33	43	43	56	
#7	48	63	63	82	
#8	55	72	72	94	
#9	62	81	81	106	
#10	70	91	91	119	
#11	78	102	102	133	

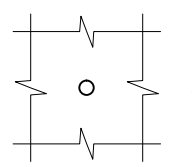
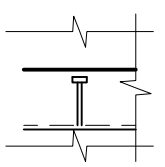
F'c=4000 psi					
BAR SIZE	LD	LT	LSB	LSBT	
#3	15	20	20	26	
#4	19	25	25	33	
#5	24	32	32	42	
#6	29	38	38	50	
#7	42	55	55	72	
#8	48	63	63	82	
#9	54	71	71	93	
#10	61	80	80	104	
#11	67	88	88	114	

F'c=5000 psi					
BAR SIZE	LD	LT	LSB	LSBT	
#3	13	17	17	23	
#4	17	23	23	30	
#5	22	29	29	30	
#6	26	34	34	45	
#7	38	50	50	65	
#8	43	56	56	73	
#9	48	63	63	82	
#10	54	71	71	93	
#11	60	78	78	102	

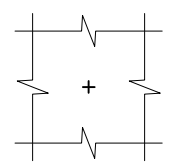
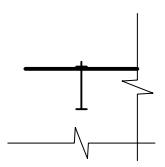
ALL CONC F'c				
BAR SIZE	LD	LT	LSB	
#3	8	12	12	
#4	10	25	12	
#5	12	19	14	
#6	15	23	17	
#7	17	26	20	
#8	19	30	23	
#9	22	34	26	
#10	24	38	29	
#11	27	42	32	

SECTION

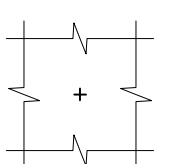
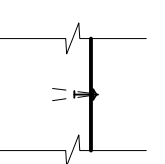
PLAN VIEW



STUD



CONCRETE ANCHOR BOLT



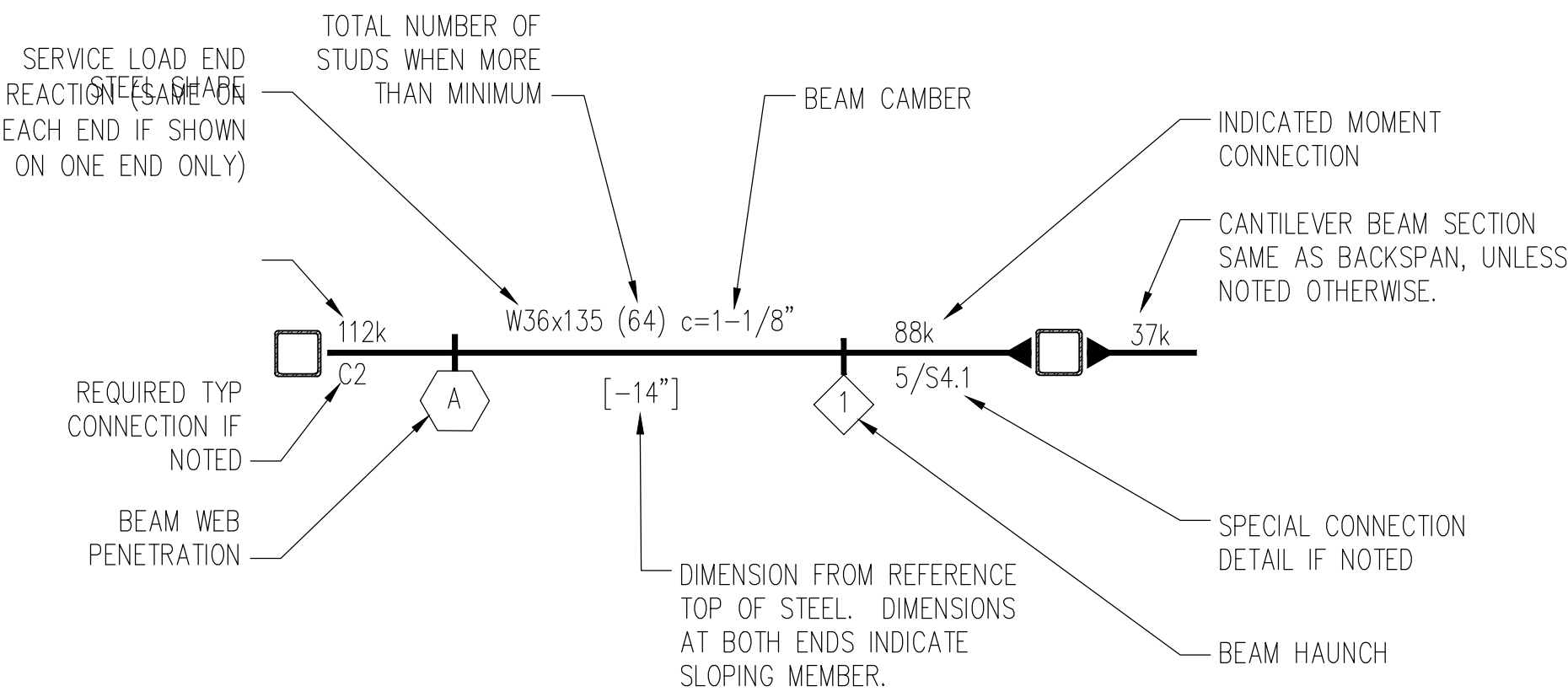
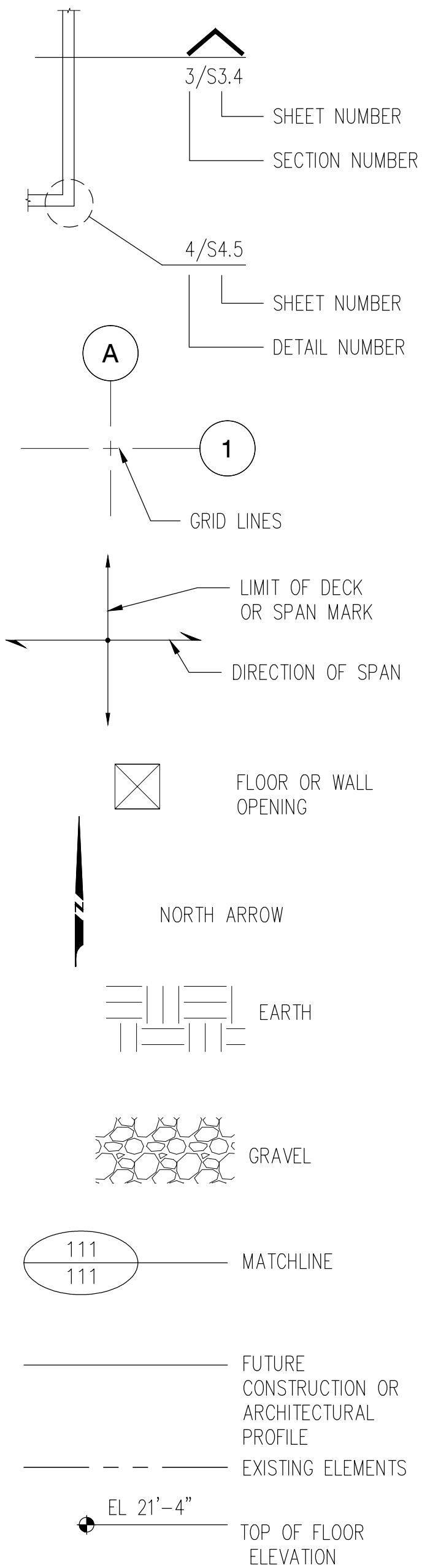
DRILLED IN CONCRETE ANCHOR

REINFORCING BAR DEVELOPMENT & SPLICE LENGTH

1

CONNECTORS

2

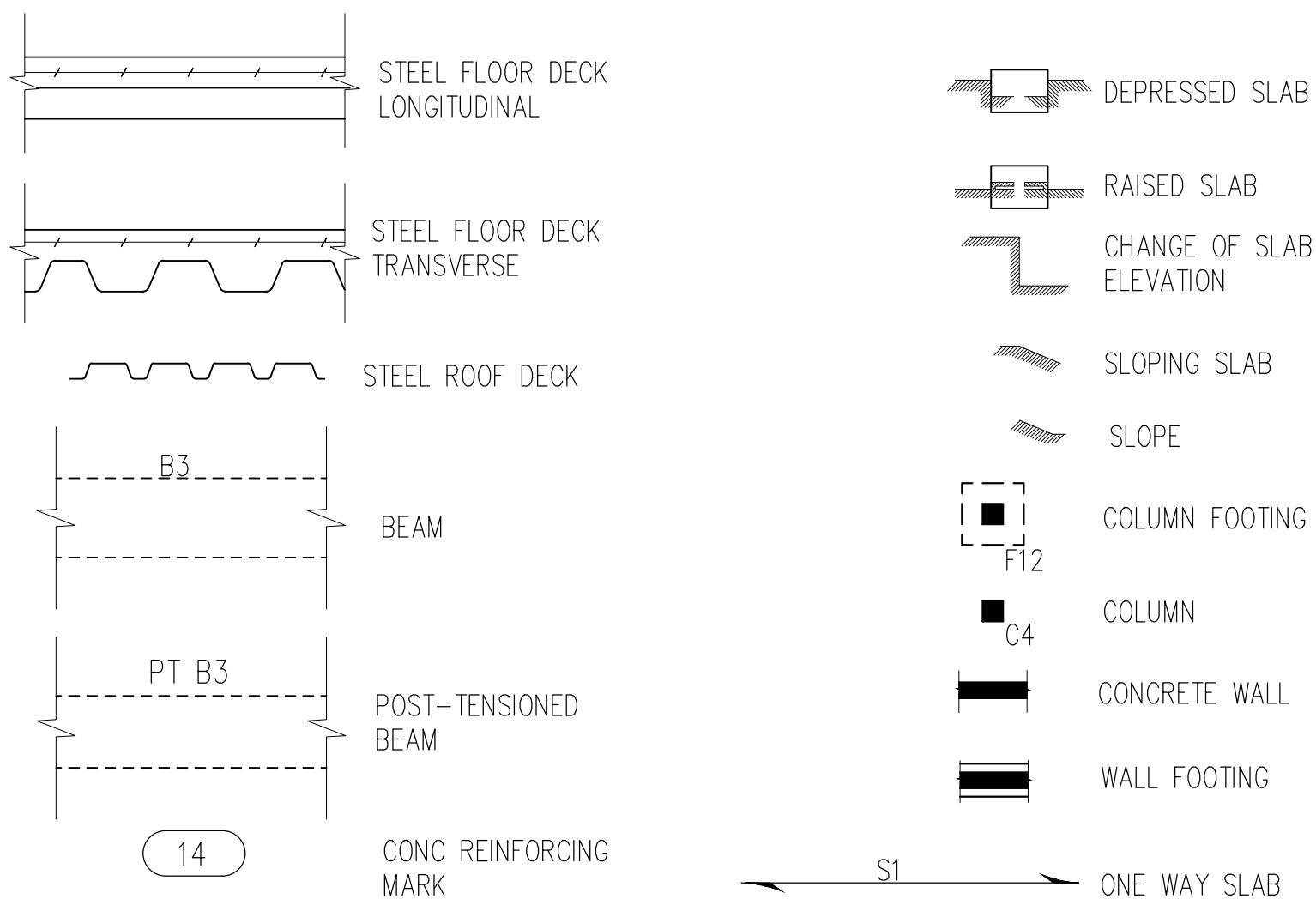


NOTES:

- NO REACTION AT EITHER END INDICATES MINIMUM CONNECTION FOR BEAM DEPTH. SEE GENERAL NOTES FOR STEEL CONNECTIONS.
- SPACE STUDS PER TYPICAL SHEAR STUD PLACEMENT DETAIL.
- "M" IN PLACE OF STEEL SHAPE INDICATES W10x12 WITH MINIMUM CONNECTION.
- WHERE NO BEAM SIZE IS CALLED OUT ADJACENT TO FLOOR OR ROOF OPENING, REFER TO TYPICAL DETAILS FOR SIZES AND CONNECTIONS.
- INDICATES BEAM PENETRATION PER "TYPICAL BEAM PENETRATION" DETAIL.
- INDICATES BEAM HAUNCH PER "TYPICAL BEAM HAUNCH DETAIL."

TYPICAL BEAM CALLOUT KEY

4



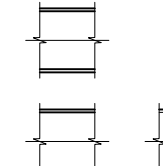
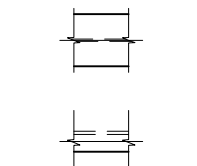
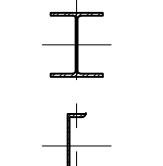
CONCRETE SYMBOLS

8

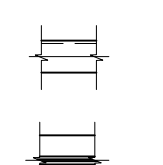
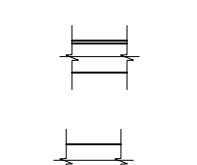
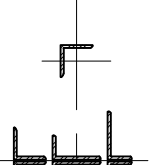
SECTION

PLAN VIEW

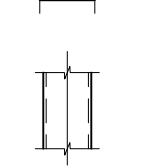
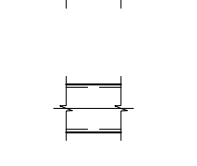
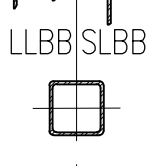
ELEVATION



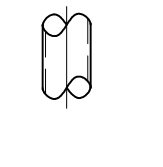
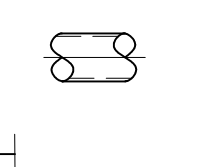
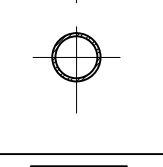
STEEL BEAM



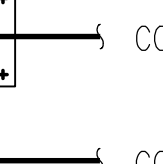
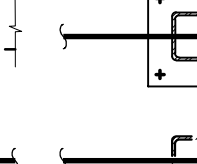
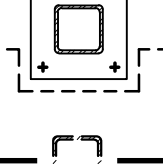
CHANNEL



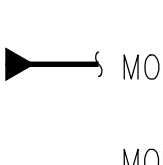
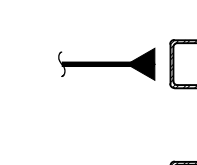
ANGLE



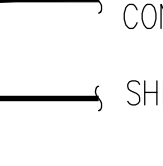
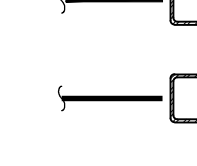
DOUBLE ANGLE



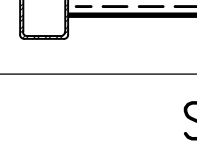
SQUARE OR RECTANGULAR HOLLOW SECTION



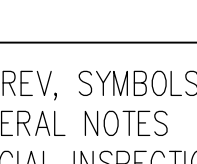
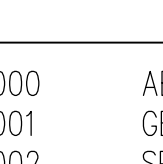
CIRCULAR HOLLOW SECTION



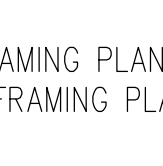
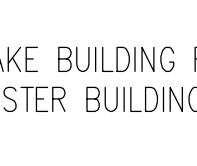
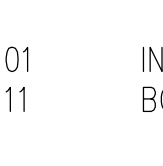
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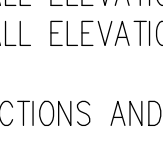
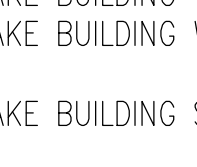
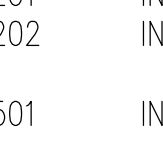
COLUMN ENDS HERE



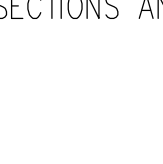
MOMENT CONNECTION



MOMENT FRAME CONNECTION



SHEAR CONNECTION



DIAGONAL BRACING

STEEL SYMBOLS

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S000	ABBREV, SYMBOLS, INDEX
S001	GENERAL NOTES
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S111	BOOSTER BUILDING FRAMING PLANS
S201	INTAKE BUILDING WALL ELEVATIONS
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S501	INTAKE BUILDING SECTIONS AND DETAILS
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SHEET INDEX

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ABBREVIATIONS, SYMBOLS, AND SHEET INDEX

RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO



DESIGNED BY:	GEF
DRAWN BY:	CTH
APPROVED BY:	GEF
DESIGN PROJ:	14-124
CONST	--
SCALE	AS NOTED
DATE:	10/09/15
DRAWING NO:	S000
SHEET NO:	83 of 114

GENERAL:	
ALL TYPICAL DETAILS AND NOTES SHOWN ON DRAWINGS SHALL APPLY UNLESS NOTED OTHERWISE. TYPICAL DETAILS MAY NOT NECESSARILY BE INDICATED ON THE PLANS BUT SHALL STILL APPLY AS SHOWN OR DESCRIBED IN THE DETAILS. THE CONTRACTOR SHALL SUBMIT ALL PROPOSED ALTERNATE DETAILS TO THOSE PROVIDED WITH RELATED CALCULATIONS TO THE ENGINEER FOR APPROVAL PRIOR TO SHOP DRAWING PRODUCTION AND FIELD USE.	
BUILDING CODE:	
ALL CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE BUILDING CODE. THE PUBLICATIONS LISTED BELOW ARE THE GOVERNING CODES AND STANDARDS AND ARE REFERENCED BY THEIR BASIC DESIGNATION. IN THE CASE OF CONFLICTING REQUIREMENTS, THE BUILDING CODE SHALL GOVERN.	
APPLICABLE CODES AND STANDARDS:	
BUILDING CODES	INTERNATIONAL BUILDING CODE (IBC), 2006 EDITION
ACI	AMERICAN CONCRETE INSTITUTE BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE (ACI 318), 2005 EDITION
ACI	AMERICAN CONCRETE INSTITUTE, "SPECIFICATIONS FOR STRUCTURAL CONCRETE", (ACI 301) 2005 EDITION
AISC	AMERICAN INSTITUTE OF STEEL CONSTRUCTION, SPECIFICATION FOR STRUCTURAL STEEL BUILDINGS (AISC 360), 13TH EDITION, 2005
AISC	AISC "SPECIFICATION FOR STRUCTURAL JOINTS USING ASTM A325 OR A490 BOLTS," JUNE 30, 2004
ASCE	ASCE "MINIMUM DESIGN LOADS FOR BUILDINGS AND OTHER STRUCTURES", (ASCE 7), 2005 EDITION
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM INTERNATIONAL)
AWS D1.1	AMERICAN WELDING SOCIETY D1.1-04, "STRUCTURAL WELDING CODE – STEEL"
AWS D1.3	AMERICAN WELDING SOCIETY D1.3-98, "STRUCTURAL WELDING CODE – SHEET STEEL"
AWS D1.4	AMERICAN WELDING SOCIETY D1.4-98, "STRUCTURAL WELDING CODE – REINFORCING STEEL"
AWS A2.4	AMERICAN WELDING SOCIETY A2.4-98, "SYMBOLS FOR WELDING AND NONDESTRUCTIVE TESTING"
SJI	STEEL JOIST INSTITUTE "STANDARD SPECIFICATION FOR OPEN WEB STEEL JOISTS, K-SERIES (SJI-K-1.1) 2005 EDITION
STRUCTURAL DESIGN DATA:	
BUILDING LOADS	
GROUND LEVEL DESIGN LOADS:	
DEAD LOAD	SELF WEIGHT
LIVE LOAD	250 PSF
ROOF DESIGN LOADS:	
SELF WEIGHT	
ROOFING/INSULATION	5 PSF
MECH/ELEC/CEILING/MISC	5 PSF
LIVE LOAD	50 PSF (NON-REDUCIBLE)
SNOW LOADS: SNOW LOADING AND SNOW DRIFT LOADING SHALL BE IN ACCORDANCE WITH THE BUILDING CODE	
GROUND SNOW LOAD, Pg	70 psf
FLAT ROOF SNOW LOAD, P _f	50 psf
SNOW LOAD IMPORTANCE FACTOR, I	1.0
THERMAL FACTOR, Ct	1.0
WIND LOADS: WIND PRESSURE SHALL BE IN ACCORDANCE WITH THE BUILDING CODE.	
BASIC WIND SPEED (3-SEC. GUST)	90 mph
WIND IMPORTANCE FACTOR	1.15
WIND EXPOSURE	C
INTERNAL PRESSURE COEFFICIENT, GCpi	±0.18
SEISMIC LOADS: SEISMIC LOADING SHALL BE IN ACCORDANCE WITH THE BUILDING CODE, SEISMIC SITE COEFFICIENT SHALL BE IN ACCORDANCE WITH THE GEOTECHNICAL REPORT.	
OCCUPANCY CATEGORY	I
SEISMIC IMPORTANCE FACTOR, I	1.0
MAPPED SPECTRAL RESPONSE ACCELERATIONS:	
0.2 SEC. RESPONSE, S _s	0.17
1 SEC. RESPONSE, S ₁	0.052
SOIL SITE CLASS	D
SPECTRAL RESPONSE COEFFICIENTS:	
0.2 SEC. RESPONSE, S _{ds}	0.181
1 SEC. RESPONSE, S _{d1}	0.083
SEISMIC DESIGN CATEGORY	B
BASIC SEISMIC-FORCE RESISTING SYSTEM:	ORDINARY PRECAST CONCRETE SHEAR WALLS/ ORDINARY STEEL CONC. BRACED FRAMES
RESPONSE MODIFICATION FACTOR, R	3.0
SEISMIC RESPONSE COEFFICIENT CS	0.076
DESIGN BASE SHEAR	57 KIPS
ANALYSIS PROCEDURE	EQUIVALENT LATERAL FORCE
LATERAL FORCES ARE CARRIED BY THE ROOF AND FLOOR DIAPHRAGMS TO THE CONCRETE WALLS. MOMENTS, SHEARS, AND ROTATIONAL FORCES ARE DELIVERED TO THE FOUNDATION BY THE CONCRETE WALLS. FOR ANALYSIS PURPOSES, THE ROOF DIAPHRAGM IS CONSIDERED FLEXIBLE AND THE FLOOR DIAPHRAGM IS CONSIDERED RIGID.	
DEFERRED SUBMITTAL ITEMS:	
PLANS, CALCULATIONS AND DETAILS FOR DEFERRED SUBMITTAL ITEMS SHALL BE SUBMITTED TO THE ARCHITECT, ENGINEER OF RECORD AND THE BUILDING OFFICIAL FOR REVIEW. DEFERRED SUBMITTAL ITEMS SHALL NOT BE FABRICATED OR INSTALLED PRIOR TO APPROVAL BY THE ENGINEER OF RECORD AND THE BUILDING OFFICIAL. DEFERRED SUBMITTAL ITEMS ARE AS FOLLOWS:	
PRECAST WALL PANELS (LOAD BEARING AND NON-LOAD BEARING)	
SEE THE APPROPRIATE SECTION(S) FOR PERFORMANCE REQUIREMENTS OF THE DEFERRED SUBMITTAL ITEMS.	

FOUNDATIONS:

SPREAD FOOTINGS: DESIGN SOIL BEARING PRESSURE = 3000 PSF FOR ALL FOOTINGS. ALL FOOTINGS SHALL BE OVEREXCAVATED A MINIMUM OF ONE (1) FOOT. THE BOTTOM OF THE EXCAVATION SHALL BE OBSERVED AND ANY PROOF COMPLETED PRIOR TO REPLACEMENT OF EXCAVATED MATERIALS, AND ANY YIELDING, LOOSE, LOW DENSITY, OR AREAS OF DELETERIOUS SUBSTANCES SHALL BE REMOVED AND/OR PROPERLY STABILIZED. MOISTURE CONDITIONED FILL SHALL BE PLACED IN THIN LIFTS UP TO THE BOTTOM OF THE STRUCTURAL FILL. ELEVATION AND COMPACTED TO NINETY (90) PER CENT OF MAXIMUM DRY DENSITY PER ASTM D1557, MODIFIED PROCTOR TEST. AFTER COMPLETION AND COMPACTION OF THE MOISTURE CONDITIONED EXISTING FILL MATERIAL, A ONE (1) FOOT THICK LAYER OF STRUCTURAL FILL SHALL BE PLACED, MOISTURE CONDITIONED AND COMPACTED. SEE THE GEOTECHNICAL REPORT FOR ADDITIONAL INFORMATION.

THE PROJECT GEOTECH REPORT BY TRAUTNER GEOTECH. (PROJECT NO. 535770E, DATED FEBRUARY 11, 2015) AND THE RECOMMENDATIONS CONTAINED IN THE GEOTECH REPORT SHALL BE CONSIDERED PART OF THE CONSTRUCTION DOCUMENTS.

ALL SLABS ON GRADE SHALL BE PLACED ON A COMPOSITE FILL BLANKET COMPOSED OF A SIX (6) INCH LAYER OF SCARIFIED, MOISTURE CONDITIONED AND COMPACTED EXISTING FILL MATERIAL UNDER A SIX (6) INCH LAYER OF COMPACTED STRUCTURAL FILL PER THE GEOTECHNICAL REPORT.

ALL INTERIOR SLABS ON GRADE SHALL BE PLACED ON A TWO INCH LAYER OF FINE-GRAINED CRUSHER REJECT MATERIAL CLOSELY CONFORMING TO ASTM D448,NO. 10 OVER A 10 MIL VAPOR BARRIER. SEE THE GEOTECHNICAL REPORT FOR ADDITIONAL INFORMATION.

STRUCTURAL FILL:

FILL PLACED TO SUPPORT SLABS ON GRADE, BEHIND PERMANENT WALLS, AND AROUND ALL DRAINS SHALL CONSIST OF WELL GRADED, GRANULAR MATERIAL PER THE GEOTECHNICAL REPORT. MATERIALS FOR STRUCTURAL FILL SHALL CONFORM TO COLORADO DEPARTMENT OF TRANSPORTATION (CDOT) "CLASS 6" AGGREGATE ROAD BASE MATERIAL OR SHALL BE APPROVED BY THE GEOTECHNICAL ENGINEER. STRUCTURAL FILL SHALL BE PLACED ON SOUND MATERIAL AND COMPACTED TO NINETY (90) PER CENT OF MAXIMUM DRY DENSITY AS DEFINED BY ASTM D1557, MODIFIED PROCTOR TEST. PROOF-ROLL OUT AREAS WHICH PROVIDE SUPPORT FOR PERMANENT STRUCTURES. AREAS WHICH ARE EXCESSIVELY YIELDING, AS DETERMINED BY THE CONTINUOUS OBSERVATION OF THE GEOTECHNICAL ENGINEER, SHALL BE OVEREXCAVATED AND REPLACED WITH STRUCTURAL FILL. STRUCTURAL FILL SHALL BE PLACED PER THE GEOTECHNICAL REPORT

CONCRETE:

MIXING, BATCHING, TRANSPORTING, PLACING, AND CURING OF ALL CONCRETE, AND SELECTION OF CONCRETE MATERIALS, SHALL CONFORM TO ACI 301, "SPECIFICATION FOR STRUCTURAL CONCRETE FOR BUILDINGS", EXCEPT AS NOTED BELOW. PROPORTIONS OF AGGREGATE TO CEMENTITIOUS PASTE SHALL BE SUCH AS TO PRODUCE A DENSE, WORKABLE MIX THAT CAN BE PLACED WITHOUT SEGREGATIONS OR EXCESS FREE SURFACE WATER.

ALL CONCRETE USED IN HORIZONTAL SURFACES EXPOSED TO THE WEATHER SHALL CONTAIN AN ACCEPTABLE ADMIXTURE TO PRODUCE AIR-ENTRAINED CONCRETE WITH TOTAL AIR CONTENT, AS NOTED IN THE CONCRETE MIX SPECIFICATION TABLE. TOLERANCE FOR AIR CONTENT SHALL BE + / - 1 PERCENT. AIR CONTENT SHALL BE MEASURED AT THE DISCHARGE OF THE TRUCK. IF CONCRETE IS PUMPED, AIR CONTENT SHALL BE MEASURED AT THE DISCHARGE END OF THE PUMP LINE. TESTS FOR AIR CONTENT SHALL MEET ASTM C172 REQUIREMENTS.

AIR ENTRAINED CONCRETE SHALL NOT RECEIVE HARD-TROWELED SURFACE FINISH.

MIX DESIGNS LISTED BELOW SHALL BE SUBMITTED TO THE ENGINEER AND APPROVED PRIOR TO USE. SELECTION OF CONCRETE MIX PROPORTIONS SHALL BE IN ACCORDANCE WITH ACI 301. MIX PROPORTIONS SHALL MEET OR EXCEED THE REQUIREMENTS LISTED BELOW FOR THE LOCATIONS NOTED. THE MORE STRINGENT OF THE REQUIREMENTS LISTED SHALL GOVERN.

MAXIMUM SIZE OF AGGREGATE SHALL BE AS LISTED BELOW. MAXIMUM FLY ASH AS A PERCENTAGE OF TOTAL WEIGHT OF CEMENTITIOUS MATERIAL SHALL BE 30 PERCENT. FLY ASH SHALL BE CLASS F, MEETING ASTM C618 REQUIREMENTS. WATER/CEMENT RATIO SHALL BE BASED ON TOTAL CEMENTITIOUS MATERIAL, INCLUDING FLY ASH AND OTHER POZZOLANIC MATERIALS.

THE CONTRACTOR SHALL DETERMINE SLUMP. EACH CONCRETE MIX SUBMITTED SHALL HAVE THE SLUMP SPECIFIED. SLUMP SHALL BE MEASURED AT THE DISCHARGE OF THE TRUCK. IF CONCRETE IS PUMPED, SLUMP SHALL BE MEASURED AT THE DISCHARGE END OF THE PUMP LINE. SLUMPS SHALL BE WITHIN + 1 INCH AND - 2 INCHES OF THE SPECIFIED SLUMP.

ALL ADMIXTURES SHALL BE CHLORIDE FREE UNLESS OTHERWISE APPROVED BY THE ENGINEER.

CONCRETE MIX SPECIFICATION TABLE

LOCATION	Fc (MIN) (PSI)	TEST AGE (DAYS)	W/C RATIO	MAX AIR CONTENT (PER CENT)	MAX AGGREGATE SIZE
MISCELLANEOUS CONCRETE, CURBS, SIDEWALKS	3,000	28	0.50	6	1"
EXTERIOR EXPOSED SLABS-ON-GRADE	4,000	28	0.45	6	1"
INTERIOR SLABS-ON-GRADE	4,000	28	0.50	-	1"
CONCRETE WALLS/ SPREAD FOOTINGS	4,000	28	0.44	-	1"

REINFORCING STEEL:

ALL REINFORCING SHALL BE NEW BILLET STOCK ASTM A615, GRADE 60. BARS SHALL BE SECURELY TIED IN PLACE WITH #16 DOUBLE-ANNEALED IRON WIRE. BARS SHALL BE SUPPORTED ON ACCEPTABLE CHAIRS. REINFORCING STEEL SHALL BE DETAILED IN ACCORDANCE WITH THE ACI "MANUAL OF STANDARD PRACTICE FOR DETAILING OF REINFORCED CONCRETE STRUCTURES." CONTRACTOR SHALL COORDINATE REINFORCING STEEL PLACEMENT DETAILS AND PROVIDE TEMPLATES FOR PLACING SLAB IN CONGESTED AREAS AS NECESSARY. SHOP DRAWINGS (INCLUDING PLACING PLANS AND ELEVATIONS) SHALL BE SUBMITTED TO, AND REVIEWED BY, THE ENGINEER BEFORE STARTING FABRICATION.

NO REINFORCING BARS SHALL BE SPLICED BY WELDING. REINFORCING BARS SHALL BE LAP SPLICED FOR TENSION (LSB) UNLESS NOTED OTHERWISE ON THE DRAWINGS.

WELDING OR TACK WELDING OF REINFORCING BARS TO OTHER BARS OR TO PLATES, ANGLES, ETC., IS PROHIBITED, EXCEPT WHERE SPECIFICALLY APPROVED BY THE ENGINEER. WHERE WELDING IS APPROVED, IT SHALL BE DONE BY AWS CERTIFIED WELDERS USING E6018 OR APPROVED ELECTRODES. WELDING PROCEDURES SHALL CONFORM TO THE REQUIREMENTS OF AWS D1.4.

MINIMUM CAST-IN-PLACE CONCRETE COVER OVER REINFORCING STEEL, UNLESS NOTED OTHERWISE, SHALL BE AS FOLLOWS:

- CONCRETE CAST AGAINST AND PERMANENTLY EXPOSED TO EARTH: 3 INCHES
- CONCRETE EXPOSED TO EARTH OR WEATHER: 1-1/2 INCHES FOR #5 BAR OR SMALLER, 2 INCHES FOR #6 BAR OR LARGER

WELDED WIRE FABRIC:	
WELDED WIRE FABRIC (WWF) SHALL BE ELECTRICALLY WELDED AND CONFORM TO ASTM A185. AN 8-INCH MINIMUM LAP SHALL BE PROVIDED FOR SIDE AND END LAPS. WELDED WIRE FABRIC SHALL BE SUPPORTED ON APPROVED CHAIRS.	
CONSTRUCTION JOINTS:	
ALL CONSTRUCTION JOINTS IN WALLS SHALL BE KEYED OR, AT THE CONTRACTOR'S OPTION, SHALL BE INTENTIONALLY ROUGHENED IN ACCORDANCE WITH THE FOLLOWING: THE SURFACE OF ROUGHENED JOINTS SHALL BE SAND BLASTED OR ROUGHENED WITH A CHIPPING HAMMER TO EXPOSE THE AGGREGATE EMBEDDED IN THE PREVIOUS POUR. THE EXPOSED AGGREGATE SHALL PROTRUDE A MINIMUM OF 1/4 INCH. ALL SURFACES OF CONSTRUCTION JOINTS SHALL BE CLEANED AND LAITANCE REMOVED. IMMEDIATELY BEFORE NEW CONCRETE IS PLACED, ALL CONSTRUCTION JOINTS SHALL BE WETTED AND STANDING WATER REMOVED.	
ALL CONSTRUCTION, CONTROL, AND ISOLATION JOINTS FOR SLABS ON GRADE SHALL BE IN ACCORDANCE WITH THE TYPICAL SLAB ON GRADE DETAILS. THE CONTRACTOR SHALL SUBMIT THE PROPOSED LOCATION OF CONSTRUCTION JOINTS TO THE ENGINEER FOR ACCEPTANCE BEFORE STARTING CONSTRUCTION.	
SLEEVES:	
EXCEPT AS DETAILED ON STRUCTURAL DRAWINGS, NO CONCRETE FOOTINGS, BEAMS, OR GIRDERS SHALL BE SLEEVED FOR PIPING OR DUCTS, UNLESS APPROVED BY THE ENGINEER.	
CONCRETE EXPANSION BOLTS (EB):	
ACCEPTABLE CONCRETE EXPANSION BOLTS, OF SIZE, NUMBER, AND SPACING AS SHOWN ON THE DRAWINGS, SHALL BE AS FOLLOWS (OR APPROVED EQUAL):	
HILTI "XWIK-BOLT-IT" CARBON STEEL WEDGE ANCHORS (ICBO #4627)	
SIMPSON STRONG TIE "WEDGE-ALL" CARBON STEEL WEDGE ANCHORS (ICBO #3631)	
*TITW RAMSET/RED HEAD TRUBOLT CARBON STEEL WEDGE ANCHORS" (ICBO #1372)	
MINIMUM EMBEDMENT DEPTH SHALL BE 4.5 BOLT DIAMETERS UNLESS NOTED OTHERWISE ON DRAWINGS.	
ANCHORS SHALL BE INSTALLED IN STRICT ACCORDANCE WITH THE APPROVED ICBO REPORT AND MANUFACTURER'S INSTRUCTIONS. NO REINFORCEMENT SHALL BE CUT TO INSTALL ANCHORS. DEFECTIVE HOLES SHALL BE GROUTED WITH EPOXY ADHESIVE.	
CONCRETE INJECTION EPOXY ADHESIVE ANCHORS:	
INJECTABLE EPOXY ADHESIVE SHALL BE USED FOR INSTALLATION OF ALL "DRILL & EPOXY" REINFORCING DOWELS, THREADED ANCHOR RODS, OR BOLTS INTO HARDENED CONCRETE. MINIMUM COMPRESSIVE STRENGTH (ASTM D695 OR ASTM C579) OF INJECTION EPOXY ADHESIVE SHALL BE 10,000 PSI. INJECTION EPOXY ADHESIVE SHALL BE ICBO APPROVED, APPLIED, AND CURED IN STRICT ACCORDANCE WITH THE ICBO REPORT AND MANUFACTURER'S INSTRUCTIONS. HOLES FOR DOWELS, RODS, OR BOLTS, SHALL BE DRILLED WITH A ROTARY IMPACT HAMMER, OR EQUIVALENT METHOD TO PRODUCE A HOLE WITH A ROUGH INSIDE SURFACE. NO REINFORCING SHALL BE CUT TO INSTALL DOWELS, BARS, OR BOLTS. ALL PLACEMENT AND CURING SHALL BE CONDUCTED WITH CONCRETE AND AIR TEMPERATURES ABOVE 50 DEGREES.	
APPLY INJECTION EPOXY ADHESIVE TO CLEAN, DRY CONCRETE. PROVIDE POSITIVE PROTECTION SO ANCHORS ARE NOT DISTURBED DURING THE CURING PERIOD. INJECTION EPOXY ADHESIVE FOR BONDING REINFORCING BARS, THREADED RODS, OR BOLTS INTO EXISTING CONCRETE SHALL BE A MANUFACTURED PRODUCT APPROVED BY THE ENGINEER. PRE-APPROVED MANUFACTURER'S ARE:	
HILTI "TIT HY 150" (ICBO #5193)	
SIMPSON STRONG TIE "SET HIGH STRENGTH EPOXY" (ICBO #5279)	
*TITW RAMSET/RED HEAD "EPCON CERAMIC-6" (ICBO #4285)	
ANCHOR BOLTS:	
ANCHOR BOLTS SHALL BE ASTM F1554 GRADE 36 STANDARD HEX HEAD FURNISHED WITH HEAVY HEX NUTS AND LOCK WASHERS, UNLESS NOTED OTHERWISE. ANCHOR BOLTS SHALL HAVE SUFFICIENT LENGTH TO PROVIDE THE MINIMUM EMBEDMENT SHOWN ON THE DRAWINGS MEASURED FROM THE FACE OF CONCRETE TO THE NEAR FACE OF THE HEAD OR NUT. ANCHOR BOLTS SHALL BE INSTALLED TO A SNUG TIGHT CONDITION. NO HEATING OR BENDING OF ANCHOR RODS IS PERMITTED. NO ENLARGEMENT OF ANCHOR BOLT HOLES BY BURNING IS PERMITTED.	
NONSHRINK GROUT FOR BASE PLATES, SLEEVES, AND EMBEDDED STEEL:	
GROUT SHALL BE AN APPROVED NONSHRINK CEMENTITIOUS GROUT CONTAINING NATURAL AGGREGATES DELIVERED TO THE JOB SITE IN FACTORY PREPACKAGED CONTAINERS REQUIRING ONLY THE ADDITION OF WATER. THE MINIMUM 28-DAY COMPRESSIVE STRENGTH SHALL BE AT LEAST 1,000 PSI HIGHER THAN THE SUPPORTING CONCRETE STRENGTH, UNLESS NOTED OTHERWISE. APPROVED GROUTS INCLUDE:	
CHEM REX INC'S "MASTER FLOW 928",	
SIKA CORPORATION'S "SIKA-GROUT 212 HP",	
BURKE COMPANY'S "NONFERROUS NONSHRINK GROUT",	
OR APPROVED EQUAL.	
GROUT SHALL BE MIXED, APPLIED, AND CURED STRICTLY IN ACCORDANCE WITH THE MANUFACTURER'S PRINTED INSTRUCTIONS.	
PRECAST CONCRETE WALL PANELS	
PRECAST CONCRETE WALL PANELS SHALL BE DESIGNED BY THE CONTRACTOR BY A PROFESSIONAL ENGINEER REGISTERED IN THE PROJECT JURISDICTION. PANEL DESIGN SHALL INCLUDE, BUT NOT BE LIMITED TO, DESIGN OF WALL PANELS, CONNECTIONS, ACCESSORIES AND EMBEDDED ITEMS.	
SHOP DRAWINGS BEARING THE STAMP OF THE ENGINEER OF RECORD SHALL BE SUBMITTED, AND SHALL INCLUDE:	
WALL PANEL ELEVATIONS FOR ALL WALL PANELS WITH REINFORCING, CONNECTIONS AND EMBEDDED ITEMS SHOWN.	
LOCATIONS, MAGNITUDES AND DIRECTIONS OF FORCES IMPOSED ON THE STRUCTURE, CLEARLY INDICATED.	
DESIGN LOADS AND DESIGN INFORMATION USED FOR DETERMINATION OF LOADING	

STRUCTURAL STEEL:	
ALL STEEL SHALL CONFORM TO THE FOLLOWING:	
W-SHAPES	ASTM A 992, FY=50 KSI
ALL ANGLES & CHANNELS	ASTM A36, FY=36 KSI
UNLESS NOTED OTHERWISE	
ALL PLATE	ASTM A36 FY = 36 KSI
SQUARE OR RECTANGULAR STRUCTURAL TUBE	ASTM A500 GRADE B, FY=46 KSI
STEEL PIPE DIAMETER LESS THAN OR EQUAL TO 12 INCHES	ASTM A53, TYPE E OR S GRADE B, FY=35 KSI
HEADED STUDS	
MATERIAL CALLED OUT ON PLANS AS (A36)	ASTM A36, FY=36 KSI
ALL OTHER STEEL UNLESS NOTED OTHERWISE	ASTM A572, FY=50 KSI ASTM A588, FY=50 KSI ASTM A441, FY=50 KSI
ALL STEEL FASTENERS AND CONNECTIONS SHALL CONFORM TO THE FOLLOWING:	
HIGH STRENGTH BOLTS	ASTM A325, Fu= 120 KSI ASTM A490, Fu= 150 KSI
HIGH STRENGTH TC BOLTS-TWIST-OFF, TENSION CONTROL NUTS	ASTM F1852, Fu= 120 KSI
WASHERS	ASTM A563
TENSION INDICATOR WASHERS	ASTM F959
THREADED RODS	ASTM A36, FY= 36 KSI
HEADED SHEAR STUDS	ASTM A108, Fu= 65KSI
ANCHOR RODS	ASTM F1554, GR. 36 Fy= 36 KSI
GENERAL NOTES FOR STEEL CONNECTIONS SHALL APPLY TO ALL STEEL CONNECTIONS UNLESS NOTED OTHERWISE.	
ALL WORK SHALL BE IN ACCORDANCE WITH THE AISC SPECIFICATION. SHOP DRAWINGS SHALL BE SUBMITTED AND REVIEWED BY THE ARCHITECT/ENGINEER BEFORE COMMENCING FABRICATION. ALL STEEL ANCHORS AND TIES AND OTHER MEMBERS EMBEDDED IN CONCRETE OR MASONRY SHALL BE LEFT UNPAINTED.	
STEEL BEAMS ARE EQUALLY SPACED BETWEEN DIMENSION POINTS AT THE MAXIMUM DECK SPAN LOCATION UNLESS NOTED OTHERWISE. MINIMUM CONNECTIONS SHALL BE A TWO-BOLT CONNECTION USING 3/4 INCH DIAMETER A325 BOLTS IN SINGLE SHEAR. ALL HIGH-STRENGTH BOLTS SHALL BE INSTALLED, TIGHTENED AND INSPECTED IN ACCORDANCE WITH THE AISC SPECIFICATION FOR STRUCTURAL JOINTS USING ASTM A325 OR A490 BOLTS. THE CRITERIA FOR SLIP-CRITICAL CONNECTIONS SHALL APPLY TO ALL CONNECTIONS UNLESS NOTED OTHERWISE AS SNUG-TIGHT. BOLTS IN CONNECTIONS OF BEAM-TO-BEAM/ORDER MAY BE SNUG TIGHT, UNLESS SPECIFICALLY CALLED OUT AS SLIP CRITICAL (SC). WHERE CONNECTIONS ARE NOTED AS SNUG-TIGHT, THE CONTRACTOR MAY INSTALL PER THE CRITERIA FOR SNUG-TIGHT BOLTS. SLIP-CRITICAL CONNECTIONS SHALL USE LOAD INDICATOR WASHERS OR TENSION CONTROL BOLTS. ALL ASTM A307 BOLTS SHALL BE PROVIDED WITH LOCK WASHERS UNDER NUTS OR SELF-LOCKING NUTS. ALL BOLT HOLES SHALL BE STANDARD SIZE UNLESS NOTED OTHERWISE.	
ALTERNATE CONNECTION DESIGNS SHALL ONLY BE ALLOWED WITH PRIOR APPROVAL OF THE STRUCTURAL ENGINEER. CLEARLY INDICATE SUCH DESIGNS ON THE SHOP DRAWINGS WITH A REQUEST FOR REVIEW AND APPROVAL. IF SUCH APPROVAL IS GRANTED, ALL CONNECTIONS, SPLICES AND ERECTION PIECES NOT IN ACCORDANCE WITH THE CONTRACT DRAWINGS (DUE TO FABRICATOR REDESIGN) SHALL BE DESIGNED BY THE FABRICATOR'S ENGINEER, REGISTERED IN THE PROJECT JURISDICTION, CALCULATIONS AND SHOP DRAWINGS SHALL BE SUBMITTED BEARING THE ENGINEER'S SEAL AND SIGNATURE. THE FABRICATOR'S ENGINEER SHALL DESIGN AND DETAIL ANY CONNECTIONS THAT ARE NEEDED TO COMPLETE THE PROJECT THAT ARE NOT SPECIFICALLY DETAILED ON THE CONTRACT DRAWINGS.	
THE CONTRACTOR SHALL BE RESPONSIBLE FOR COORDINATING THE SELECTION OF OPTIONAL DETAILS SHOWN ON THE DRAWINGS. THE CONTRACTOR SHALL ALSO BE RESPONSIBLE FOR ALL ERECTION AIDS THAT INCLUDE, BUT ARE NOT LIMITED TO, ERECTION ANGLES, LIFT HOLES, AND OTHER AIDS.	
STRUCTURAL STEEL WELDING:	
STRUCTURAL STEEL SHOP DRAWINGS SHALL SHOW ALL WELDING WITH AWS A2.4 SYMBOLS. ALL WELDING SHALL BE DONE BY AWS CERTIFIED WELDERS AND IN ACCORDANCE WITH AWS D1.1. WELDS SHOWN ON THE DRAWINGS ARE THE MINIMUM SIZES. INCREASE WELD SIZE TO AWS MINIMUM SIZES, BASED ON PLATE THICKNESS. THE MINIMUM WELD SIZE SHALL BE 3/16 INCH. FIELD WELDING SYMBOLS HAVE NOT NECESSARILY BEEN INDICATED ON THE DRAWINGS. WHERE SHOWN, PROPER FIELD WELDING PER AWS D1.1 SHALL BE USED. WHERE NO FIELD WELDING SYMBOLS ARE SHOWN, IT IS THE CONTRACTOR'S RESPONSIBILITY TO COORDINATE THE USE OF SHOP AND FIELD WELDS. ALL PARTIAL PENETRATION GROOVE WELD SIZES SHOWN ON THE DRAWINGS REFER TO EFFECTIVE THROAT THICKNESS. ALL WELDS SHALL BE MADE USING LOW HYDROGEN ELECTRODES WITH MINIMUM TENSILE STRENGTH PER AWS D1.1 (MINIMUM 70 KSI). LOW HYDROGEN SMAW ELECTRODES SHALL BE USED WITHIN FOUR HOURS OF OPENING THEIR HERMETICALLY SEALED CONTAINERS, OR SHALL BE REDRIED PER AWS D1.1, SECTION 4.5. ELECTRODES SHALL BE REDRIED NO MORE THAN ONE TIME, AND ELECTRODES THAT HAVE BEEN WET SHALL NOT BE USED.	
ALL WELDING SHALL BE PERFORMED IN STRICT ADHERENCE TO A WRITTEN WELDING PROCEDURE SPECIFICATION (WPS) PER AWS D1.1. ALL WELDING PARAMETERS SHALL BE WITHIN THE ELECTRODE MANUFACTURER'S RECOMMENDATIONS. WELDING PROCEDURES SHALL BE SUBMITTED TO THE OWNER'S TESTING AGENCY FOR REVIEW BEFORE STARTING FABRICATION OR ERECTION. COPIES OF THE WPS SHALL BE ON SITE AND AVAILABLE TO ALL WELDERS AND THE SPECIAL INSPECTOR.	
ALL COMPLETE-PENETRATION WELDS SHALL BE ULTRASONICALLY TESTED UPON COMPLETION OF THE CONNECTION, EXCEPT PLATE LESS THAN OR EQUAL TO 1/4 INCH THICK SHALL BE MAGNETIC PARTICLE TESTED. REDUCTION IN TESTING MAY BE MADE IN ACCORDANCE WITH THE BUILDING CODE WITH APPROVAL OF THE ENGINEER.	
THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE JOINT PREPARATIONS AND WELDING PROCEDURES THAT INCLUDE, BUT ARE NOT LIMITED TO: REQUIRED ROOT OPENINGS, ROOT FACE DIMENSIONS, GROOVE ANGLES, BACKING BARS, COPELS, SURFACE ROUGHNESS VALUES, AND TAPERS AND TRANSITIONS OF UNEQUAL PARTS.	
ELECTRICAL CONDUIT:	
ELECTRICAL CONDUIT SHALL BE RIGID STEEL CONDUIT OR FLEXIBLE PLASTIC CONDUIT. ALUMINUM CONDUIT IS PROHIBITED. CONDUIT WITH A MAXIMUM OUTSIDE DIAMETER OF 1/6 TIMES THE SLAB THICKNESS MAY BE EMBEDDED IN ONE LAYER AT THE MID-DEPTH OF SLABS. MINIMUM CLEAR DISTANCE BETWEEN CONDUITS SHALL BE 3 TIMES CONDUIT DIAMETER. CONDUIT SHALL BE FIRMLY CHAIRED AND TIED TO PREVENT DISPLACEMENT DURING POURING.	

STEEL JOISTS AND JOIST GIRDERS	
DESIGN OF STEEL JOISTS SHALL BE BY MANUFACTURER'S ENGINEER REGISTERED IN THE PROJECT JURISDICTION FOR ALL LOADINGS REQUIRED BY THESE DOCUMENTS. ALL SUBMITTALS SHALL BEAR THIS ENGINEER'S SEAL AND SIGNATURE.	
SPECIAL JOISTS (SP JST), WHERE INDICATED ON PLANS, HAVE SPECIAL DESIGN REQUIREMENTS. REFER TO PLANS AND DETAILS FOR LOCATIONS AND LOADING DIAGRAM.	
BRIDGING SHALL BE DESIGNED AND FURNISHED BY THE MANUFACTURER IN ACCORDANCE WITH THE APPLICABLE STEEL JOIST INSTITUTE SPECIFICATION. BRIDGING SHALL BE WELDED OR BOLTED AND ANCHORED AT END WALLS OR BEAMS. ALL BRIDGING, BRIDGING ANCHORS AND JOIST CONNECTIONS SHALL BE COMPLETELY INSTALLED PRIOR TO THE APPLICATION OF ANY CONSTRUCTION LOADS.	
FOR ROOF JOISTS RESISTING NET WIND UPLIFT, PROVIDE BRIDGING AT THE FIRST PANEL POINT FROM SUPPORTS.	
ALL SUPPORTED ROOFTOP UNITS, SUSPENDED EQUIPMENT AND PIPING SHALL BE DIRECTLY SUPPORTED FROM JOIST PANEL POINTS UNLESS TOP OR BOTTOM CHORD IS SPECIFICALLY DESIGNED FOR INTERPANEL LOADING OR ADDITIONAL REINFORCEMENT IS PROVIDED.	
STEEL ROOF DECK:	
THE STEEL DECK SHALL BE OF DEPTH AND GAGE SHOWN ON THE STRUCTURAL DRAWINGS. STEEL DECK AND ALL OF ITS FLASHINGS SHALL CONFORM TO ASTM A611. THE STEEL SHALL HAVE A COAT OF MANUFACTURER'S STANDARD SHOP PRIMER. ALL WELDING SHALL BE IN ACCORDANCE WITH AWS D1.3. UNITS SHALL SPAN OVER FOUR SUPPORTS, CONTINUOUS OVER THREE OR MORE SPANS, EXCEPT WHERE THE FRAMING DOES NOT PERMIT.	
NONCOMPOSITE UNITS SHALL BE FASTENED TO THE STEEL SUPPORTS AT THE ENDS OF THE UNITS AND AT INTERMEDIATE SUPPORTS BY A MINIMUM OF FIVE 5/8 INCH DIAMETER PUDDLE WELDS PER 3'-0" OF WIDTH (3% PATTERN). WHERE TWO UNITS ABUT, EACH UNIT SHALL BE SO FASTENED TO THE STEEL FRAMING. THE SIDE LAPS OF ADJACENT UNITS SHALL BE FASTENED BETWEEN SUPPORTS BY WELDS AT 1'-0" ON CENTER UNLESS NOTED OTHERWISE. SIDE LAP WELDS SHALL BE 5/8 INCH DIAMETER PUDDLE WELDS OR 3/8 x 1-1/4 ARC SEAM WELDS. DECK UNITS SHALL BE FASTENED TO THE STEEL SUPPORTS AT THE SIDE BOUNDARIES BY 5/8 INCH DIAMETER PUDDLE WELDS AT 6" ON CENTER. ALTERNATIVELY, POWDER ACTUATED FASTENERS OR PNEUMATIC PINS MAY BE USED WITH SELF DRILLING SCREWS AT SIDELAPS, PROVIDED THE CONTRACTOR PRESENTS CALCULATIONS WITH ICBO REPORTS DEMONSTRATING EQUIVALENT VALUES OF SHEAR CAPACITY, DECK CAPACITY AND DECK FLEXIBILITY.	
WHERE STEEL MEMBERS ARE PARALLEL TO THE DECK FLUTES AND AT THE SAME ELEVATION OF THE BOTTOM OF THE DECK, ADJUST DECK LAYOUT AND WELD DECK TO STEEL WITH SAME WELDING AS REQUIRED FOR SIDE BOUNDARIES. STEEL DECK TYPES SHALL BE VERO TYPE B, IMSA TYPE B, OR APPROVED EQUAL.	
BEAM DEFLECTION:	
FLOOR BEAMS, ESPECIALLY EDGE BEAMS, TRANSFER GIRDERS, AND CANTILEVERS WILL CONTINUE TO DEFLECT WHEN ADDITIONAL LOAD IS APPLIED. THESE MEMBERS HAVE BEEN DIMENSIONED TO COMPENSATE FOR THE THEORETICAL DEFLECTION. HOWEVER, THIS MAY NOT OCCUR UNTIL ALL THE DEAD LOAD IS APPLIED TO THE MEMBER. THE CONTRACTOR SHALL COORDINATE THE ATTACHMENT OF ANY ITEMS TO MEMBERS WHICH WILL CONTINUE TO SHORTEN OR DEFLECT DUE TO LATER STAGES OF CONSTRUCTION.	
PARTITIONS:	
FRAMING FOR INTERIOR PARTITIONS SHALL CONSIST OF ICBO APPROVED METAL STUD TYPE FRAMING. CONNECTION OF STUDS, TRACK, AND OTHER ITEMS BY MEANS OF EITHER DRILLED IN ANCHORAGE OR POWDER DRIVEN FASTENERS MAY OCCUR WITH ICBO APPROVED FASTENERS. PARTITIONS SHALL BE SO CONNECTED TO THE STRUCTURE SO AS TO ALLOW FOR BOTH THE VERTICAL AND LATERAL DEFLECTIONS DESCRIBED IN THE BUILDING CLADDING SECTION OF THE NOTES.	
INTERIOR PARTITIONS SHALL EXTEND TO THE UNDERSIDE OF STRUCTURE- SEE ARCHITECTURAL DRAWINGS FOR ADDITIONAL INFORMATION.	
DEFLECTION TRACKS AT INTERIOR PARTITIONS SHALL ALLOW FOR A MINIMUM OF 3/4" OF DEFLECTION.	
BUILDING TOLERANCES:	
STANDARD TOLERANCES SHALL BE BASED ON THE REQUIREMENTS OF THE AISC CODE OF STANDARD PRACTICE AND ACI 117. STANDARD SPECIFICATIONS FOR TOLERANCES FOR CONCRETE CONSTRUCTION AND MATERIALS.	
SEQUENCING CONSTRUCTION AND LATERAL STABILITY:	
THE STRUCTURAL COMPONENTS BY THEMSELVES ARE A NON-SELF-SUPPORTING STRUCTURE. LATERAL FORCES DUE TO WIND, EARTHQUAKE, OR SOIL ARE CARRIED BY THE ROOF AND FLOOR DIAPHRAGMS TO THE LATERAL SYSTEM. CERTAIN ELEMENTS SHOWN ON THE STRUCTURAL DRAWINGS (SUCH AS BRACING, ROOF AND FLOOR SLABS) ARE REQUIRED FOR OVERALL OR LOCAL STABILITY OF OTHER ELEMENTS (SUCH AS BEAMS, COLUMNS, AND WALLS). IF, DUE TO SEQUENCING OF CONSTRUCTION, THESE STABILITY ELEMENTS ARE NOT IN PLACE, THE CONTRACTOR SHALL RETAIN A LICENSED STRUCTURAL ENGINEER WHO SHALL INVESTIGATE WHERE TEMPORARY SHORING/BRACING IS REQUIRED, AND SHALL DESIGN THIS TEMPORARY SHORING/BRACING. THE CONTRACTOR SHALL PROVIDE THIS SHORING/BRACING UNTIL THE REQUIRED STRUCTURAL ELEMENTS AND THEIR CONNECTIONS HAVE BEEN INSTALLED AND REACH THEIR FINAL DESIGN STRENGTHS.	
MISCELLANEOUS:	
REFER TO ARCHITECTURAL, MECHANICAL, ELECTRICAL, CIVIL, ELEVATOR, OR OTHER SPECIALTY ENGINEERING DRAWINGS FOR DIMENSIONS NOT SHOWN, INCLUDING BUT NOT LIMITED TO: SIZE AND LOCATION OF CURBS, EQUIPMENT HOUSEKEEPING PADS, WALL AND FLOOR OPENINGS, BLOCKOUTS, FLOOR DEPRESSIONS, SUMPS, DRAINS, ANCHOR BOLTS, EMBEDDED ITEMS, ARCHITECTURAL TREATMENT, ETC. CONTRACTOR SHALL VERIFY DIMENSIONS AND RESOLVE DISCREPANCIES OR CONFLICTS PRIOR TO CONSTRUCTION.	
SPECIAL INSPECTION:	
SPECIAL INSPECTIONS ARE REQUIRED PER IBC, CHAPTER 17. THE OWNER SHALL EMPLOY ONE OR MORE SPECIAL INSPECTORS TO PROVIDE INSPECTIONS DURING CONSTRUCTION ON THE TYPES OF WORK LISTED UNDER SECTION 1704. THESE INSPECTIONS SHALL BE PERFORMED BY A CERTIFIED SPECIAL INSPECTOR TO PERFORM THE TYPES OF INSPECTIONS SPECIFIED. SEE THE SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS FOR SPECIAL INSPECTION AND TESTING.	

VERIFICATION AND INSPECTION OF CONCRETE CONSTRUCTION				
INSPECTION TASK		FREQUENCY	REFERENCED STANDARD	IBC REFERENCE
1	INSPECTION OF REINFORCING STEEL, INCLUDING PRESTRESSING TENDONS, AND PLACEMENT	PERIODIC	ACI 318: 3.5, 7.1-7.7	1913.4
2	INSPECTION OF REINFORCING STEEL WELDING IN ACCORDANCE WITH IBC TABLE 1704.3, ITEM 5b	VARIES	AWS D1.4 ACI 318: 3.5.2	-
3	INSPECT BOLTS TO BE INSTALLED IN CONCRETE PRIOR TO AND DURING PLACEMENT OF CONCRETE WHERE ALLOWABLE LOADS HAVE BEEN INCREASED	CONTINUOUS	-	1911.5
4	VERIFYING USE OF REQUIRED MIX DESIGN	PERIODIC	ACI 318: CHAPTER 4, 5.2-5.4	1904.2.2 1913.2 1913.3
5	AT THE TIME FRESH CONCRETE IS SAMPLED TO FABRICATE SPECIMENS FOR STRENGTH TESTS, PERFORM SLUMP AND AIR CONTENT TESTS, AND DETERMINE THE TEMPERATURE OF THE CONCRETE	CONTINUOUS	ASTM C172 ASTM C31 ACI 318: 5.6, 5.8	1913.10
6	INSPECTION OF CONCRETE AND SHOTCRETE PLACEMENT FOR PROPER APPLICATION TECHNIQUES	CONTINUOUS	ACI 318: 5.9, 5.10	1913.6 1913.7 1913.8
7	INSPECTION FOR MAINTENANCE OF SPECIFIED CURING TEMPERATURE AND TECHNIQUES	PERIODIC	ACI 318: 5.11-5.13	1913.9
8	NOT USED			
9	ERECTION OF PRECAST CONCRETE MEMBERS	PERIODIC	ACI 318: CHAPTER 16	-
10	NOT USED			
11	NOT USED			

INSPECTION TASK		FREQUENCY	REFERENCED STANDARD	IBC REFERENCE	
1	MATERIAL VERIFICATION OF HIGH-STRENGTH BOLTS, NUTS AND WASHERS:				
	A	IDENTIFICATION MARKINGS TO CONFORM TO ASTM STANDARDS SPECIFIED IN THE APPROVED CONSTRUCTION DOCUMENTS	PERIODIC	APPLICABLE ASTM MATERIAL SPECS; AISC 360, SECTION A3.3	-
	B	MANUFACTURER'S CERTIFICATE OF COMPLIANCE REQUIRED	PERIODIC	-	-
2	INSPECTION OF HIGH-STRENGTH BOLTING:				
	A	BEARING-TYPE CONNECTIONS	PERIODIC	AISC 360, SECTION M2.5	1704.3.3
	B	SLIP-CRITICAL CONNECTIONS	CONTINUOUS & PERIODIC		
3	MATERIAL VERIFICATION OF STRUCTURAL STEEL:				
	A	IDENTIFICATION MARKINGS TO CONFORM TO ASTM STANDARDS SPECIFIED IN THE APPROVED CONSTRUCTION DOCUMENTS	-	ASTM A6 OR ASTM A568	1708.4
	B	MANUFACTURER'S CERTIFIED MILL TEST REPORTS	-	ASTM A6 OR ASTM A568	
4	MATERIAL VERIFICATION OF WELD FILLER MATERIALS				
	A	IDENTIFICATION MARKINGS TO CONFORM TO AWS SPECIFICATION IN THE APPROVED CONSTRUCTION DOCUMENTS	-	AISC 360, SECTION A3.5	-
	B	MANUFACTURER'S CERTIFICATE OF COMPLIANCE REQUIRED	-	-	-
5	INSPECTION OF WELDING:				
	A	STRUCTURAL STEEL:		AWS D1.1	1704.3.1
		1) COMPLETE AND PARTIAL PENETRATION GROOVE WELDS	CONTINUOUS		
		2) MULTIPASS FILLET WELDS	CONTINUOUS		
		3) SINGLE PASS FILLET WELDS > 5/16" "	CONTINUOUS		
		4) SINGLE PASS FILLET WELDS ≤ 5/16" "	PERIODIC		
		5) FLOOR AND ROOF DECK WELDS	PERIODIC	AWS D1.3	-
	B	REINFORCING STEEL:		AWS D1.4 ACI 318: 3.5.2	-
		1) VERIFICATION OF WELDABILITY OF REINFORCING STEEL OTHER THAN ASTM A706	PERIODIC		
		2) REINFORCING STEEL-RESISTING FLEXURAL AND AXIAL FORCES IN INTERMEDIATE AND SPECIAL MOMENT FRAMES, AND BOUNDARY ELEMENTS OF SPECIAL REINFORCED CONCRETE SHEAR WALLS AND SHEAR REINFORCEMENT	CONTINUOUS		
		3) SHEAR REINFORCEMENT	CONTINUOUS		
4) OTHER REINFORCING STEEL		PERIODIC			
6	INSPECTION OF STEEL FRAME JOINT DETAILS FOR COMPLIANCE WITH APPROVED CONSTRUCTION DOCUMENTS				
	A	DETAILS SUCH AS BRACING AND STIFFENING	PERIODIC	-	1704.3.2
	B	MEMBER LOCATIONS	-		
	C	APPLICATION OF JOINT DETAILS AT EACH CONNECTION	-		

STATEMENT OF SPECIAL INSPECTIONS:

SPECIAL INSPECTIONS ARE REQUIRED PER IBC, CHAPTER 17. THE OWNER SHALL EMPLOY ONE OR MORE SPECIAL INSPECTORS TO PROVIDE INSPECTIONS DURING CONSTRUCTION ON THE TYPES OF WORK LISTED UNDER SECTION 1704. THESE INSPECTIONS SHALL BE PERFORMED BY A CERTIFIED SPECIAL INSPECTOR TO PERFORM THE TYPES OF INSPECTIONS SPECIFIED. SEE THE SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS FOR SPECIAL INSPECTION AND TESTING.

"SPECIAL STRUCTURAL INSPECTION" SHALL NOT RELIEVE THE OWNER FROM REQUESTING INSPECTIONS AS REQUIRED BY THE BUILDING OFFICIAL IN THE PROJECT JURISDICTION AS REQUIRED BY SECTION 109 OF THE IBC.

IN ACCORDANCE WITH IBC CHAPTER 17, THE FOLLOWING TYPES OF WORK REQUIRE SPECIAL INSPECTIONS AND TESTING:

VERIFICATION AND INSPECTION OF SOILS			
INSPECTION TASK		FREQUENCY	IBC SECTION
1	VERIFY MATERIALS BELOW FOOTINGS ARE ADEQUATE TO ACHIEVE THE DESIGN BEARING CAPACITY	PERIODIC	1704.7
2	VERIFY EXCAVATIONS ARE EXTENDED TO PROPER DEPTH AND HAVE REACHED PROPER MATERIAL	PERIODIC	1704.7
3	PERFORM CLASSIFICATION AND TESTING OF CONTROLLED FILL MATERIALS	PERIODIC	1704.7
4	VERIFY USE OF PROPER MATERIALS, DENSITIES AND LIFT THICKNESSES DURING PLACEMENT AND COMPACTION OF CONTROLLED FILL	CONTINUOUS	1704.7
5	PRIOR TO PLACEMENT OF CONTROLLED FILL, OBSERVE SUBGRADE AND VERIFY THAT SITE HAS BEEN PREPARED PROPERLY	PERIODIC	1704.7

[illegible]

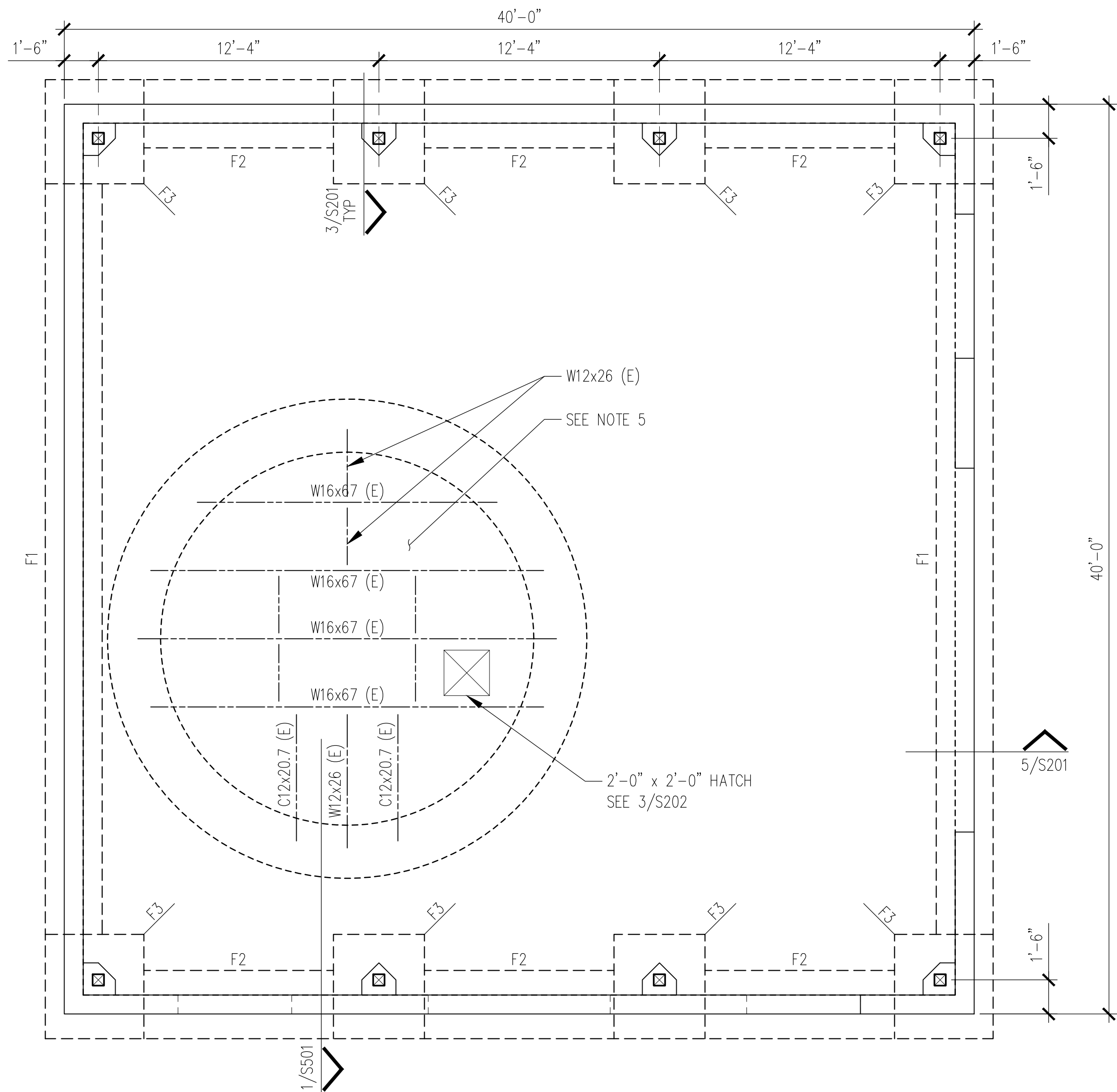
GOFF
ENGINEERING + SURVEYING INC.
126 ROCK POINT DRIVE - DURANGO, CO 81301
(970) 247-1705
www.goffengineering.com

SPECIAL INSPECTIONS

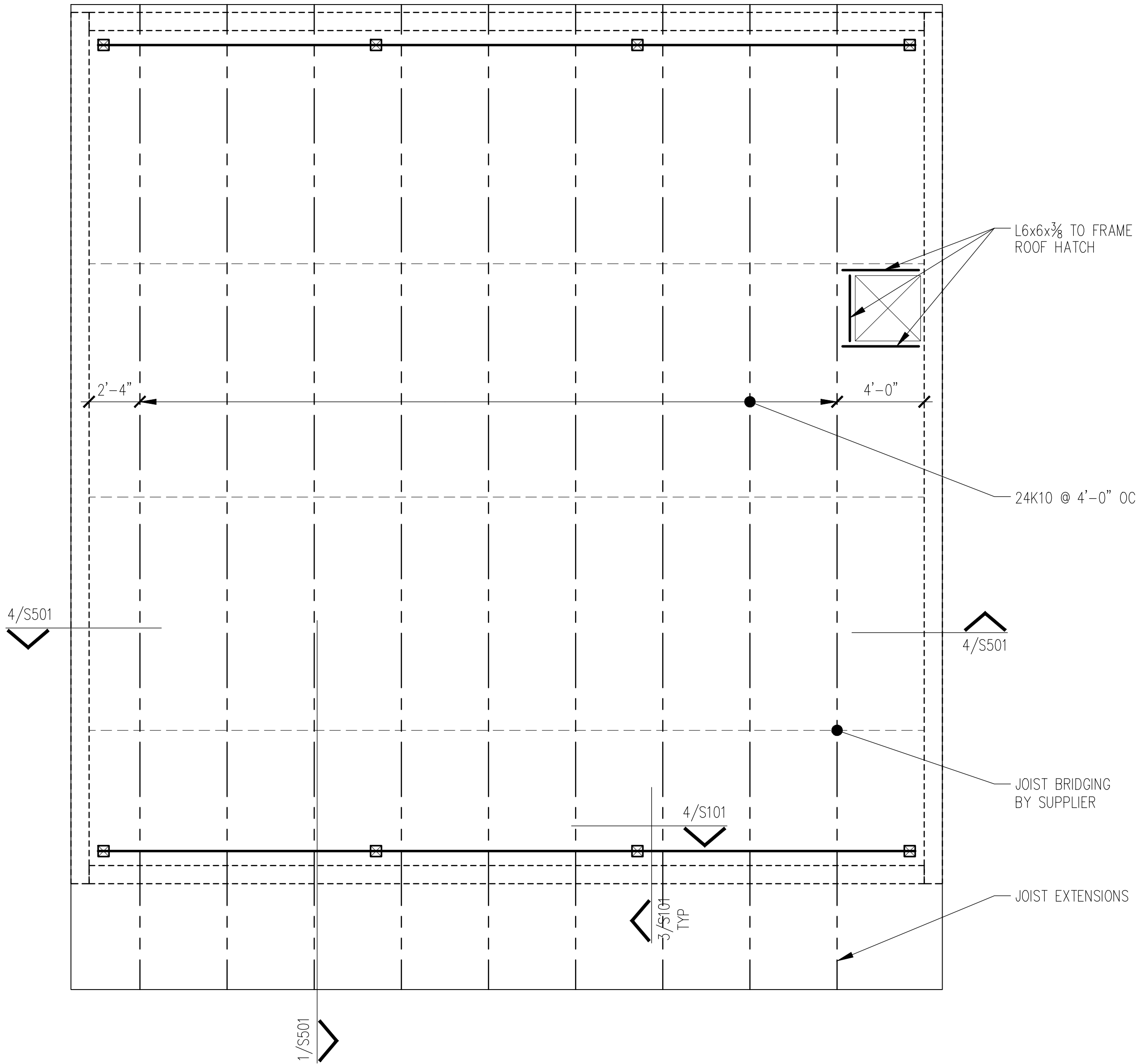
**RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO**



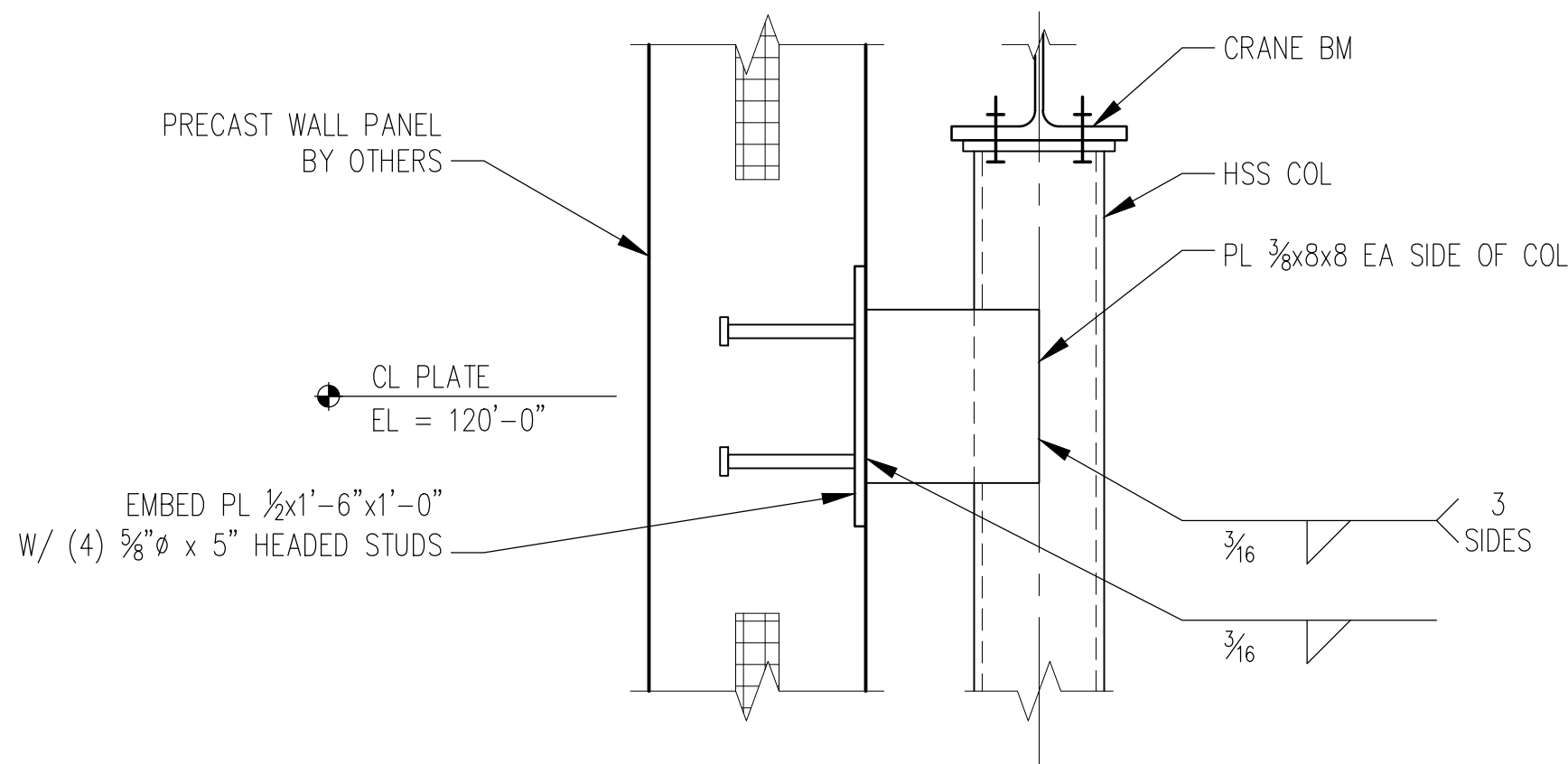
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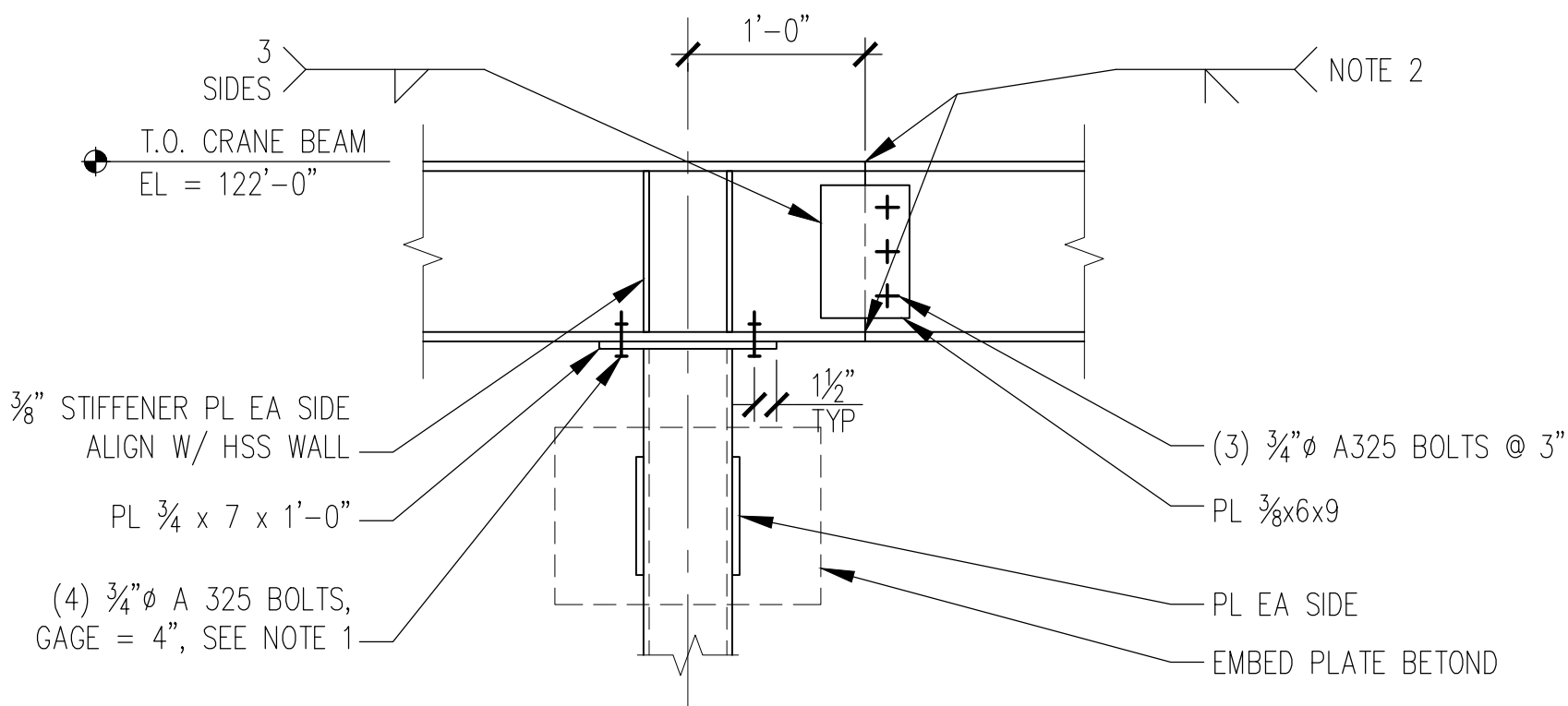
1 FLOOR LEVEL PLAN
1/4"=1'-0"



2 ROOF PLAN
1/4"=1'-0"



3 CRANE COL CONNECTION DETAIL
1/2"=1'-0"

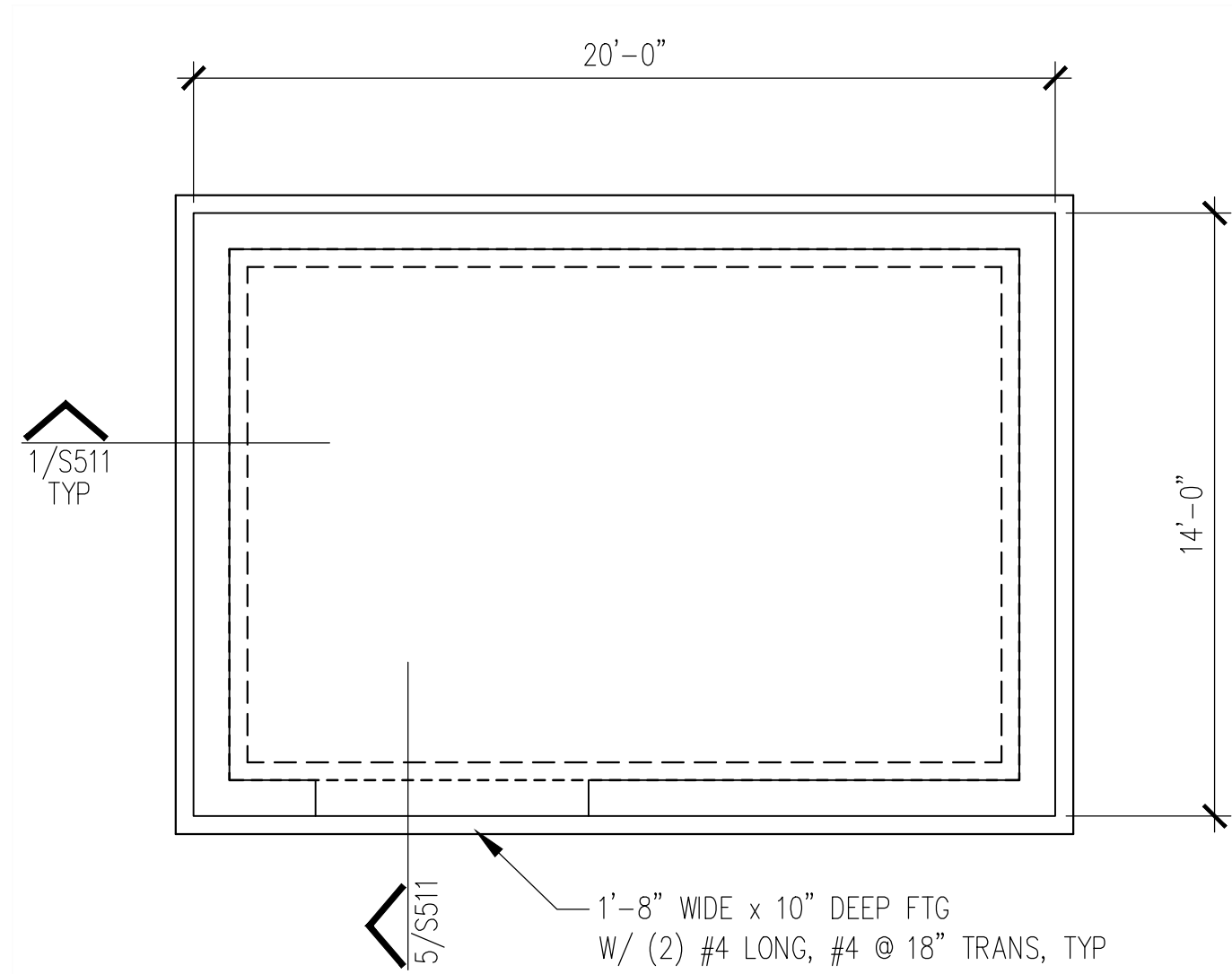


4 DETAIL- TOP OF CRANE COL
1"=1'-0"

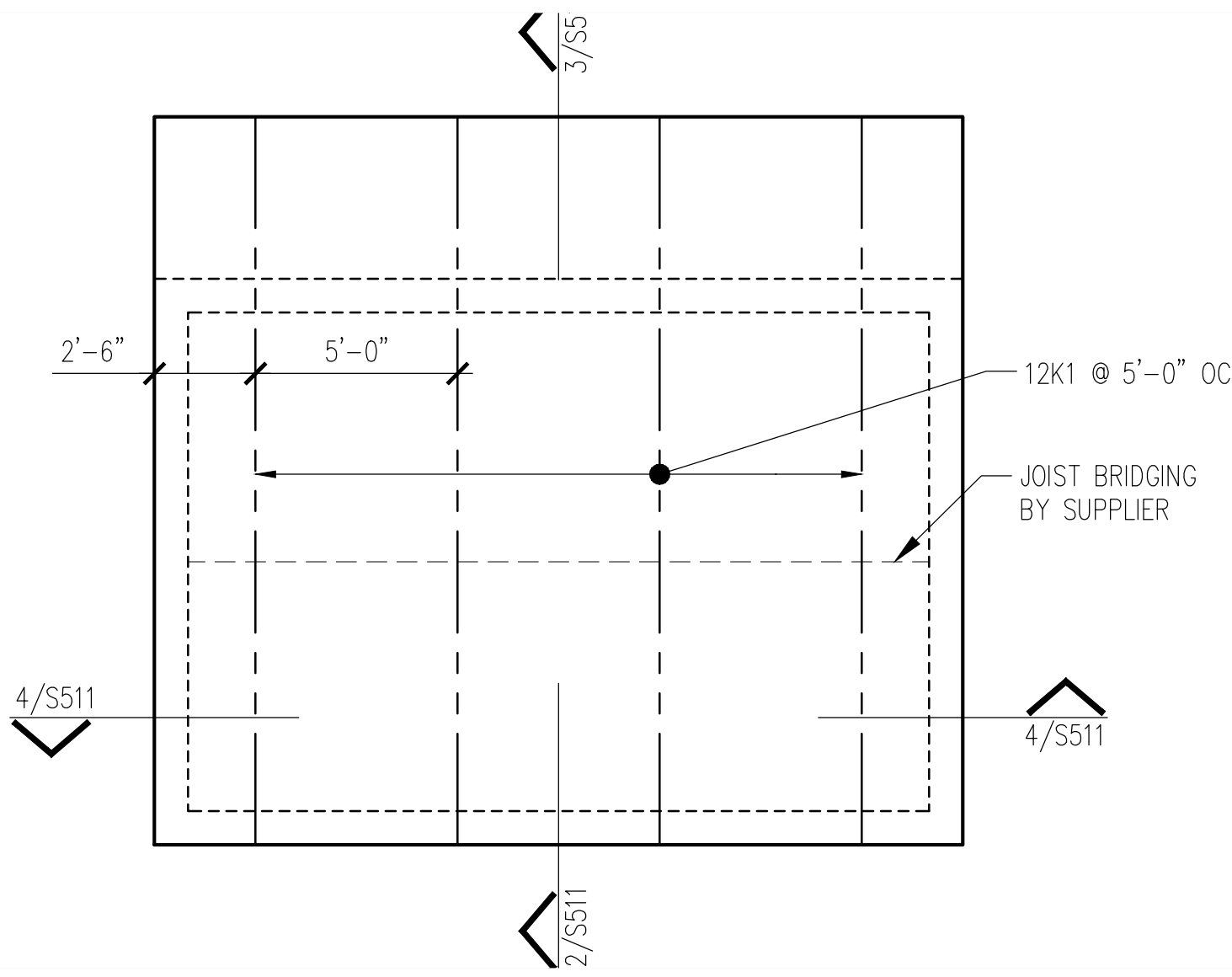
NOTES:

- PROJECT REFERENCE ELEVATION = 100'-0".
- TOP OF SLAB IS AT ELEVATION = 100'-0" UNLESS NOTED OTHERWISE.
- TOP OF FOOTING ELEVATION = 96'-10" UNLESS NOTED OTHERWISE.
- SLAB ON GRADE SHALL BE 6" THICK, REINFORCED WITH #4 @ 18" OC EA WAY.
- STRUCTURAL SLAB SHALL BE 8" THICK NORMAL WEIGHT CONCRETE OVER EXISTING STEEL BEAMS AND DIAMOND PLATE PLATFORM. REINFORCE SLAB WITH #5 @ 18" EW.
- REFERENCE TOP OF STRUCTURAL STEEL IS 6" BELOW REFERENCE FLOOR ELEVATION, UNLESS NOTED OTHERWISE.
- HEADED SHEAR STUDS SHALL BE 3/4" DIA x #" LONG AND CONFORM TO ASTM A108.
- CONCRETE FOOTING: SEE SCHEDULE.
- EXTERIOR WALL PANELS: 10" THICK CONCRETE SANDWICH PANELS.
- STEEL POST: HSS6x6x3/8.
- BRIDGE CRANE RAIL SUPPORT BEAM: W12x50.
- ROOF DECK SHALL BE 1 1/2" DEEP, 20 GAUGE, TYPE B METAL ROOF DECK.
- ROOF JOISTS SHALL BE DESIGNED AND HAVE BRIDGING FOR NET UPLIFT DUE TO WIND AS FOLLOWS:
TYPICAL ROOF JOISTS: 10psf
JOISTS AND EXTENSIONS AT OVERHANGS: 20psf

FOOTING SCHEDULE		
MARK	SIZE	REINFORCING
F1	2'-6" WIDE x 10" DEEP	(3) #4 LONG; #4 @ 18 TRANS
F2	3'-0" WIDE x 10" DEEP	(3) #4 LONG; #4 @ 18 TRANS
F3	4'-0" x 4'-0" x 12" DEEP	(4) #4 EA WAY, BOT



1 FLOOR LEVEL PLAN
1/4" = 1'-0"

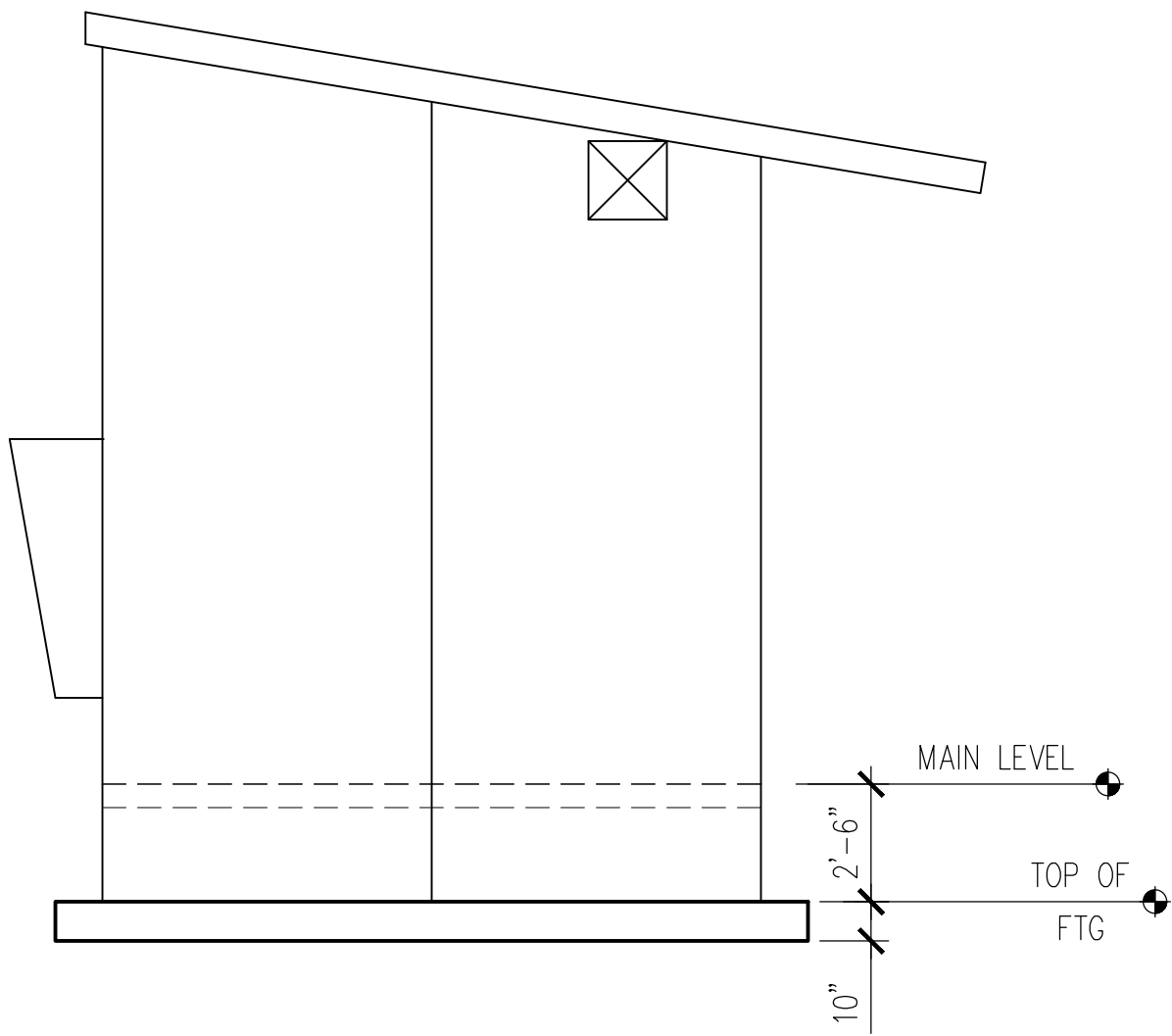
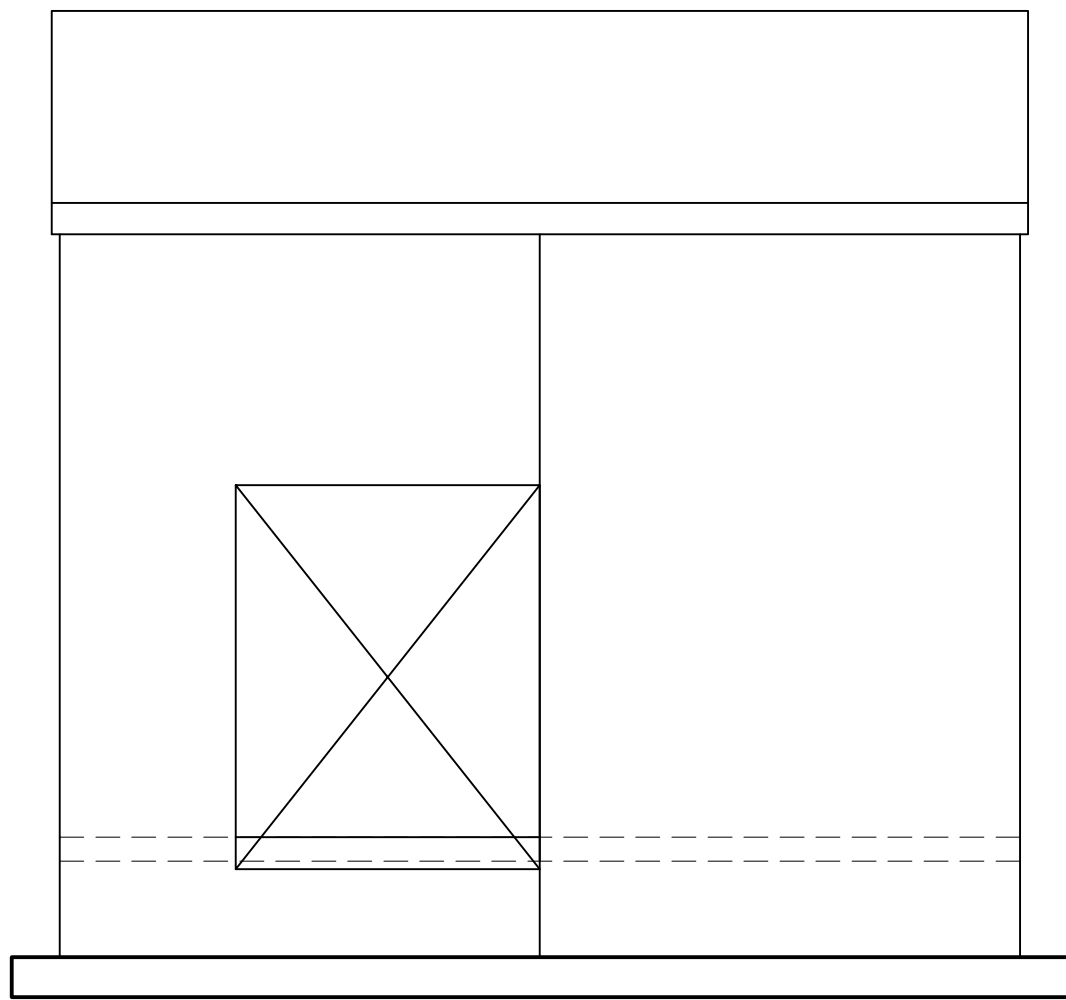
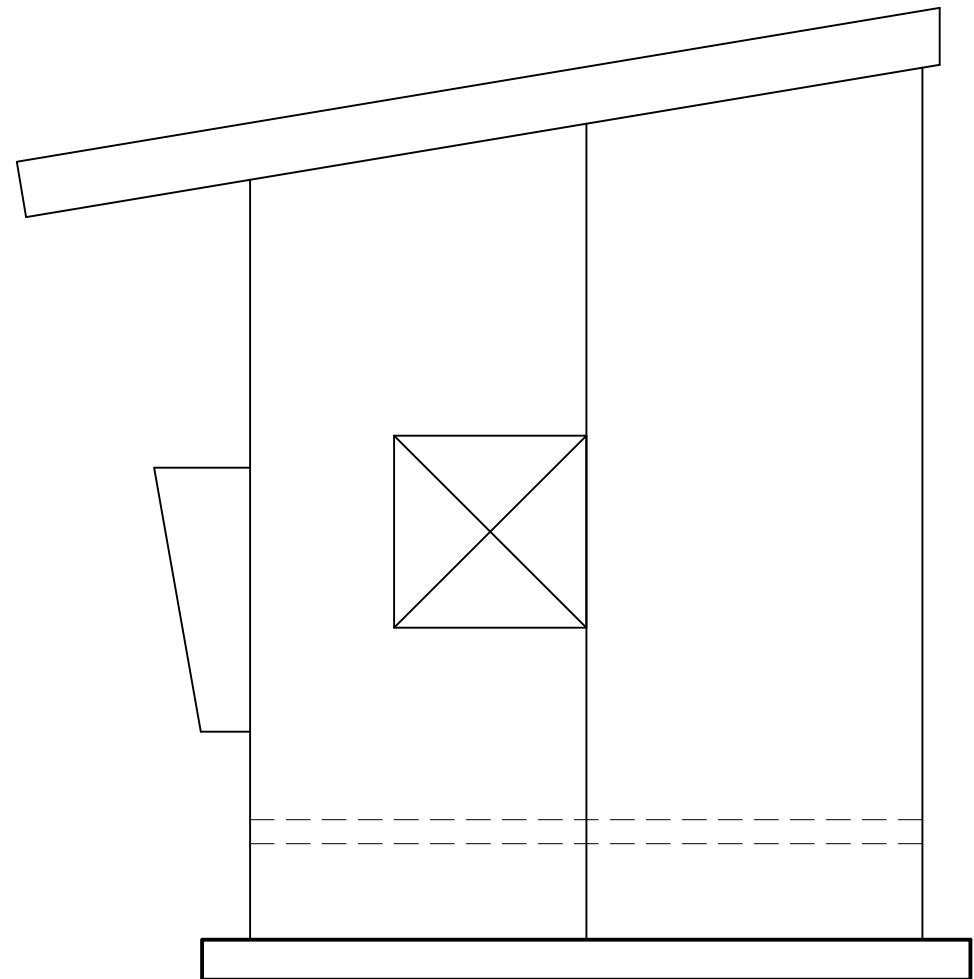
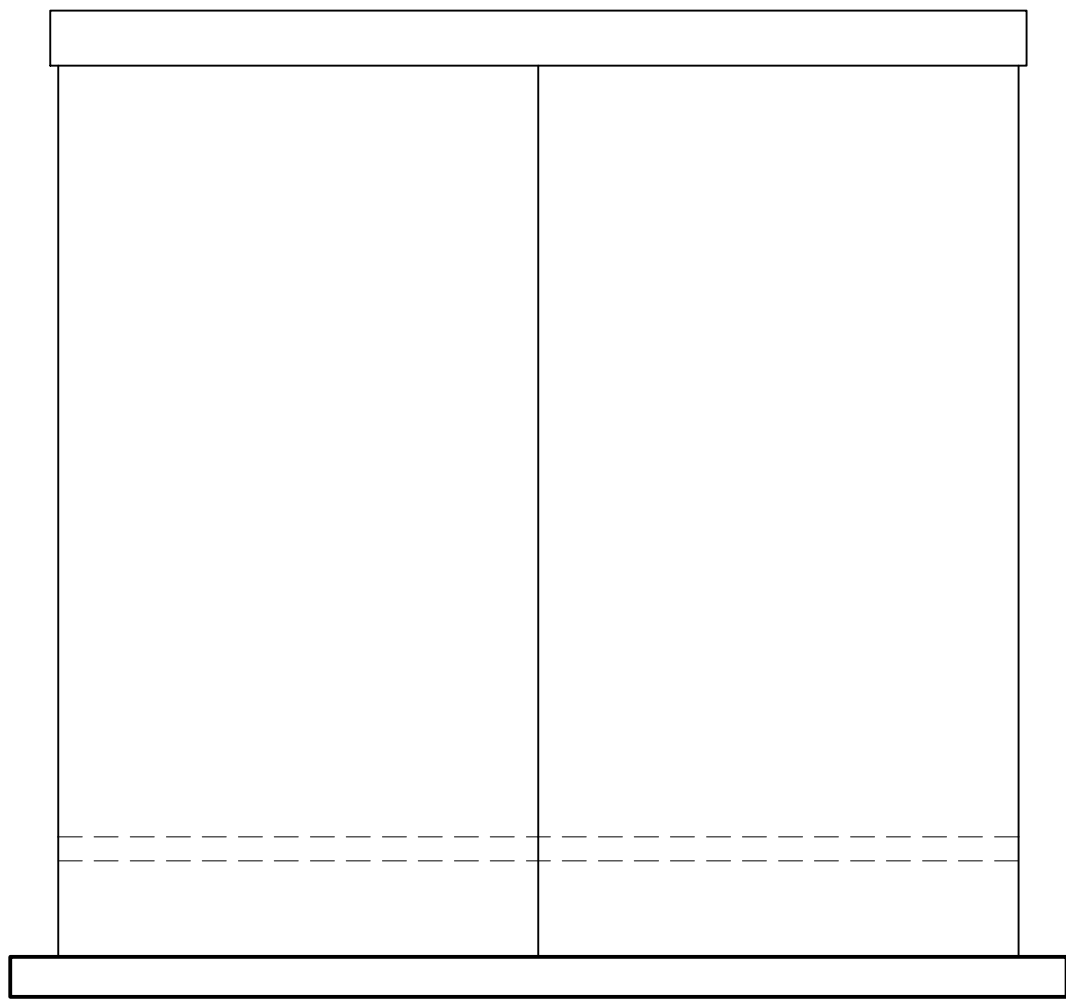


2 ROOF PLAN
1/4" = 1'-0"

NOTES:

- PROJECT REFERENCE ELEVATION = 100'-0".
- TOP OF SLAB IS AT ELEVATION = 100'-0" UNLESS NOTED OTHERWISE.
- TOP OF FOOTING ELEVATION = 96'-10" UNLESS NOTED OTHERWISE.
- SLAB ON GRADE SHALL BE 6" THICK, REINFORCED WITH #3 @ 18" OC EA WAY.
- EXTERIOR WALL PANELS: 10" THICK CONCRETE SANDWICH PANELS.
- ROOF DECK SHALL BE 1 1/2" DEEP, 20 GAUGE, TYPE B METAL ROOF DECK.
- ROOF JOISTS SHALL BE DESIGNED AND HAVE BRIDGING FOR NET UPLIFT DUE TO WIND AS FOLLOWS:

TYPICAL ROOF JOISTS:	5psf
ROOF JOISTS WITHIN 20' OF BUILDING EDGE:	10psf
JOISTS AND EXTENSIONS AT OVERHANGS:	20psf



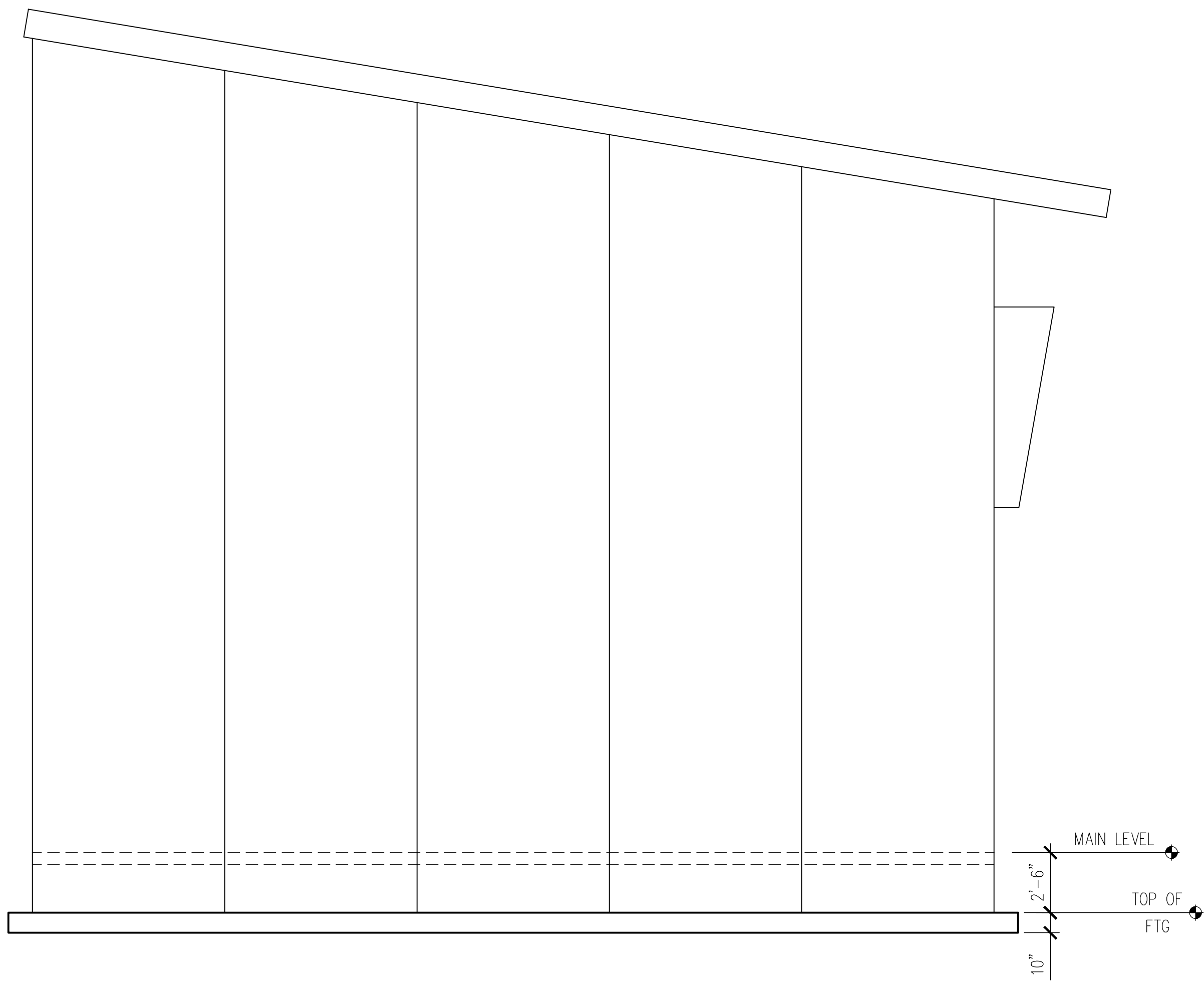
3 ELEVATIONS
1/4" = 1'-0"

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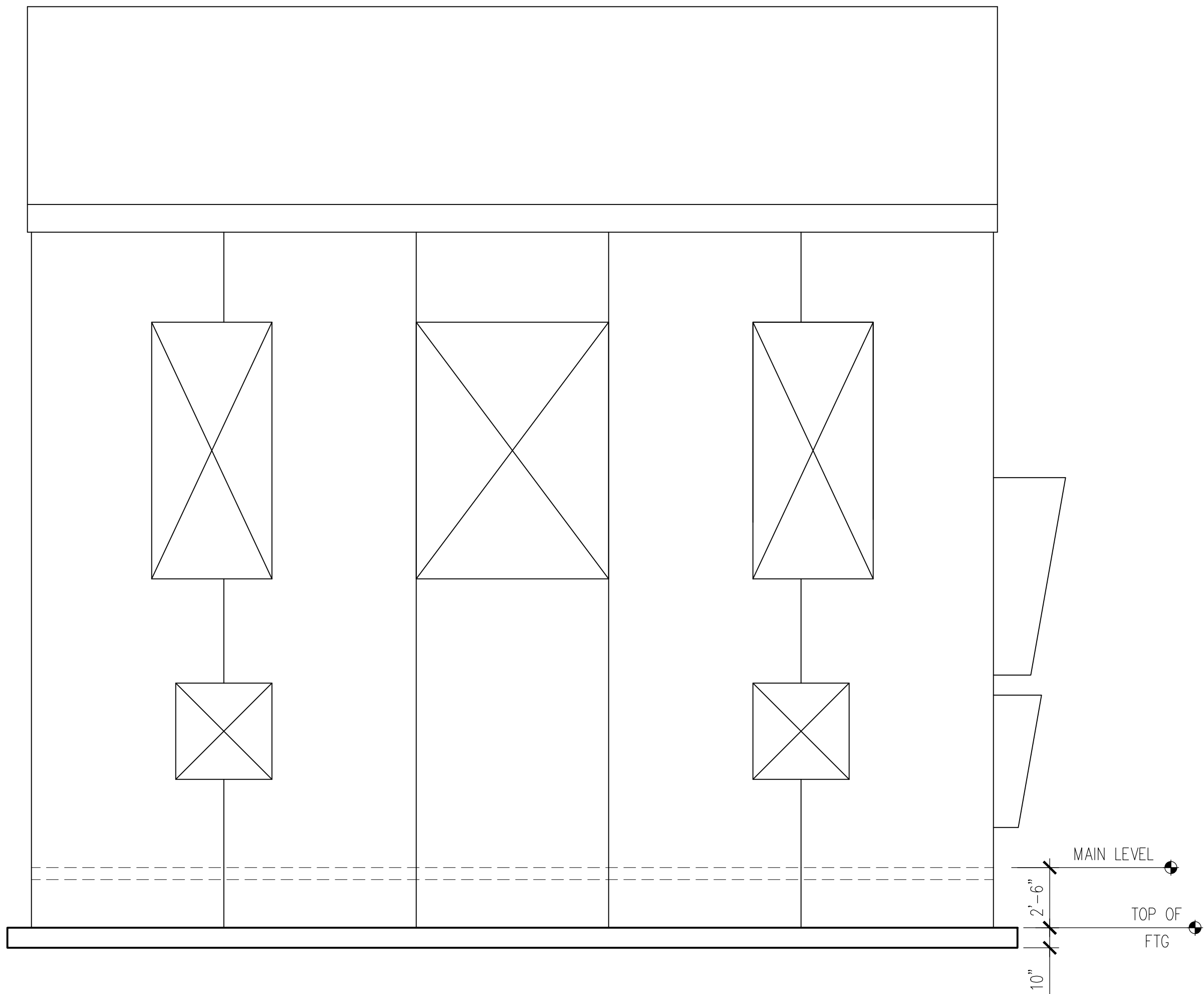
**BOOSTER BUILDING
FRAMING PLANS**
RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO



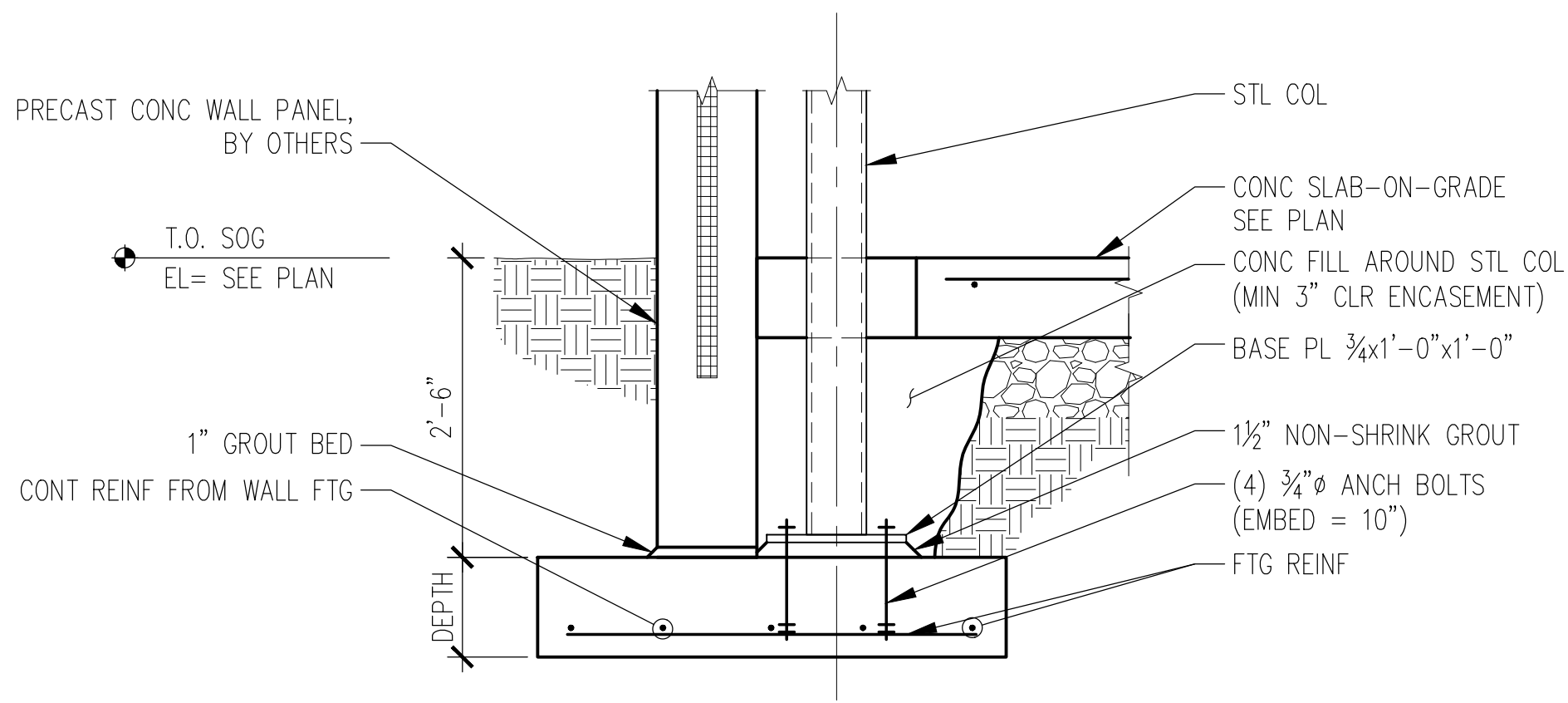
DESIGNED BY:	GEG
DRAWN BY:	CTH
APPROVED BY:	GEG
DESIGN PROJ:	14-124
DATE:	10/09/15
DRAWING NO:	S111
SHEET NO:	87 of 114



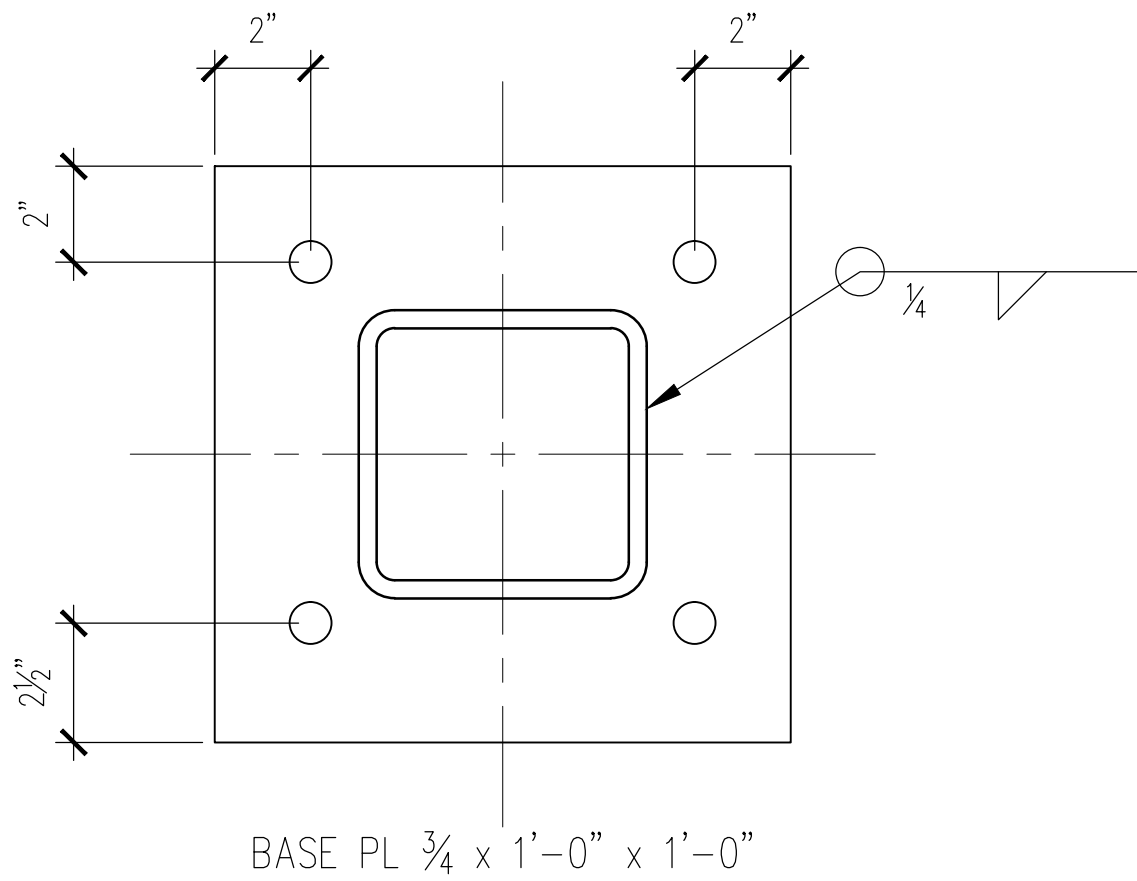
1 WEST ELEVATION
1/4"=1'-0"



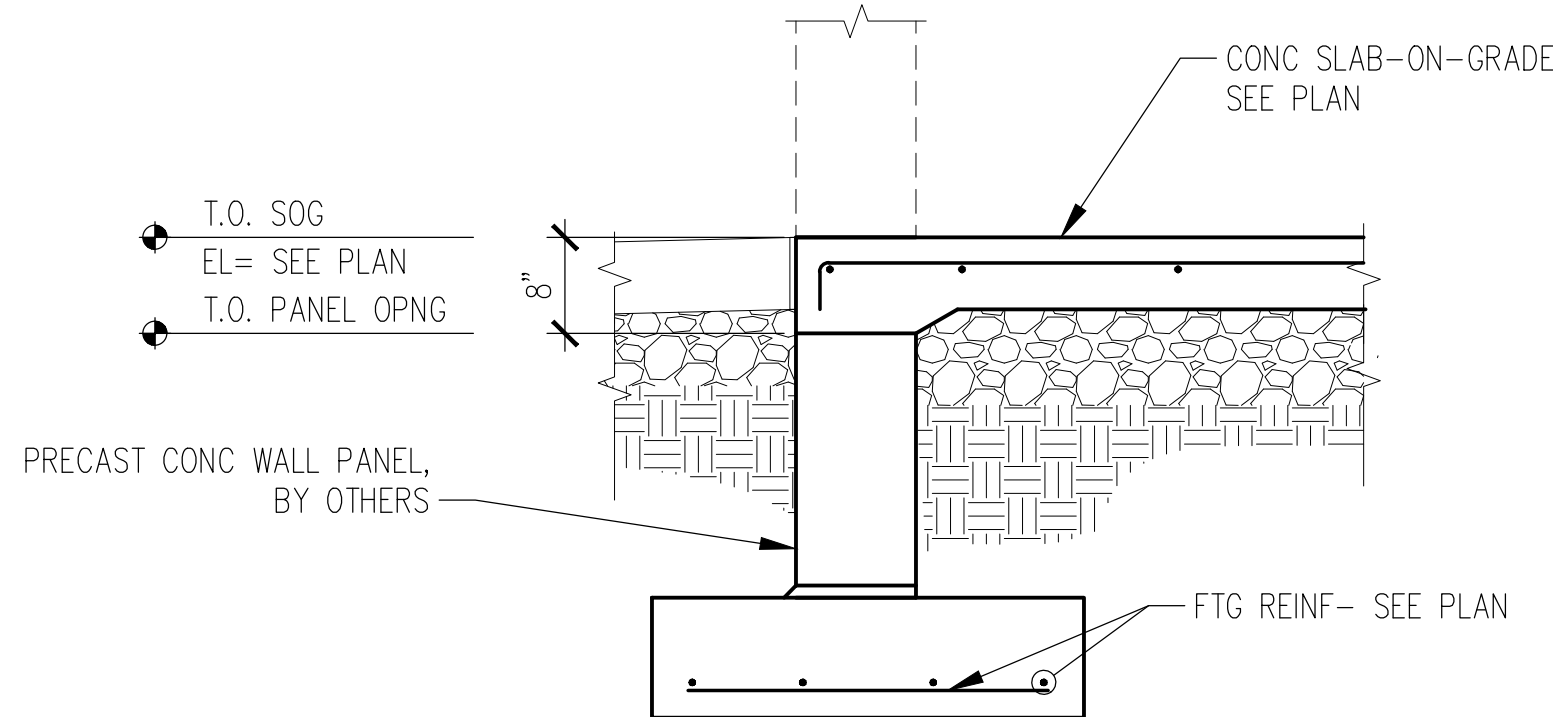
2 SOUTH ELEVATION
1/4"=1'-0"



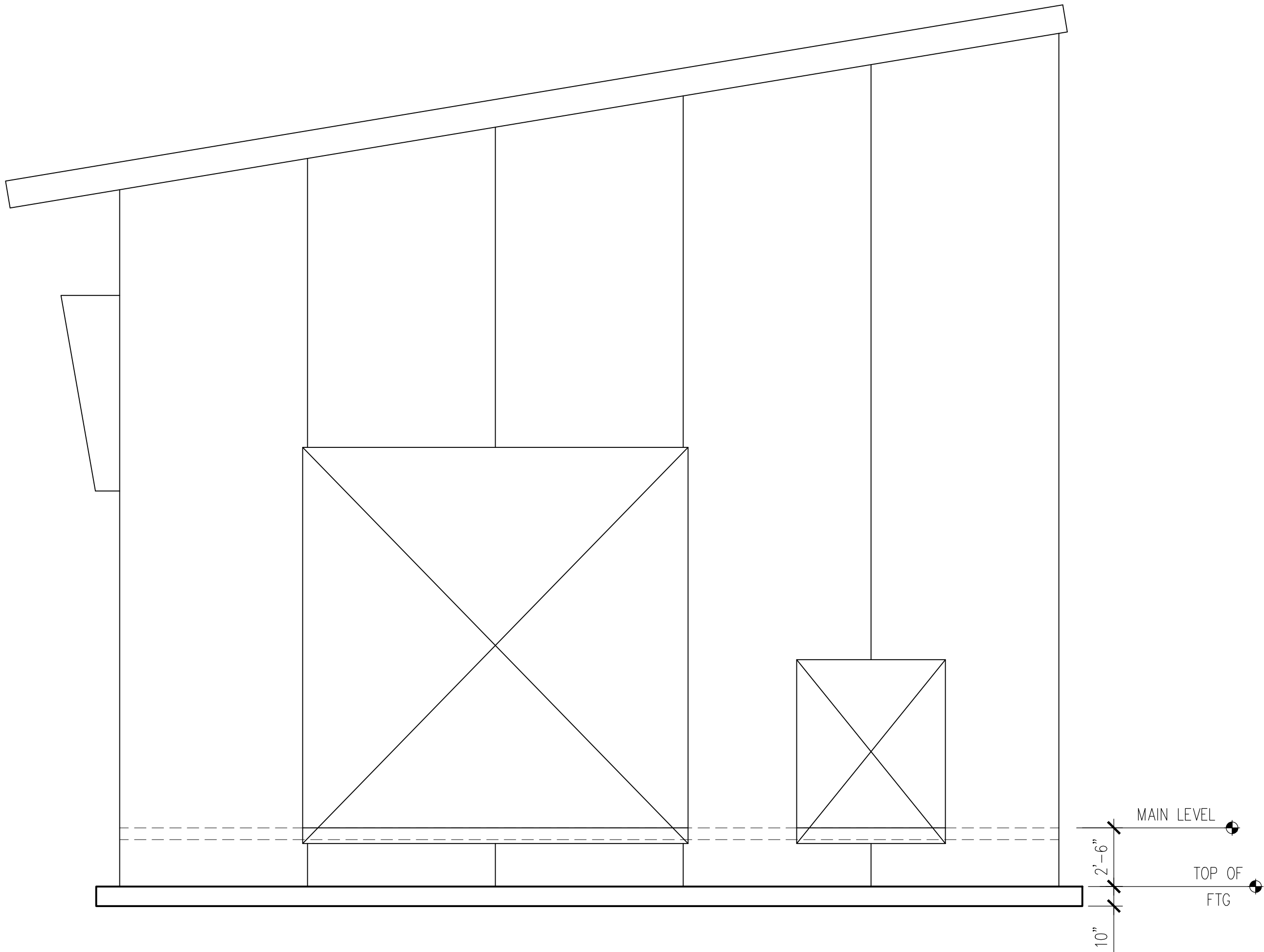
3 SECTION @ STEEL COL BASE
3/4"=1'-0"



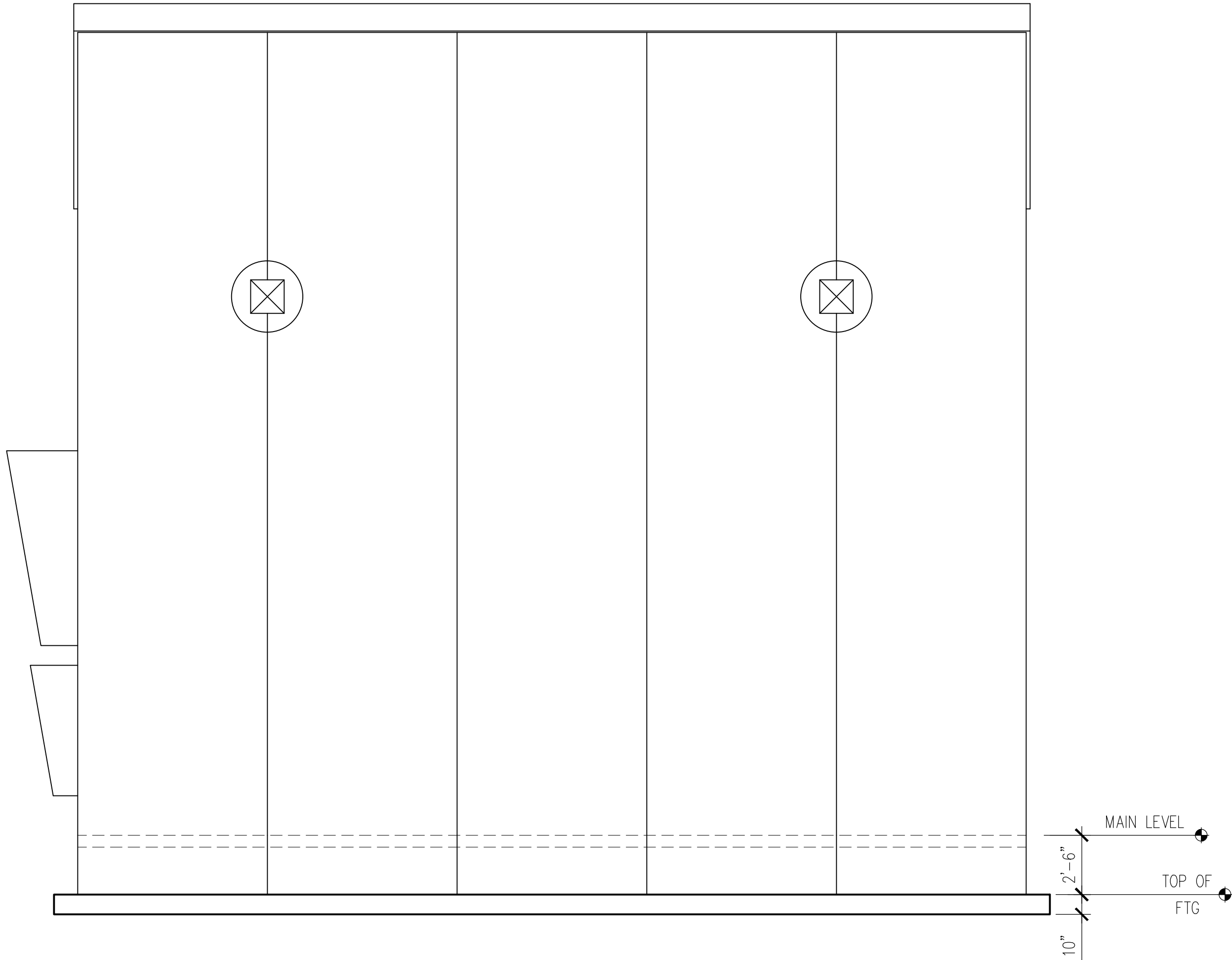
4 DETAIL - BASE PL 3/4x1'-0"x1'-0"
3"=1'-0"



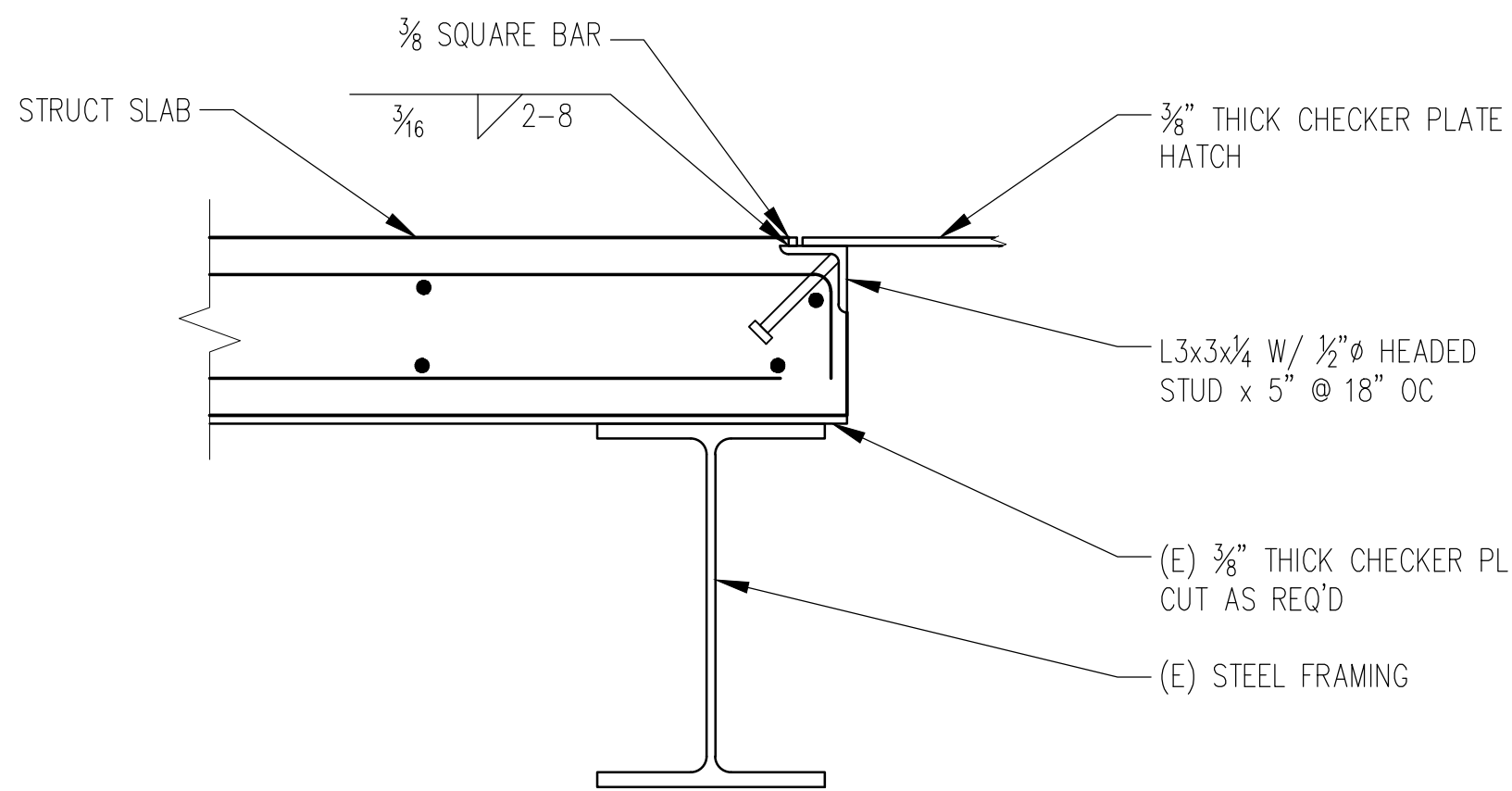
5 SECTION @ DOOR THRESHOLD
3/4"=1'-0"



1 EAST ELEVATION
1/4"=1'-0"



2 NORTH ELEVATION
1/4"=1'-0"



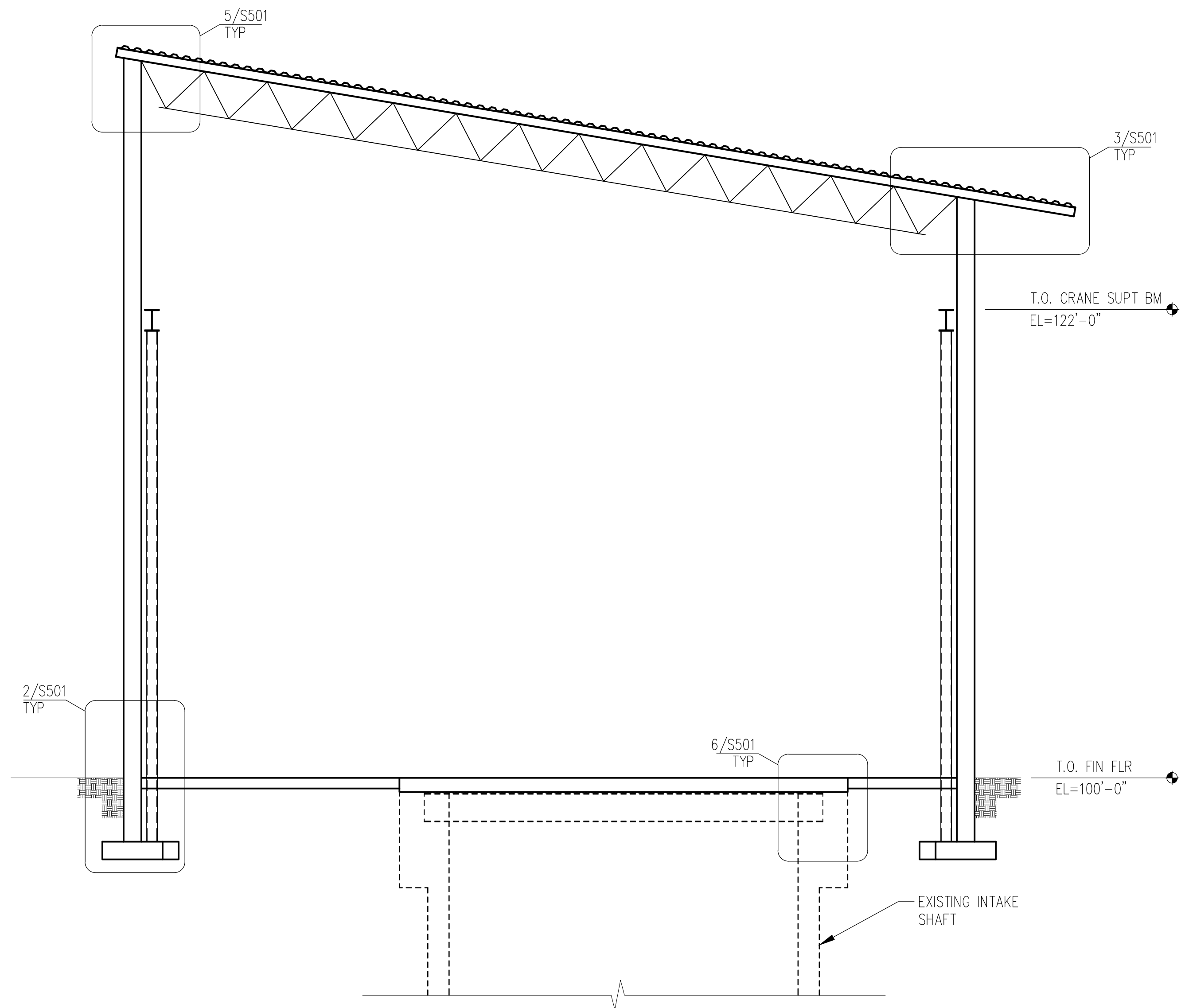
3 SECTION- SLAB HATCH
1 1/2"=1'-0"

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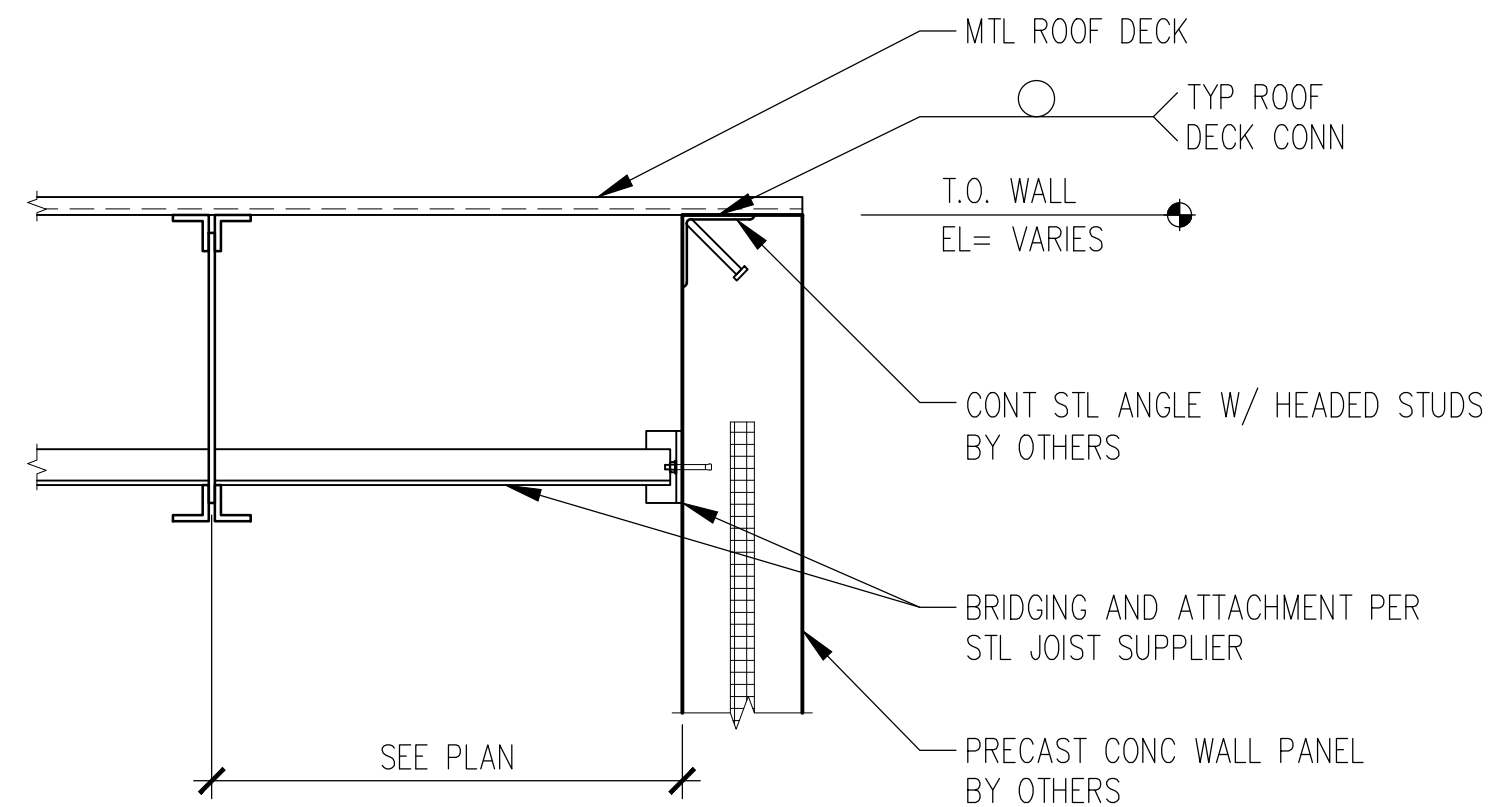
**INTAKE BUILDING
WALL ELEVATIONS**
RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO



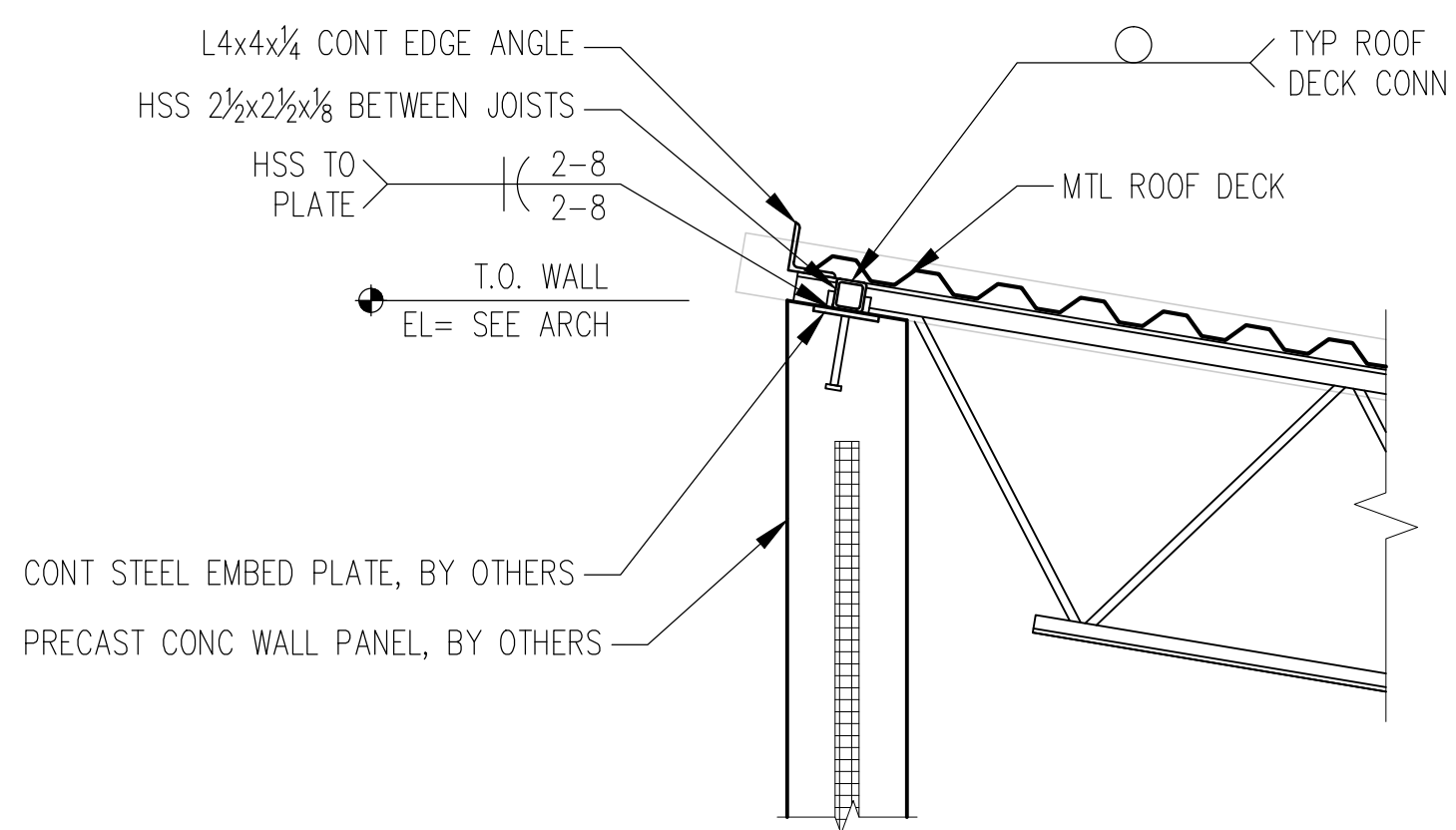
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DRAWN BY:	CTH
APPROVED BY:	GEG
DESIGN PROJ:	14-124
DATE:	10/09/15
DRAWING NO:	S202
SHEET NO:	89 of 114



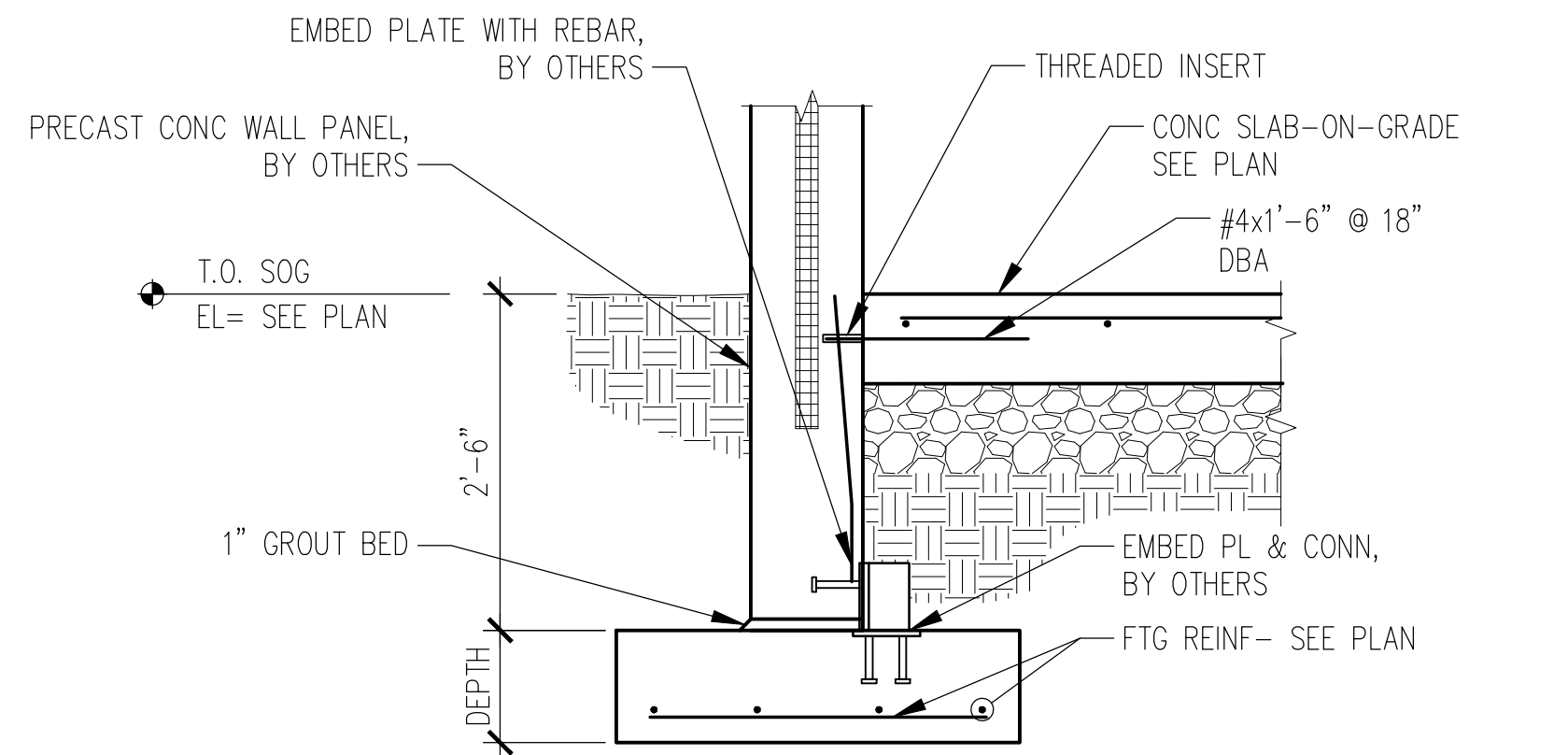
1 SECTION
 $\frac{1}{4}"=1'-0"$



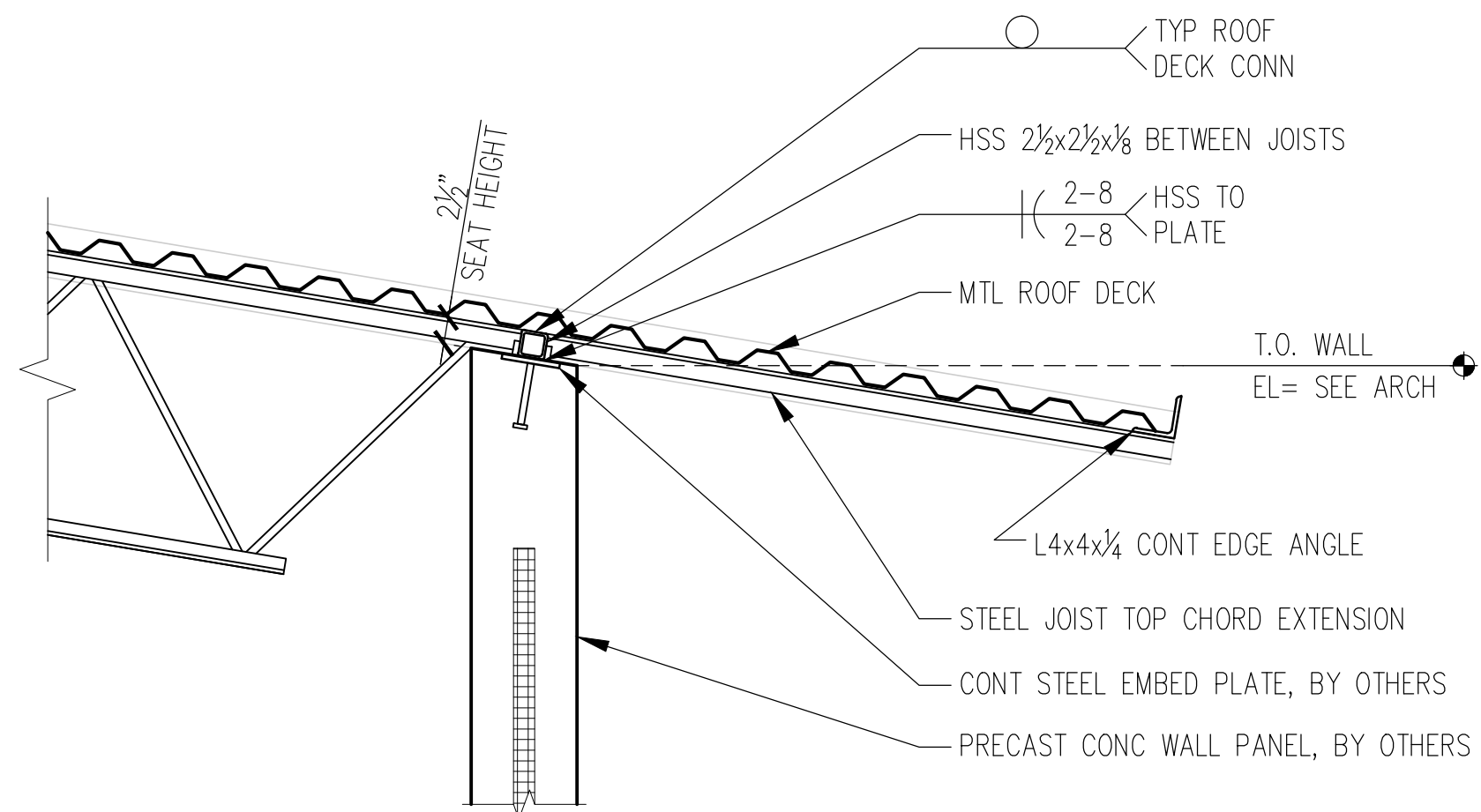
4 TYPICAL END WALL SECTION
 $\frac{3}{4}"=1'-0"$



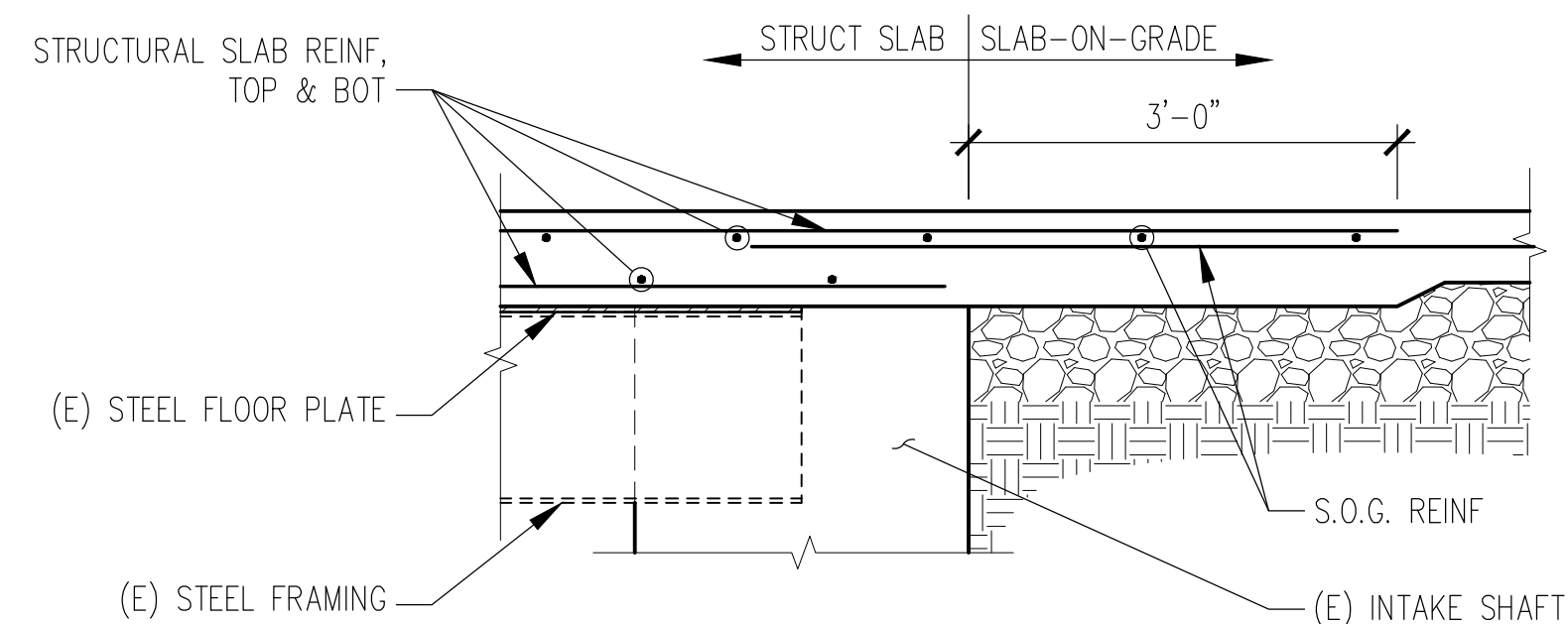
5 TYPICAL WALL SECTION
 $\frac{3}{4}"=1'-0"$



2 TYPICAL FOUNDATION SECTION
 $\frac{3}{4}"=1'-0"$



3 TYPICAL EAVE SECTION
 $\frac{3}{4}"=1'-0"$

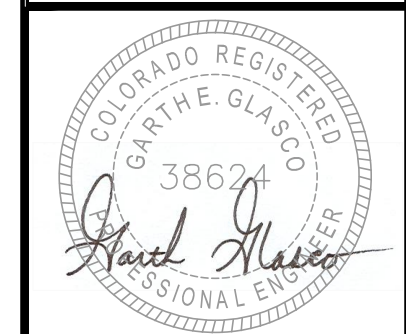


6 DETAIL
 $\frac{3}{4}"=1'-0"$

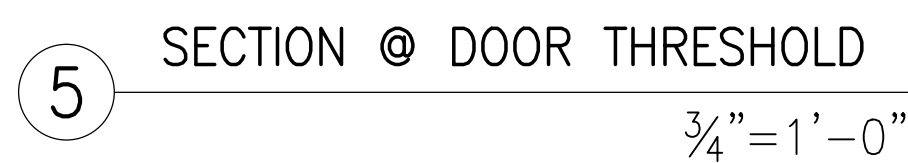
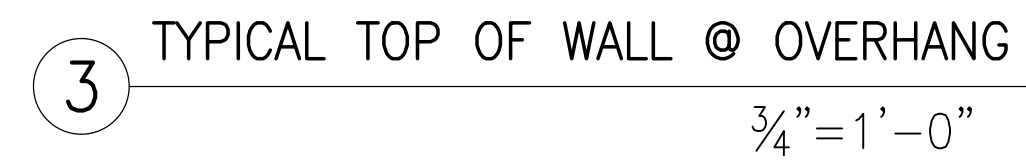
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**INTAKE BUILDING
SECTIONS AND DETAILS**

RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO



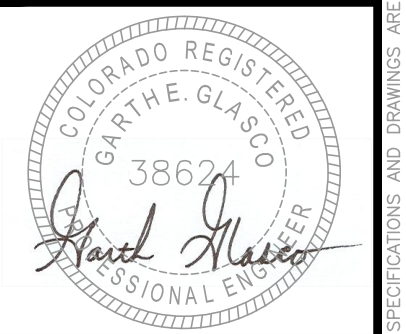
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DRAWN BY:	CTH
APPROVED BY:	GEG
DESIGN PROJ:	14-124
DATE:	10/09/15
DRAWING NO:	S501
SHEET NO:	90 of 114



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BOOSTER BUILDING SECTIONS AND DETAILS

RAW WATER PROJECT LA PLATA WEST WATER AUTHORITY LA PLATA COUNTY, COLORADO



DESIGNED:	GEG
DRAWN BY:	CTH
APPROVED BY:	GEG
DESIGN PROJ:	14-124
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	AS NOTED
DATE:	10/09/15
DRAWING NO:	S511
SHEET NO:	91 of 114

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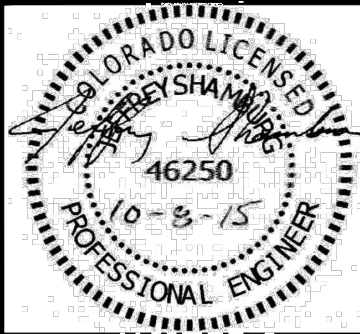
GENERAL NOTES

1. FLOORS, WALLS, DOORS, AND WINDOWS SHOWN IN PROCESS DRAWINGS ARE FOR REFERENCE ONLY. REFER TO STRUCTURAL DRAWINGS FOR SPECIFIC LOCATION.
2. DIMENSIONS AND ELEVATIONS ARE FOR BIDDING PURPOSES. CONTRACTOR IS RESPONSIBLE FOR FIELD VERIFICATIONS OF DIMENSIONS AND ELEVATIONS PRIOR TO CONSTRUCTION.
3. NOT ALL PIPE SUPPORTS, HANGERS, TAPS, AND EQUIPMENT ARE SHOWN ON THE DRAWINGS. CONTRACTOR SHALL COORDINATE LOCATION AND MODIFY IN ACCORDANCE WITH SPECIFICATIONS AND DETAILS.
4. CONTRACTOR TO COORDINATE PIPE SUPPORT LAYOUT, SPACING, AND TYPE TO MINIMIZE INTERFERENCES.
5. CONTRACTOR IS RESPONSIBLE TO PROVIDE THRUST BLOCKS, ANCHORS, RESTRAINTS, AND ADJUSTABLE SUPPORTS AS REQUIRED OR DIRECTED BY ENGINEER.
6. ALL ELECTRICAL CONNECTIONS ARE BY ELECTRICAL CONTRACTOR.
7. BURIED PIPE SHALL BE DUCTILE IRON UNLESS INDICATED OTHERWISE ON THE DRAWINGS
8. PIPE, FITTINGS, VALVES, EQUIPMENT, ETC. TAGS & LABELS ARE PROVIDED AS A COURTESY FOR THE CONTRACTOR. IT IS NOT THE INTENT OF THESE CALL OUTS, LABELS, AND TAGS TO BE A MATERIAL LIST. CONTRACTOR SHALL BE RESPONSIBLE FOR ALL ITEMS.
9. CONTRACTOR SHALL TEST ALL PIPES PLACED BENEATH CONCRETE SLAB/BASINS. TEST SHALL BE WITNESSED BY OWNER'S REPRESENTATIVE. SEE SPECIFICATIONS SECTION 400522 FOR LEAK TEST AND PRESSURE TEST REQUIREMENTS.
10. PROVIDE FLOOR MOUNTED UNI-STRUT SUPPORT SYSTEM FOR COMBINATION AIR VALVE DRAIN AND VENT PIPING.

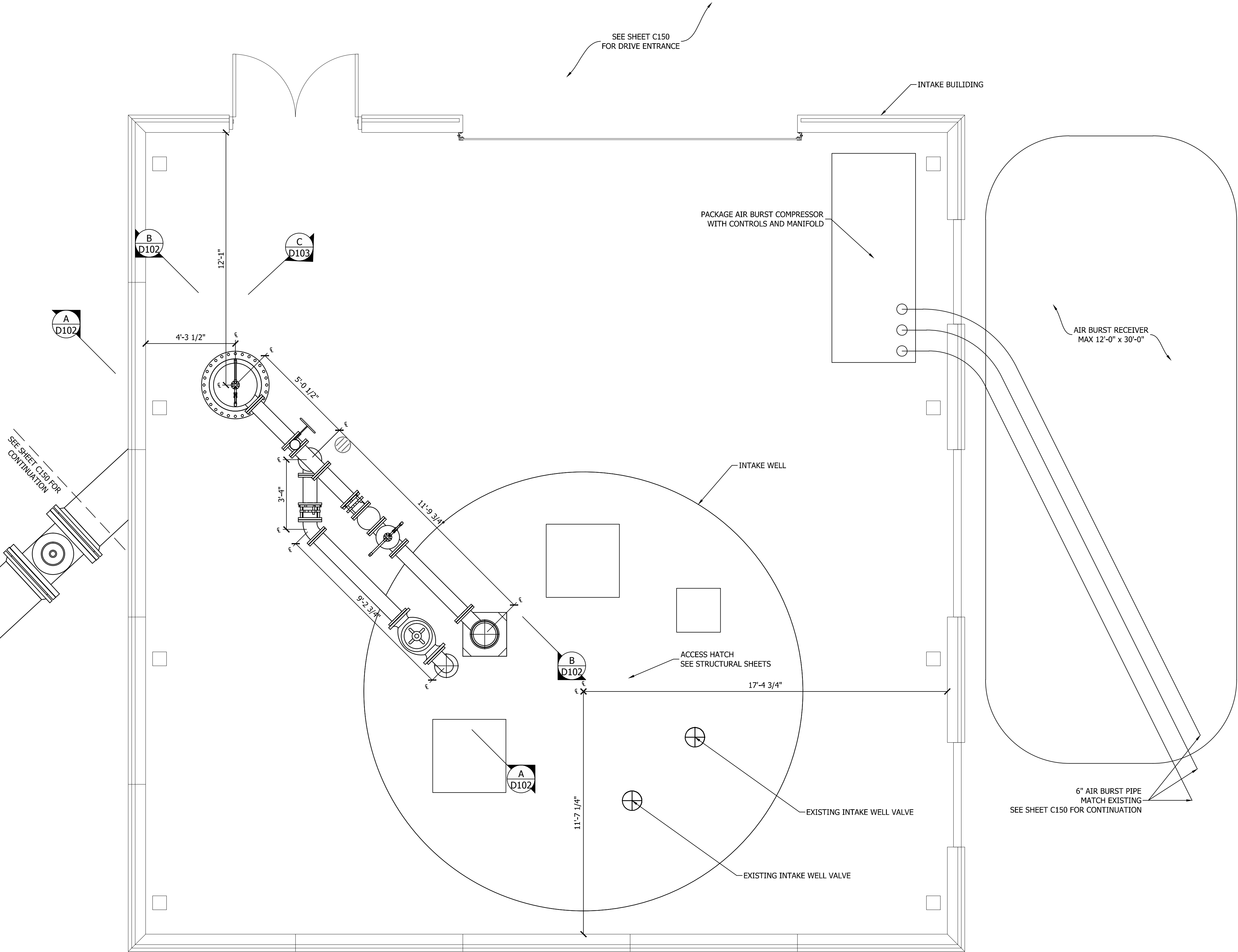
BARTLETT & WEST

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**INTAKE
PROCESS LAYOUT**
RAW WATER PROJECT
LA PLATA WATER AUTHORITY
LA PLATA COUNTY, COLORADO



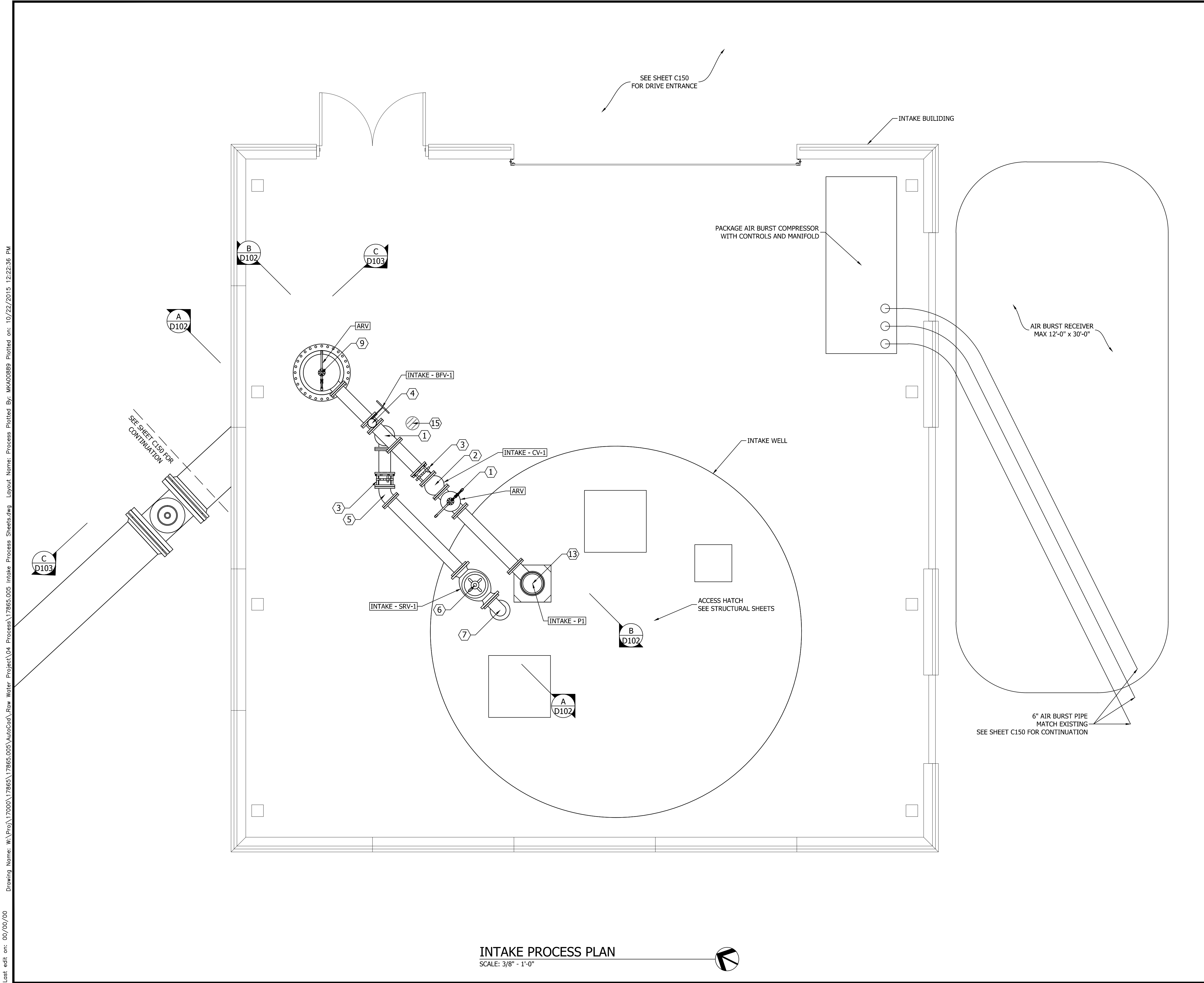
DESIGNED BY:	KJB
DRAWN BY:	MKA
APPROVED BY:	JAS
DESIGN PROJ:	17865.005
CONST PROJ:	----
SCALE:	AS NOTED
DATE:	OCT 2015
DRAWING NO:	D100
SHEET NO:	92 of 114



INTAKE PROCESS LAYOUT
SCALE: 3/8" = 1'-0"

Drawing Name: W:\Proj\17000\17865\17865.005\AutoCad\Raw Water Project\04 Process\17865.005 Intake Process Sheets.dwg Layout Name: Process Plotted By: MKA00899 Plotted on: 10/22/2015 12:22:36 PM Last edit on: 00/00/00

BAR IS ONE INCH ON OFFICIAL DRAWINGS. 0 1" IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.



GENERAL NOTES:

1. SEE SHEET D100 FOR PROCESS GENERAL NOTES
2. ENCASE ALL BURIED PIPE UNDER SLAB UNTIL 5'-0" BEYOND BUILDING PERIMETER.

EQUIPMENT LABELS:

INTAKE PUMP
8" FL BFV VALVE
8" FL SURGE RELIEF VALVE
8" FL CHECK VALVE

INTAKE - P1
INTAKE - BFV-1
INTAKE - SRV-1
INTAKE - CV-1

REFERENCE NOTES:

① 8"x8"x8" DI FL TEE
② 8" DI FL CHECK VALVE
③ 8" DI FL DISMANTLING JOINT
④ 8" DI FL BUTTERFLY VALVE
⑤ 8" DI FL 45° BEND
⑥ 8" DI FL SURGE PROTECTOR
⑦ 8" DI FL 90° BEND
⑧ 18" DI BLIND FLANGE
⑨ 18"x18"x8" DI FL REDUCING TEE
⑩ 30"x18" DI FL REDUCER
⑪ 30" DI RJ 90° BEND
⑫ 30" DI FL x PE PIPE
⑬ INTAKE PUMP 1
⑭ 8" DI BLIND FLANGE
⑮ ROUTE ALL ARVs TO FLOOR DRAIN, SEE SHEET M200

INTAKE
PROCESS PLAN

RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO

DESIGNED BY: KJB
DRAWN BY: MKA
APPROVED BY: JAS
DESIGN PROJ: 17865.005
CONST PROJ: ----
SCALE: AS NOTED
DATE: OCT 2015
DRAWING NO: D101
SHEET NO: 93 of 114

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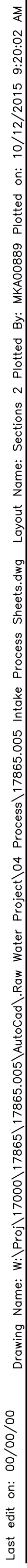
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DESIGNED BY:	KJB
DRAWN BY:	MKA
APPROVED BY:	JAS
DESIGN PROJ:	17865.005
CONST PROJ:	*****
SCALE:	AS NOTED
DATE:	OCT 2015
DRAWING NO:	D102
SHEET NO:	

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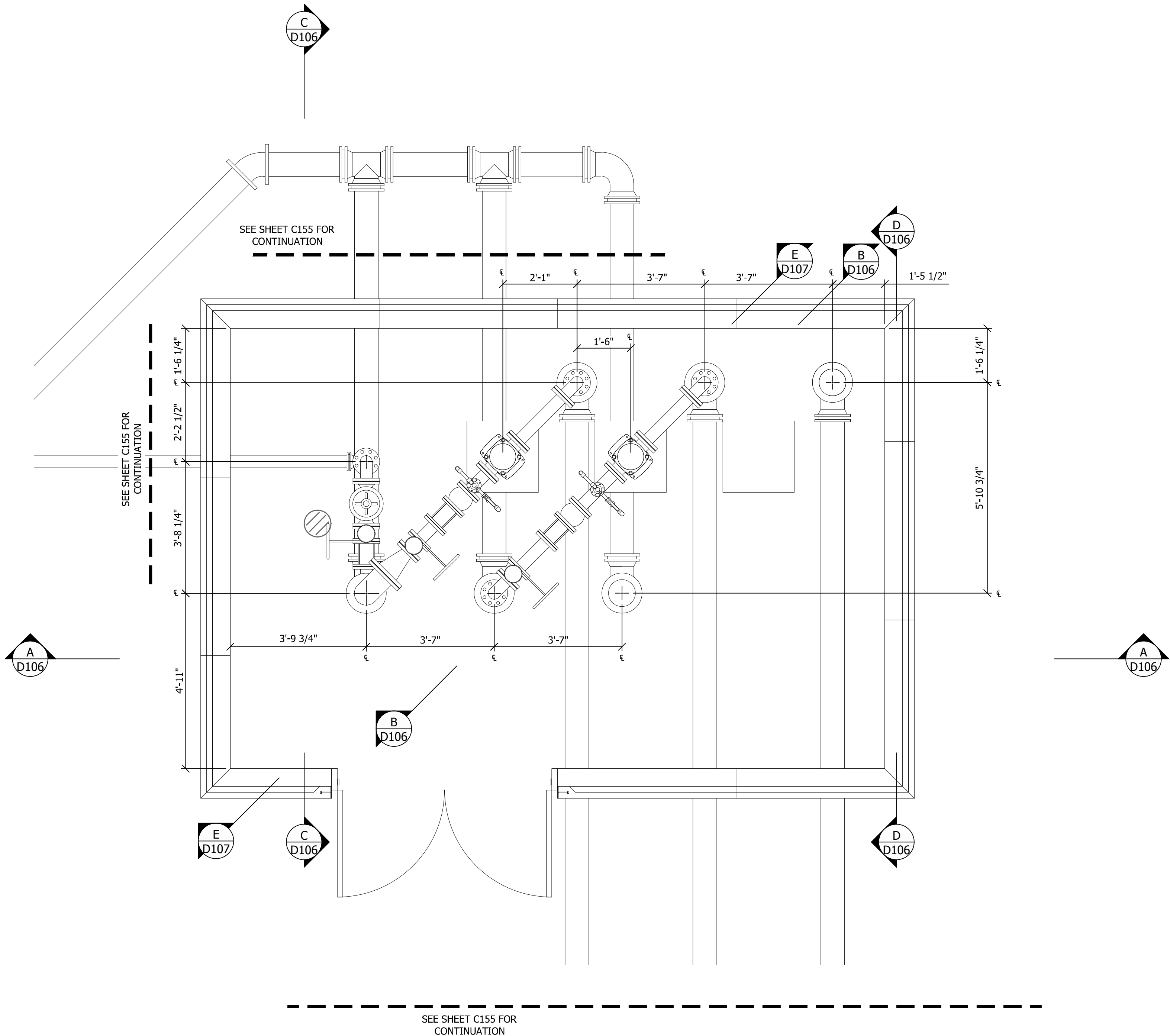


95 of 114

95 of 114

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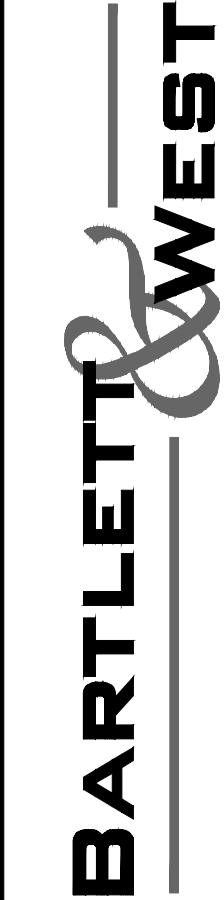
BAR IS ONE INCH ON OFFICIAL DRAWINGS.
 0
 1"
 IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.



BOOSTER STATION PROCESS LAYOUT
 SCALE: 1/2" = 1'-0"

GENERAL NOTES

- FLOORS, WALLS, DOORS, AND WINDOWS SHOWN IN PROCESS DRAWINGS ARE FOR REFERENCE ONLY. REFER TO STRUCTURAL DRAWINGS FOR SPECIFIC LOCATION.
- DIMENSIONS AND ELEVATIONS ARE FOR BIDDING PURPOSES. CONTRACTOR IS RESPONSIBLE FOR FIELD VERIFICATIONS OF DIMENSIONS AND ELEVATIONS PRIOR TO CONSTRUCTION.
- NOT ALL PIPE SUPPORTS, HANGERS, TAPS, AND EQUIPMENT ARE SHOWN ON THE DRAWINGS. CONTRACTOR SHALL COORDINATE LOCATION AND MODIFY IN ACCORDANCE WITH SPECIFICATIONS AND DETAILS.
- CONTRACTOR TO COORDINATE PIPE SUPPORT LAYOUT, SPACING, AND TYPE TO MINIMIZE INTERFERENCES.
- CONTRACTOR IS RESPONSIBLE TO PROVIDE THRUST BLOCKS, ANCHORS, RESTRAINTS, AND ADJUSTABLE SUPPORTS AS REQUIRED OR DIRECTED BY ENGINEER.
- ALL ELECTRICAL CONNECTIONS ARE BY ELECTRICAL CONTRACTOR.
- BURIED PIPE SHALL BE DUCTILE IRON UNLESS INDICATED OTHERWISE ON THE DRAWINGS
- PIPE, FITTINGS, VALVES, EQUIPMENT, ETC. TAGS & LABELS ARE PROVIDED AS A COURTESY FOR THE CONTRACTOR. IT IS NOT THE INTENT OF THESE CALL OUTS, LABELS, AND TAGS TO BE A MATERIAL LIST. CONTRACTOR SHALL BE RESPONSIBLE FOR ALL ITEMS.
- CONTRACTOR SHALL TEST ALL PIPES PLACED BENEATH CONCRETE SLAB/BASINS. TEST SHALL BE WITNESSED BY OWNER'S REPRESENTATIVE. SEE SPECIFICATIONS SECTION 400522 FOR LEAK TEST AND PRESSURE TEST REQUIREMENTS.
- PROVIDE FLOOR MOUNTED UNI-STRUT SUPPORT SYSTEM FOR BALL CONTROL ELECTRICAL, OIL AND AIR SYSTEMS AND APPURTENANCES.
- PROVIDE FLOOR MOUNTED UNISTRUT SUPPORT SYSTEM FOR COMBINATION AIR VALVE DRAIN AND VENT PIPING.

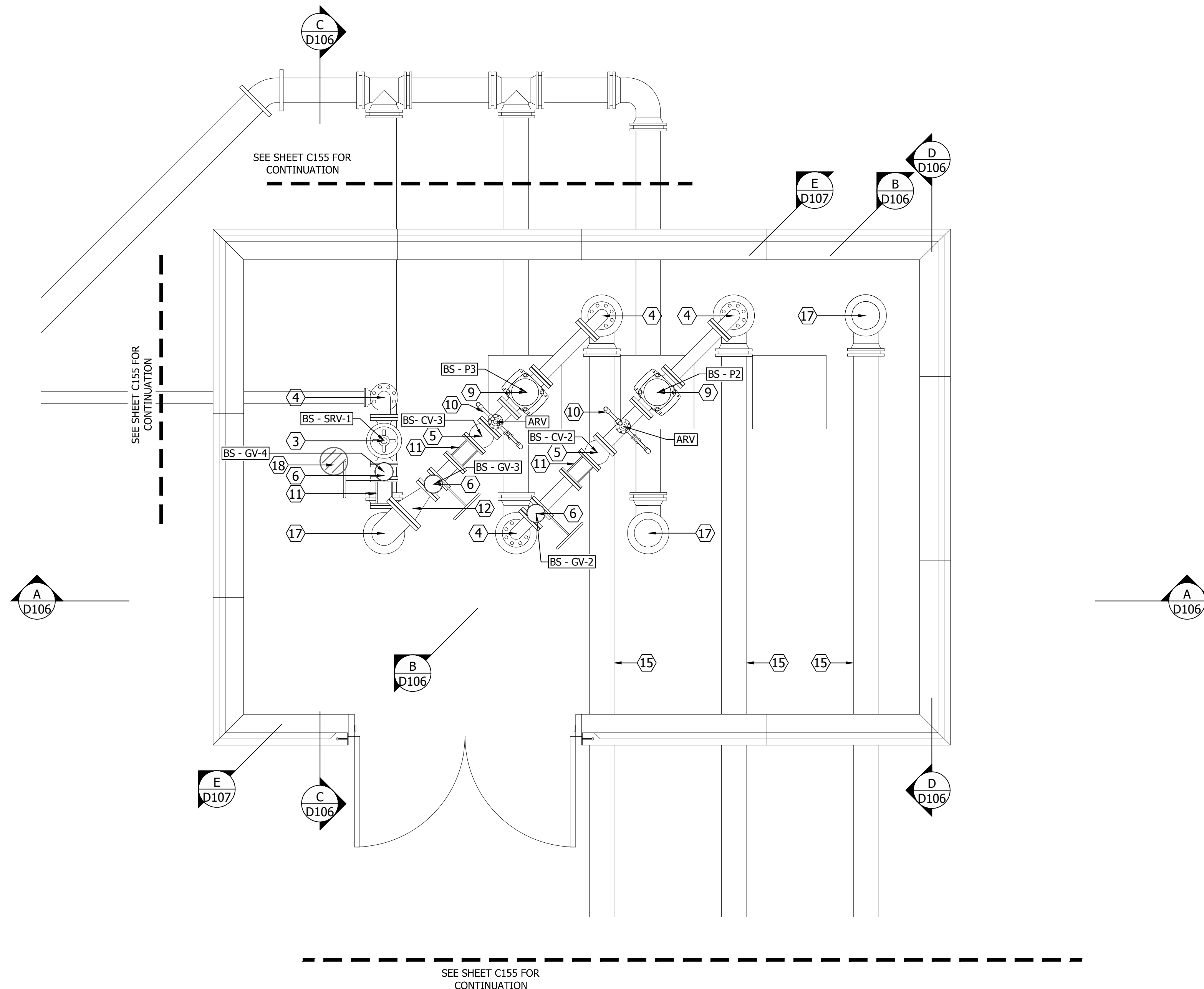


BOOSTER STATION
 PROCESS LAYOUT
 RAW WATER PROJECT
 LA PLATA WEST WATER AUTHORITY
 LA PLATA COUNTY, COLORADO



DESIGNED BY:	KJB
DRAWN BY:	MKA
APPROVED BY:	JAS
DESIGN PROJ:	17865.005
CONST PROJ:	----
SCALE:	AS NOTED
DATE:	OCT 2015
DRAWING NO:	D104
SHEET NO:	96 of 114

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BOOSTER STATION PROCESS PLAN

SCALE: 1/2" - 1'-0"



GENERAL NOTES:

1. SEE SHEET D104 FOR PROCESS GENERAL NOTES
2. ENCASE ALL BURIED PIPE UNDER SLAB UNTIL 5'-0" BEYOND BUILDING PERIMETER.

EQUIPMENT LABELS:

BOOSTER PUMP 1	BS - P1
BOOSTER PUMP 2	BS - P2
BOOSTER PUMP 3	BS - P3
4" FL GATE VALVE	BS - GV-1
4" FL GATE VALVE	BS - GV-2
4" FL GATE VALVE	BS - GV-3
4" FL GATE VALVE	BS - GV-4
4" FL SURGE RELIEF VALVE	BS - SRV-1
4" FL CHECK VALVE	BS - CV-1
4" FL CHECK VALVE	BS - CV-2
4" FL CHECK VALVE	BS - CV-3

REFERENCE NOTES:

- ① 4"x4"x4" DI FL TEE
- ② 4" DI FL GATE VALVE
- ③ 4" DI FL SURGE PROTECTOR
- ④ 4" DI FL 90° BEND
- ⑤ 4" DI FL CHECK VALVE
- ⑥ 4" DI FL BUTTERFLY VALVE
- ⑦ 8" DI RJ 90° BEND
- ⑧ 8"x8"x8" DI RJ TEE
- ⑨ 4" PUMP
- ⑩ 4" DI FL AIR RELIEF
- ⑪ 4" FI DL DISMANTLING JOINT
- ⑫ 8"x4" DI FL REDUCER
- ⑬ 8"x4" DI FL REDUCING TEE
- ⑭ 4" DI RJ 90° BEND
- ⑮ 8" DI FL x PE PIPE
- ⑯ 4" DI FL x PE PIPE
- ⑰ 8" DI FL 90° BEND
- ⑱ ROUTE ALL ARVs TO FLOOR DRAIN, SEE SHEET M300
- ⑲ 4" DI BLIND FLANGE

BOOSTER STATION PROCESS PLAN

**RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO**



DESIGNED BY: KJB

DRAWN BY: MKA

APPROVED BY: 1AS

DESIGN PROJ:	1386E 00E
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DESIGN PROJ:	17865.005
CONST PROJ:	

CONST PROJ: _____

SCALE: AS NOTED

DATE: OCT 2015

DRAWING NO:

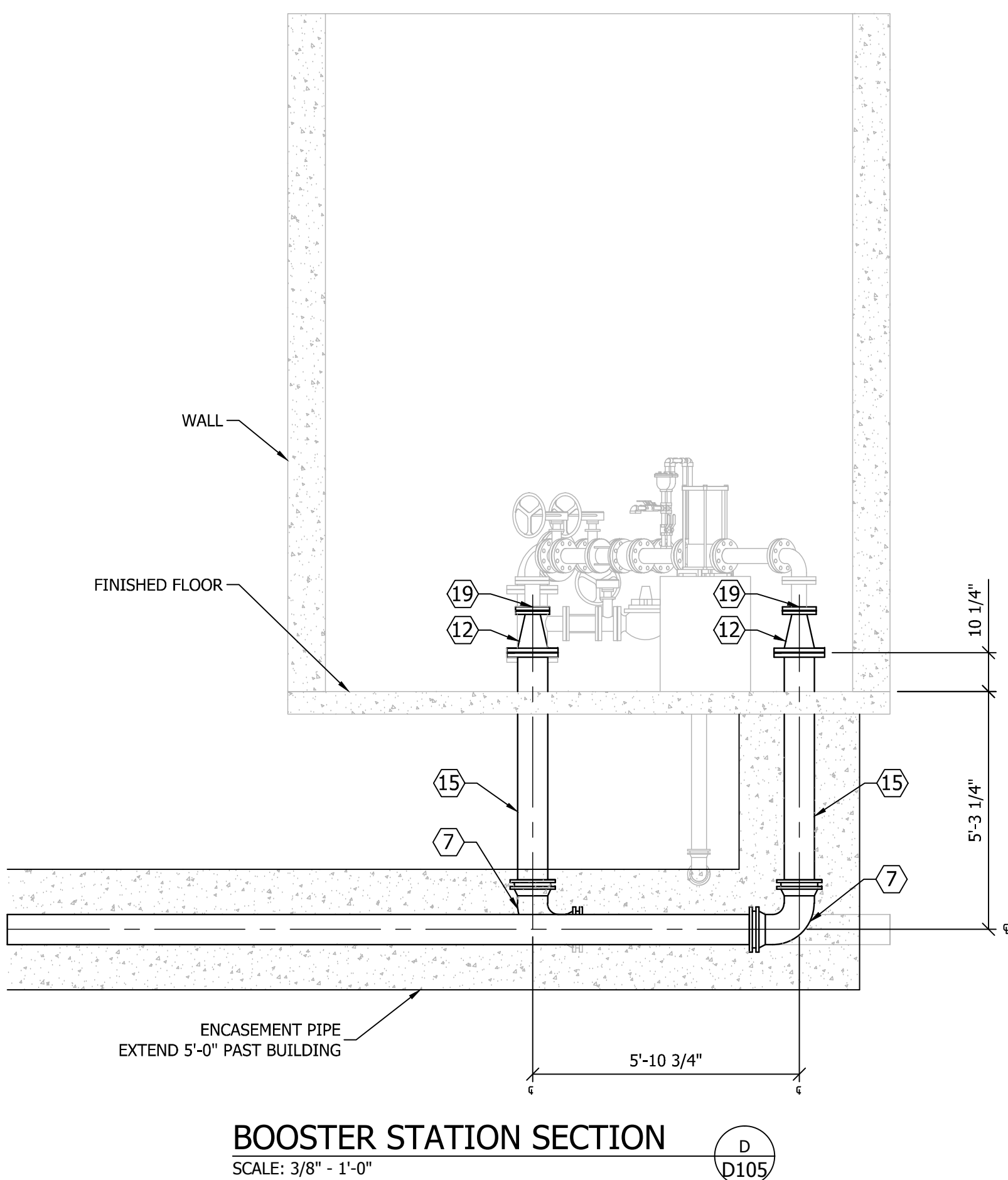
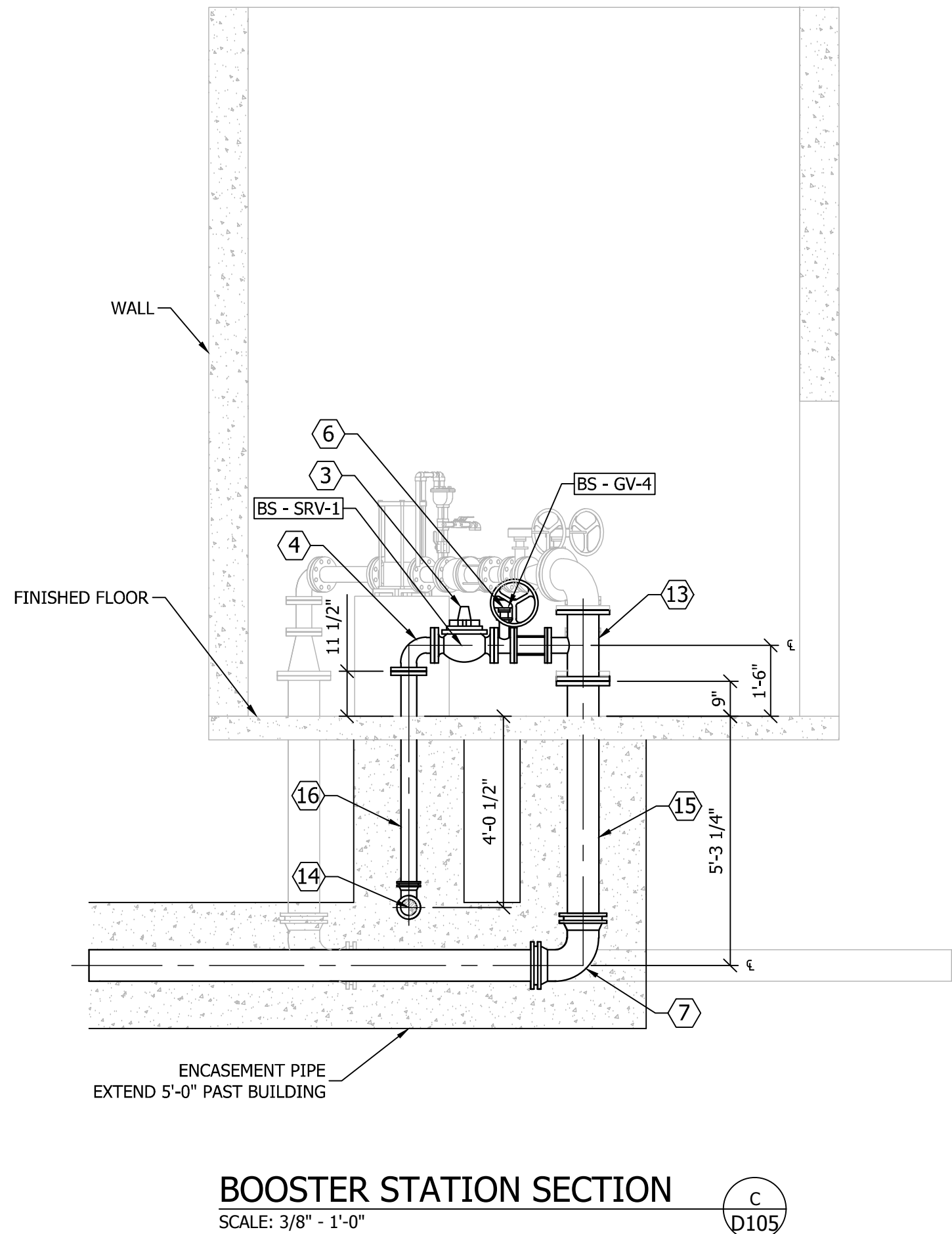
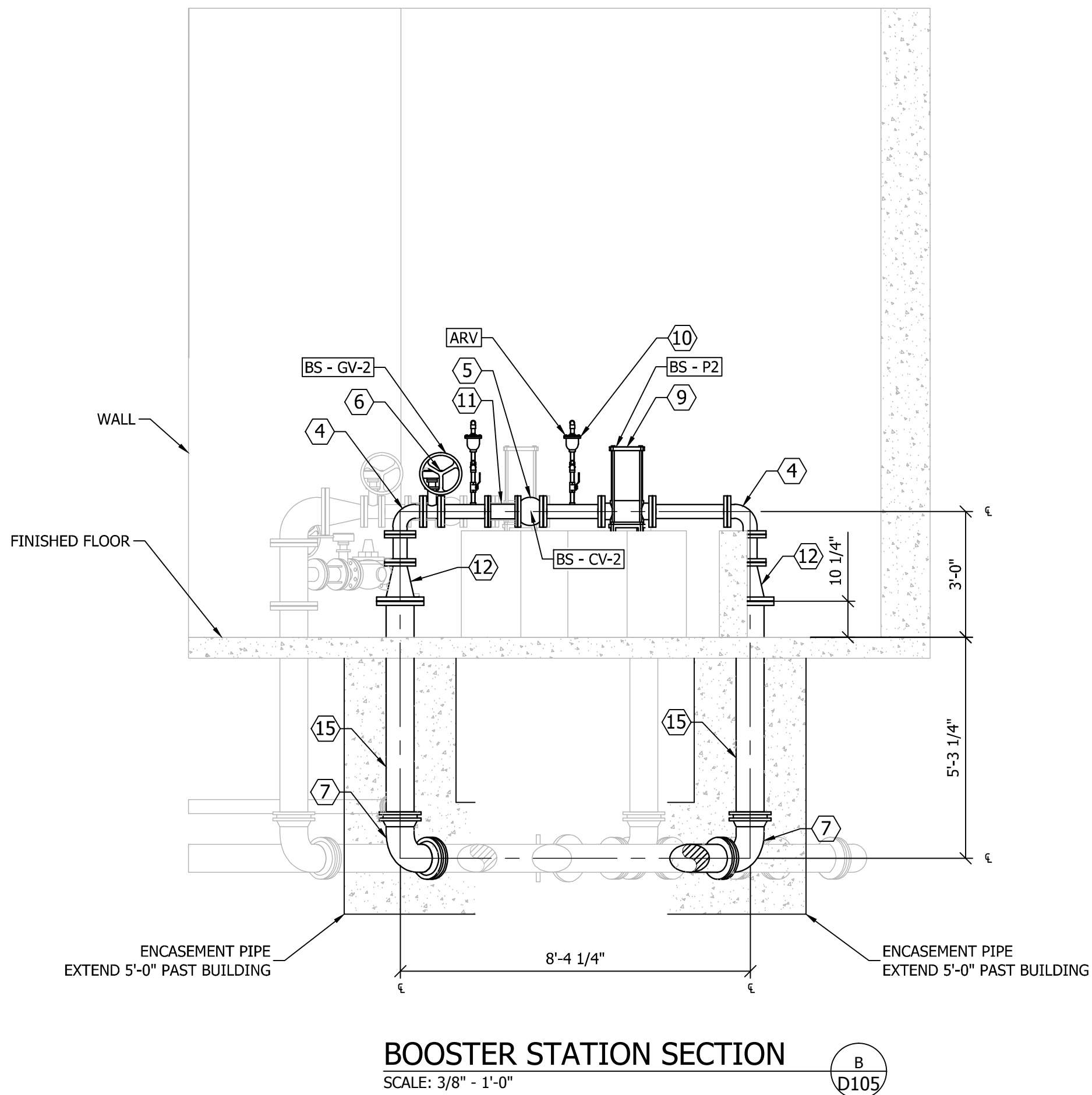
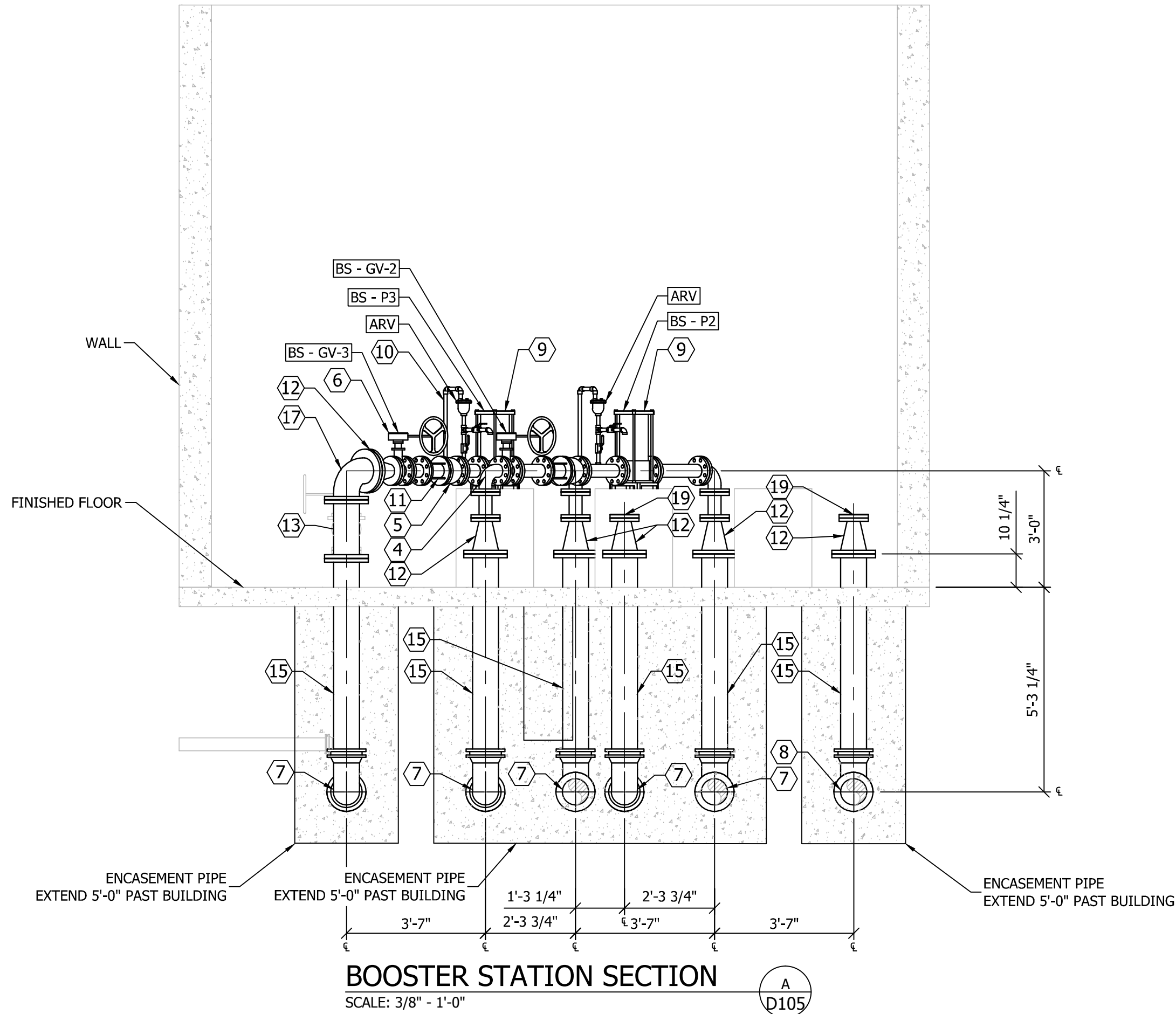
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SHEET NO.:

SHEET NO: 97 of 114

97 of 114

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Last edit on: 00/00/00



GENERAL NOTES:

- SEE SHEET D104 FOR PROCESS GENERAL NOTES
- ENCASE ALL BURIED PIPE UNDER SLAB UNTIL 5'-0" BEYOND BUILDING PERIMETER.

EQUIPMENT LABELS:

BOOSTER PUMP 1	BS - P1
BOOSTER PUMP 2	BS - P2
BOOSTER PUMP 3	BS - P3
4" FL GATE VALVE	BS - GV-1
4" FL GATE VALVE	BS - GV-2
4" FL GATE VALVE	BS - GV-3
4" FL GATE VALVE	BS - GV-4
4" FL SURGE RELIEF VALVE	BS - SRV-1
4" FL CHECK VALVE	BS - CV-1
4" FL CHECK VALVE	BS - CV-2
4" FL CHECK VALVE	BS - CV-3

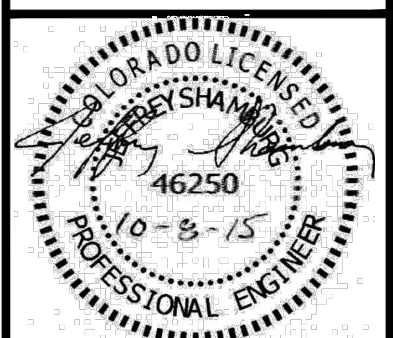
REFERENCE NOTES:

- 4"x4"x4" DI FL TEE
- 4" DI FL GATE VALVE
- 4" DI FL SURGE PROTECTOR
- 4" DI FL 90° BEND
- 4" DI FL CHECK VALVE
- 4" DI FL BUTTERFLY VALVE
- 8" DI RJ 90° BEND
- 8"x8"x8" DI RJ TEE
- 4" PUMP
- 4" DI FL AIR RELIEF
- 4" FI DL DISMANTLING JOINT
- 8"x4" DI FL REDUCER
- 8"x4" DI FL REDUCING TEE
- 4" DI RJ 90° BEND
- 8" DI FL x PE PIPE
- 4" DI FL x PE PIPE
- 8" DI FL 90° BEND
- ROUTE ALL ARVs TO FLOOR DRAIN, SEE SHEET M300
- 4" DI BLIND FLANGE



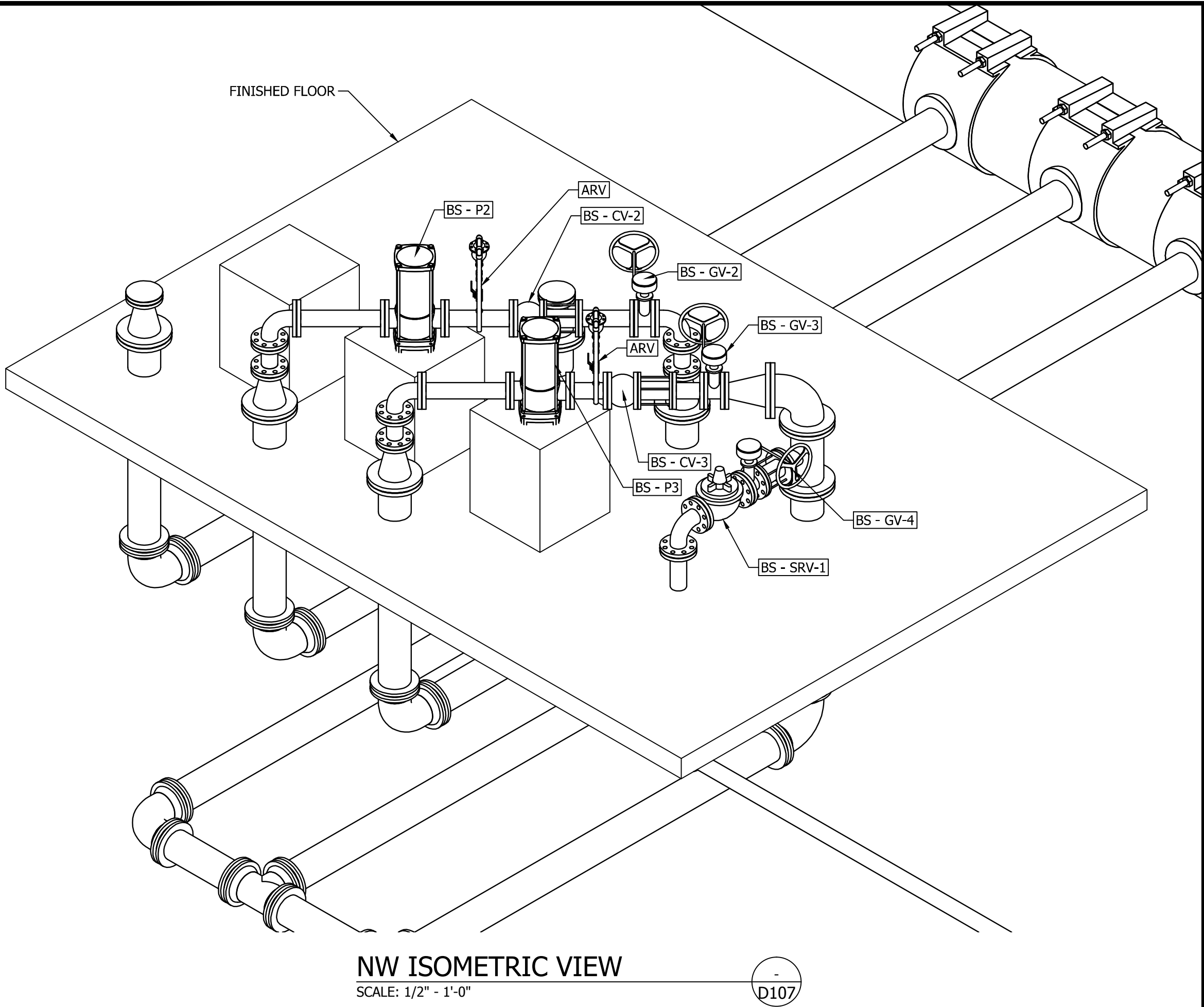
BOOSTER STATION
PROCESS SECTIONS

RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO



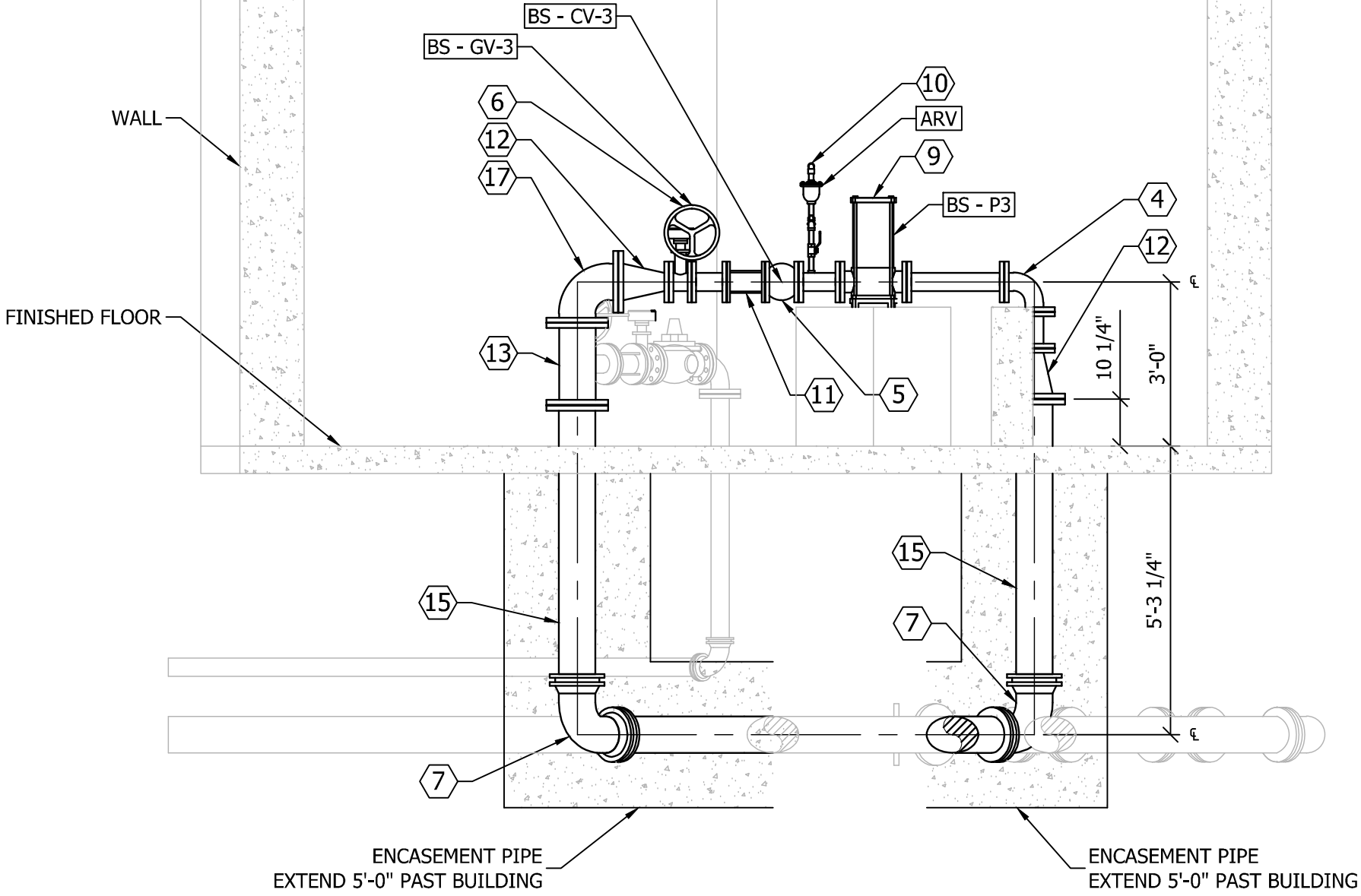
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DRAWN BY:	MKA
APPROVED BY:	JAS
DESIGN PROJ:	17865.005
CONST PROJ:	----
SCALE:	AS NOTED
DATE:	OCT 2015
DRAWING NO:	D106
SHEET NO:	98 of 114

Last edit on: 00/00/00
 Drawing Name: W:\Proj\17000\17865\17865.005\AutoCad\Raw Water Project\04 Process\17865.005 Booster Process Sheets.dwg
 Layout Name: Sections 2
 Plotted By: MKA0889
 Plotted on: 10/12/2015 9:20:24 AM



NW ISOMETRIC VIEW
 SCALE: 1/2" - 1'-0"

-
 D107



BOOSTER STATION SECTION
 SCALE: 3/8" - 1'-0"

E
 D105

GENERAL NOTES:

- SEE SHEET D104 FOR PROCESS GENERAL NOTES
- ENCASE ALL BURIED PIPE UNDER SLAB UNTIL 5'-0" BEYOND BUILDING PERIMETER.

EQUIPMENT LABELS:

BOOSTER PUMP 1	BS - P1
BOOSTER PUMP 2	BS - P2
BOOSTER PUMP 3	BS - P3
4" FL GATE VALVE	BS - GV-1
4" FL GATE VALVE	BS - GV-2
4" FL GATE VALVE	BS - GV-3
4" FL GATE VALVE	BS - GV-4
4" FL SURGE RELIEF VALVE	BS - SRV-1
4" FL CHECK VALVE	BS - CV-1
4" FL CHECK VALVE	BS - CV-2
4" FL CHECK VALVE	BS - CV-3

REFERENCE NOTES:

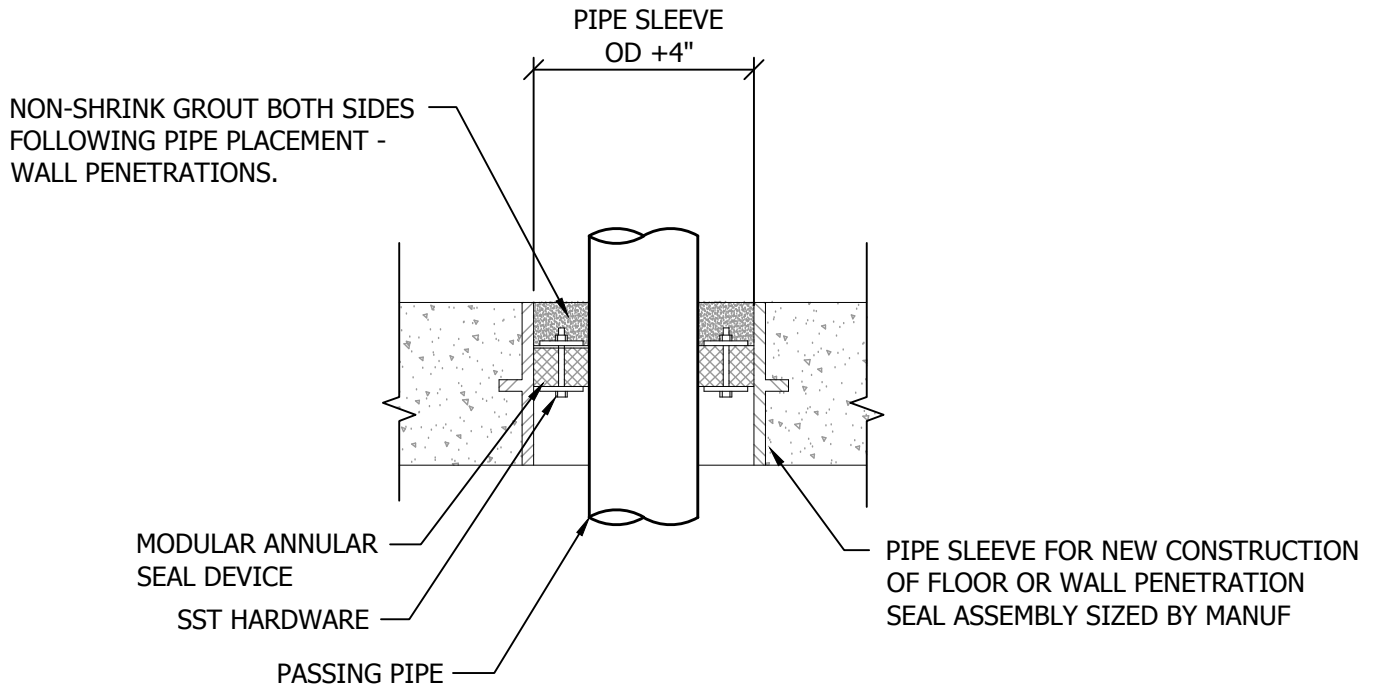
- 4"x4"x4" DI FL TEE
- 4" DI FL GATE VALVE
- 4" DI FL SURGE PROTECTOR
- 4" DI FL 90° BEND
- 4" DI FL CHECK VALVE
- 4" DI FL BUTTERFLY VALVE
- 8" DI RJ 90° BEND
- 8"x8"x8" DI RJ TEE
- 4" PUMP
- 4" DI FL AIR RELIEF
- 4" FI DL DISMANTLING JOINT
- 8"x4" DI FL REDUCER
- 8"x4" DI FL REDUCING TEE
- 4" DI RJ 90° BEND
- 8" DI FL x PE PIPE
- 4" DI FL x PE PIPE
- 8" DI FL 90° BEND
- ROUTE ALL ARVs TO FLOOR DRAIN, SEE SHEET M300
- 4" DI BLIND FLANGE

BOOSTER STATION
 PROCESS SECTIONS
 RAW WATER PROJECT
 LA PLATA WEST WATER AUTHORITY
 LA PLATA COUNTY, COLORADO



DESIGNED BY:	KJB
DRAWN BY:	MKA
APPROVED BY:	JAS
DESIGN PROJ:	17865.005
CONST PROJ:	----
SCALE:	AS NOTED
DATE:	OCT 2015
DRAWING NO:	D107
SHEET NO:	99 of 114

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- NOTES:
1. WALL SPOOL SHALL BE SAME MATERIAL AS CONNECTING PIPE.
 2. WALL SPOOLS SHALL BE CONSTRUCTED PER APPLICABLE SPEC SECTION

FLOOR /WALL PIPE PENETRATION

NOT TO SCALE

1
D108

NOT USED

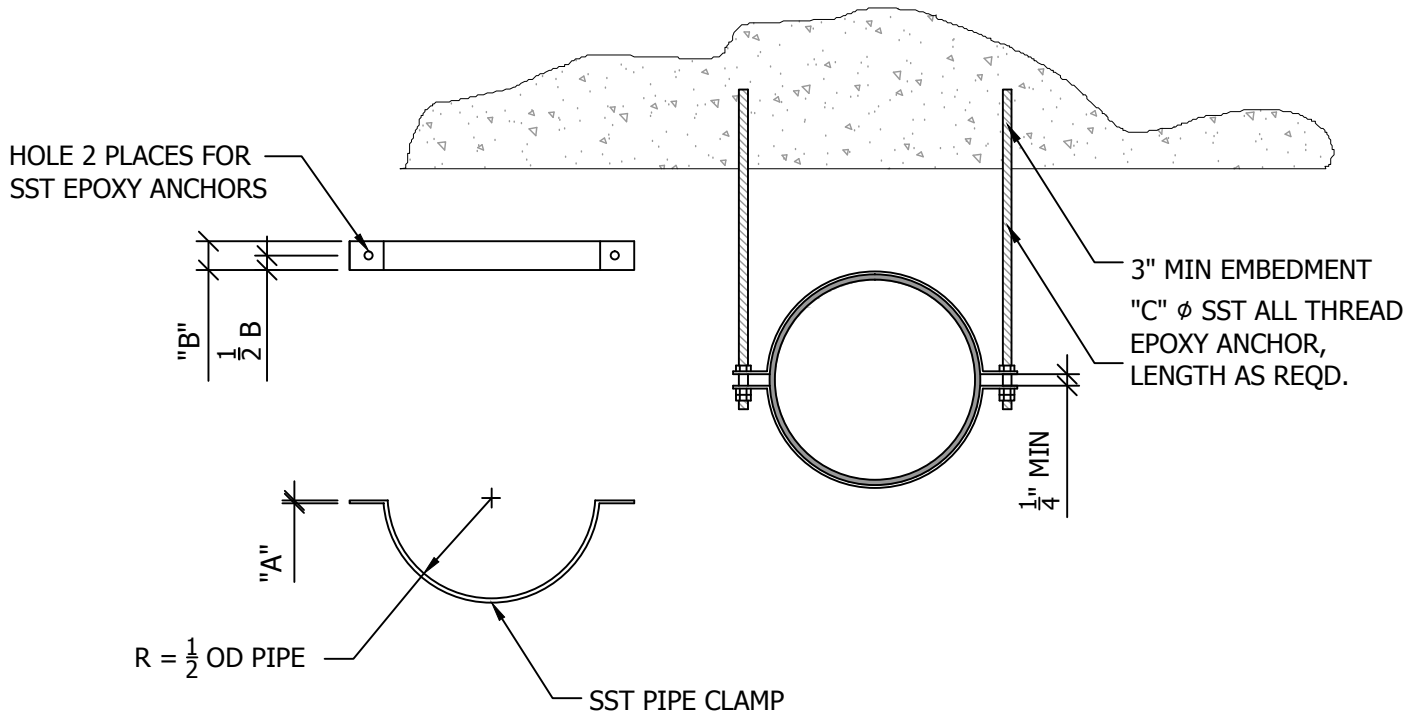
NOT TO SCALE

2
D108

NOT USED

NOT TO SCALE

3
D108



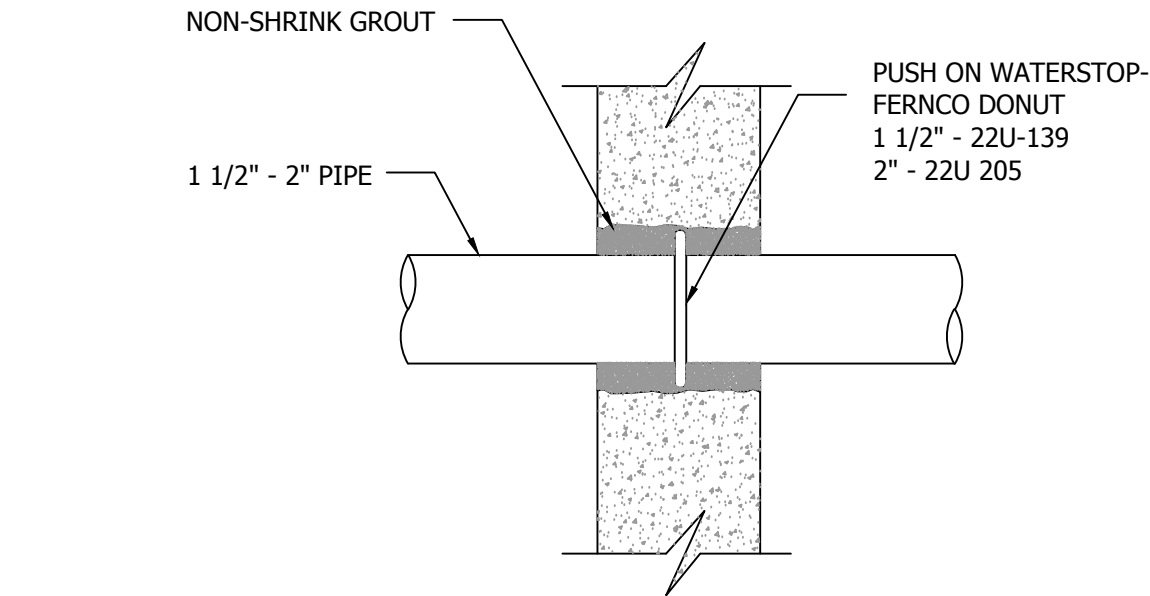
PIPE CLAMP TABLE			
PIPE SIZE	A	B	C
1/2	3/16	1	3/8
1	3/16	1 1/4	3/4
1 1/2	3/16	1 1/4	3/4
2	1/4	1 1/4	1
2 1/2	1/4	1 1/4	1 1/2
3	1/4	1 1/4	1 1/2
4	1/4	1 1/2	1 1/2
5	1/4	2	2
6	1/4	2	2 1/2
8	1/4	2	2 1/2
10	1/4	2 1/2	3 1/4
12	3/8	2 1/2	4 1/4

ALL DIMENSIONS ARE IN INCHES

PIPE STRAP ASSEMBLY & CLAMP TABLE

NOT TO SCALE

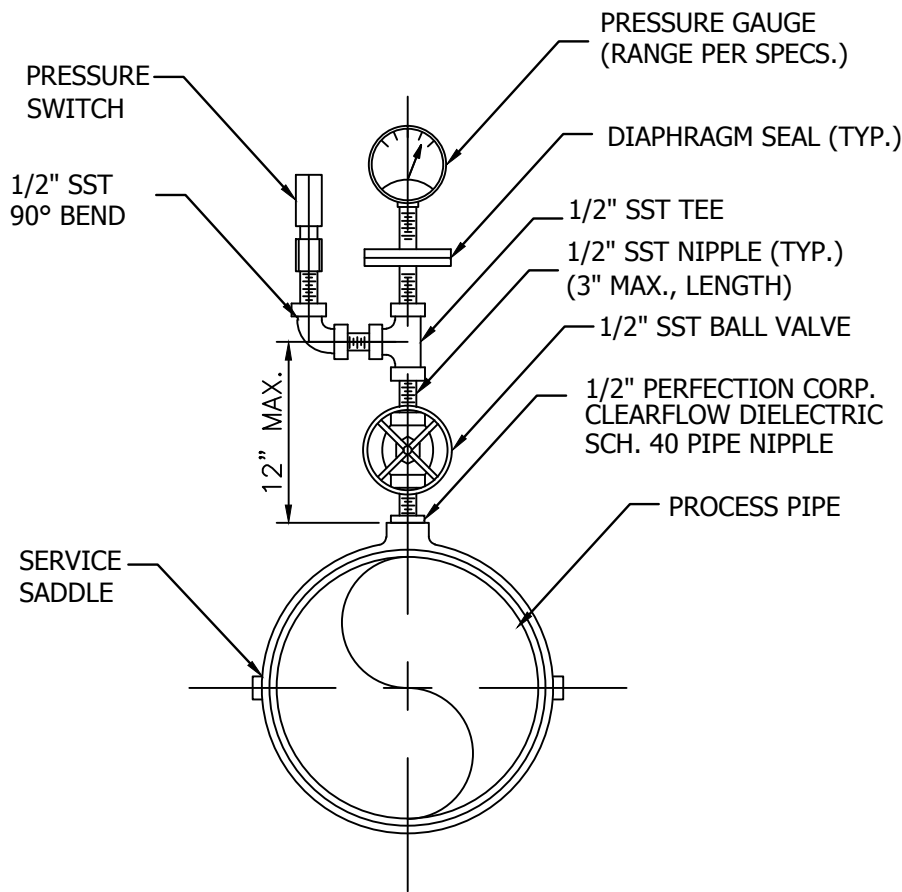
7
D108



2" AND UNDER WALL PENETRATIONS

NOT TO SCALE

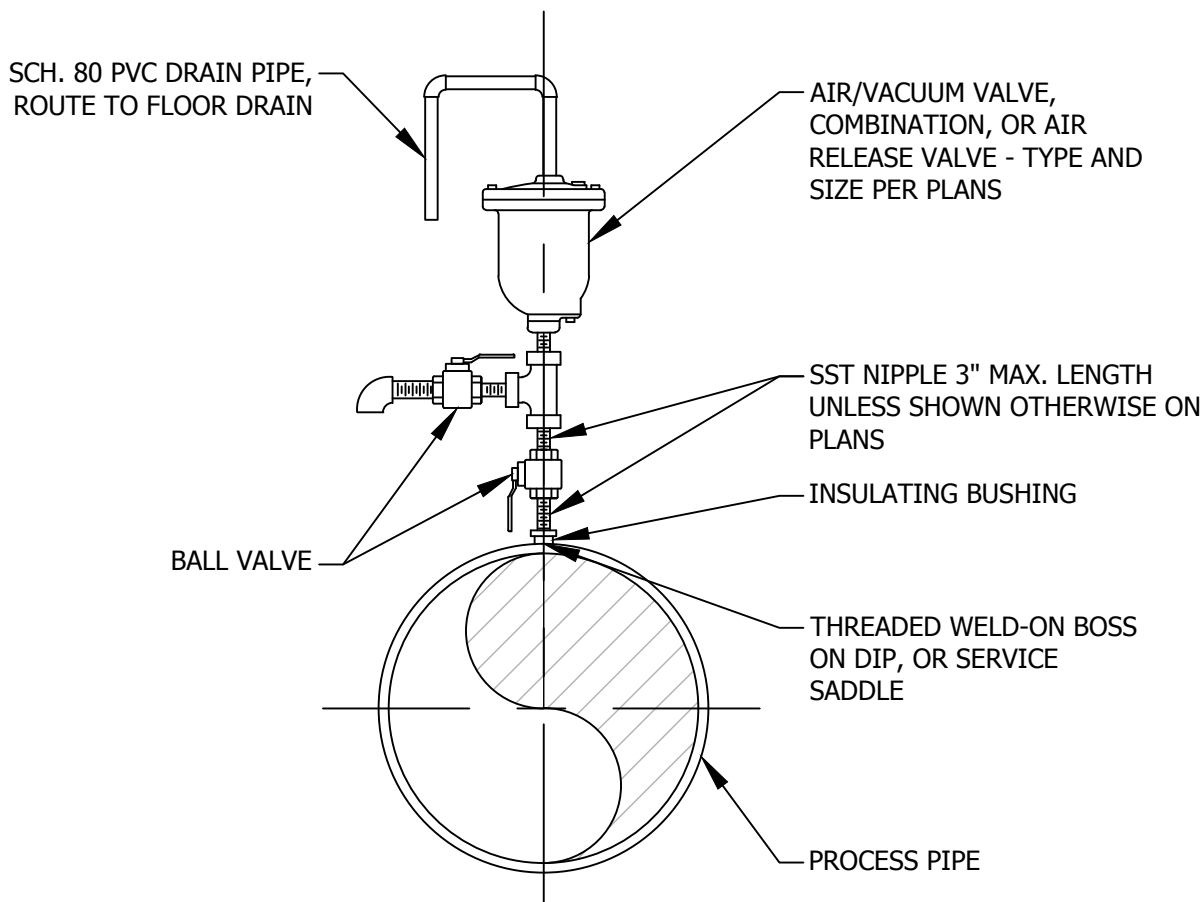
8
D108



PRESSURE INSTRUMENT

NOT TO SCALE

5
D108

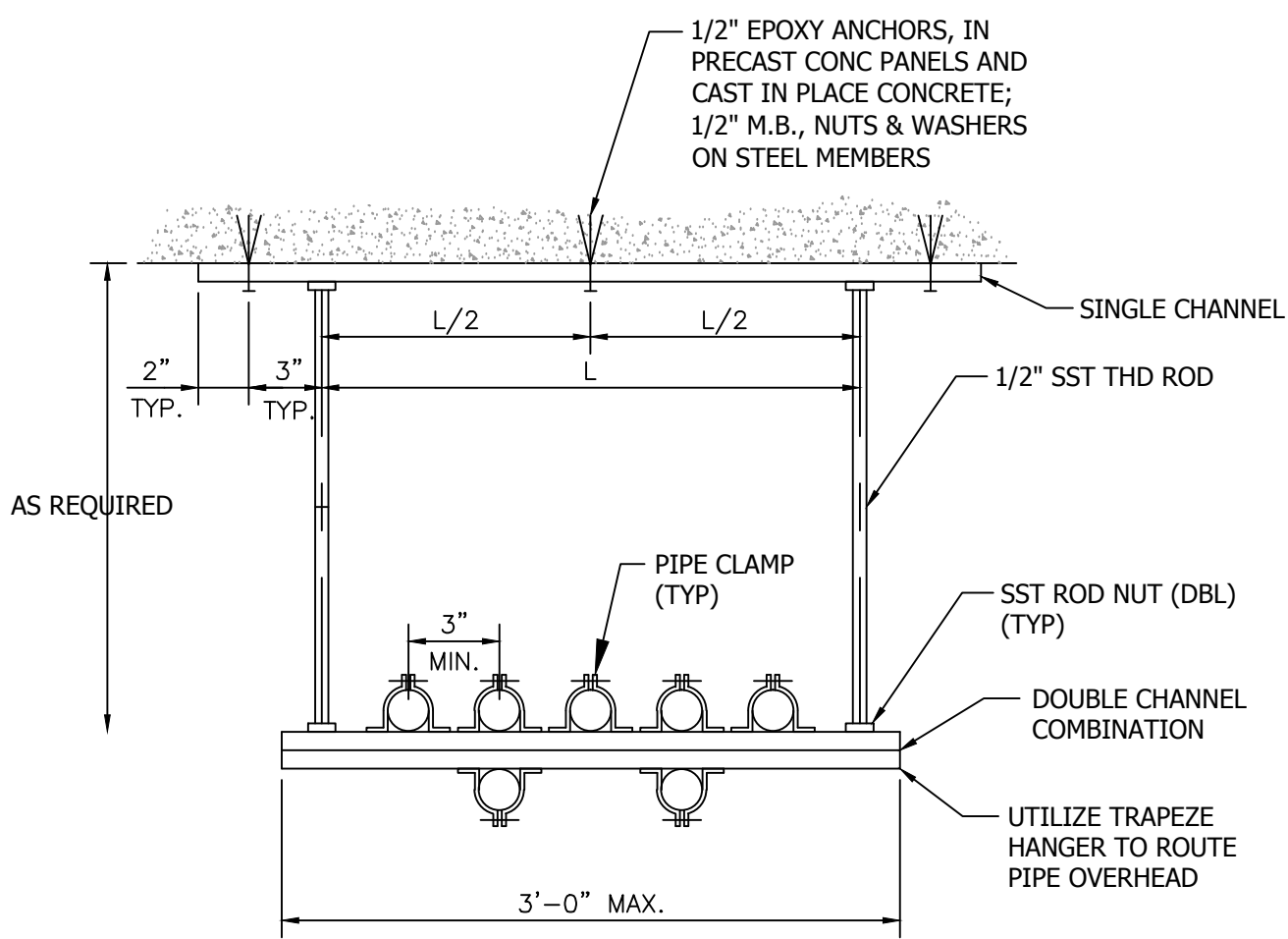


NOTE:
PIPING & BALL VALVE SHALL BE SAME
SIZE AS AIR VALVE

AIR RELEASE VALVE ASSEMBLY

NOT TO SCALE

6
D108

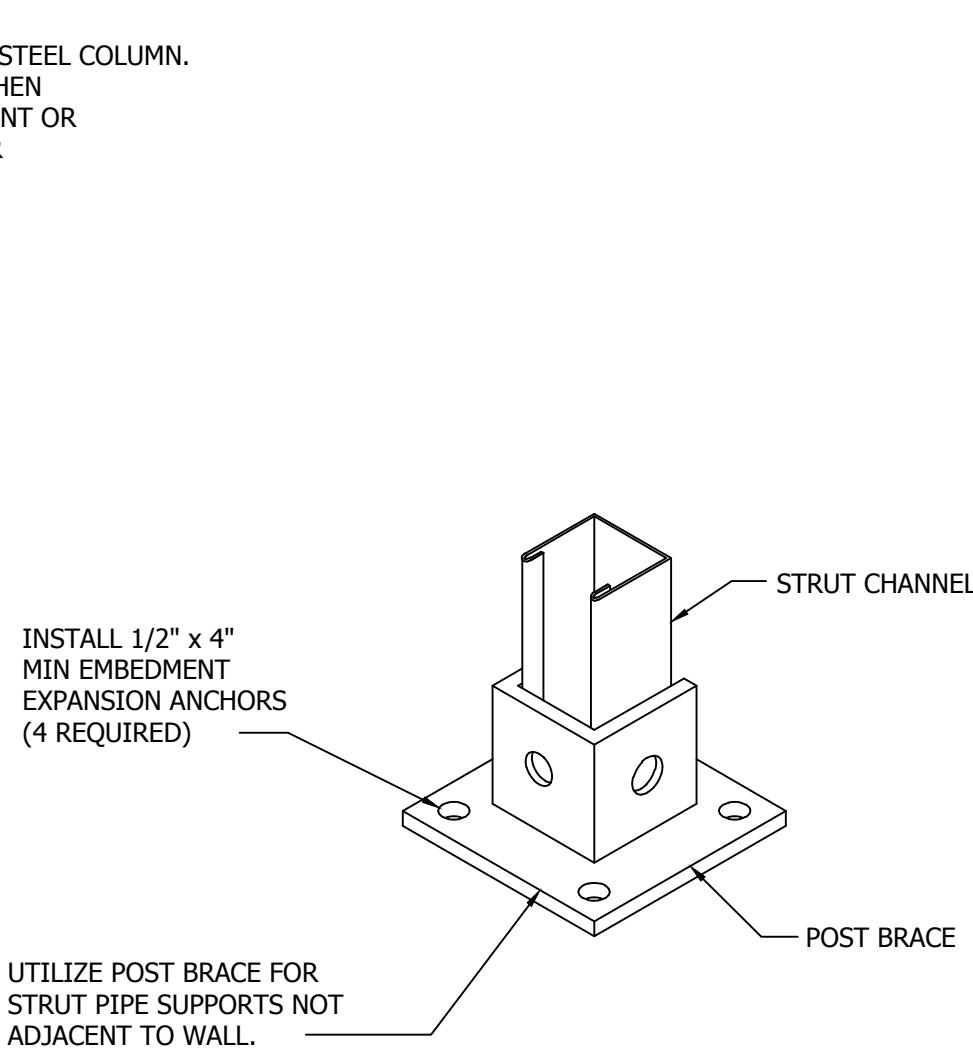


- NOTES:
1. SEE SPECIFICATIONS FOR MATERIAL OF PIPES.
 2. FOR INSTALLATION REQUIRING A BRACKET LONGER THAN 18" USE DOUBLE CHANNEL COMBINATION.
 3. PROVIDE NEOPRENE ISOLATING SLEEVE AT EACH CLAMP, FOR METAL PIPES.
 4. MAX SPACING PER SPEC SECTION 400521
 5. COORDINATE LOCATION OF EXPANSION ANCHORS IN PRECAST CONCRETE PANELS WITH PANEL MANUFACTURER.
 6. STRUT SHALL BE 1-5/8"x1-5/8" x14 GA (MIN) SST OUTSIDE AND IN CORROSIVE ENVIRONMENT, GALV ALL OTHER LOCATIONS
 7. ALL FASTENERS AND THD ROD SHALL BE 304/316 SST

TYPICAL STRUT PIPE SUPPORT

NOT TO SCALE

9
D108



BARTLETT & WEST

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**BOOSTER STATION & INTAKE
PROCESS DETAILS**

**RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO**



DESIGNED BY:	KJB
DRAWN BY:	MKA
APPROVED BY:	JAS
DESIGN PROJ:	17865.005
CONST PROJ:	----
SCALE:	AS NOTED
DATE:	OCT 2015
DRAWING NO:	D108
SHEET NO:	100 of 114

INSTALL 3 LAYERS OF
FELT PAPER BETWEEN



NOT TO SCALE



NOT TO SCALE



NOT TO SCALE

NOTES:

1. EXCEPT WHERE THE TIE RODS ARE REQUIRED, BOLTS FOR FOLLOWER RINGS SHALL BE BOLT-STUDS ON WALL PIPES AND TIE HEAD BOLTS IN OTHER LOCATIONS.
2. ALL BOLT HOLES IN WALL PIPES SHALL BE TAPPED AND SIZED IN ACCORDANCE WITH THE TOP (SIDE IN VERTICAL PIPING) CENTERLINE.
3. 14" PIPE SHALL USE A MINIMUM OF 4 TIE RODS.
4. DETAIL FOR FLANGED FITTING APPLIES ONLY TO 8" AND SMALLER PIPING UNLESS SPECIAL PROVISIONS ARE MADE TO MATCH BOLT CIRCLE DIAMETER & TIE ROD DIAMETER.
5. TIE RODS SHALL BE 316 ST FOR BURIED INSTALLATION.



NOT TO SCALE

NOT USED

NOT TO SCALE

NOTE:
1. SUPPORTS TO BE LOCATED AS SHOWN
ON PLANS UNLESS OTHERWISE REQD. BY MANUF.



NOT TO SCALE



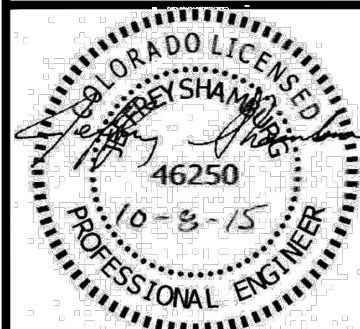
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BOOSTER STATION & INTAKE PROCESS DETAILS

**RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO**



DESIGNED BY: K18

DRAWN BY: MKA

APPROVED BY: 1AC

DESIGN PROJ:	17065 005
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D109

SHEET NO: _____

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MECHANICAL / HVAC

	THIS SYMBOL REFERS TO THE SIZE OF PIPE
	LIQUEFIED PETROLEUM GAS
	NATURAL GAS
	VENT PIPING
	WASTE PIPING
	COMPRESSED AIR
	HIGH PRESSURE STEAM SUPPLY
	HIGH PRESSURE STEAM RETURN
	MEDIUM PRESSURE STEAM SUPPLY
	MEDIUM PRESSURE STEAM RETURN
	LOW PRESSURE STEAM SUPPLY
	LOW PRESSURE STEAM RETURN
	CONDENSATE PUMP DISCHARGE
	FEEDWATER PUMP DISCHARGE
	STORM SEWER
	ROOF DRAIN
	DRAIN
	CHILLED WATER SUPPLY
	CHILLED WATER RETURN
	CHILLED/HOT WATER SUPPLY
	CHILLED/HOT WATER RETURN
	CONDENSER WATER SUPPLY
	CONDENSER WATER RETURN
	HEATING HOT WATER SUPPLY
	HEATING HOT WATER RETURN
	HEAT PUMP SUPPLY
	HEAT PUMP RETURN
	REFRIGERANT LIQUID
	REFRIGERANT SUCTION
	MANUAL VOLUME DAMPER
	LINEAR SLOT DIFFUSER
	INSULATED FLEXIBLE DUCT (MAX. 5'-0" LONG)
	BRANCH DUCT WITH 45° RECTANGLE-ROUND BRANCH FITTING AND MANUAL VOLUME DAMPER
	ELBOW WITH TURNING VANES
	EXHAUST AIR DUCT UP
	EXHAUST AIR DUCT DOWN
	RETURN OR FRESH AIR DUCT DOWN
	RETURN OR FRESH AIR DUCT UP
	SUPPLY AIR DUCT UP
	SUPPLY AIR DUCT DOWN
	EXHAUST AIR GRILLE
	RETURN AIR GRILLE
	SUPPLY AIR DIFFUSER
	REGISTER, NECK SIZE, TYPE & CFM
	REGISTER, NECK SIZE, TYPE & CFM
	REGISTER, NECK SIZE, TYPE & CFM
	FIRE DAMPER
	FIRE/SMOKE DAMPER
	SMOKE DAMPER
	MOTORIZED DAMPER
	CONTROL DAMPER
	BACKDRAFT DAMPER
	TEMPERATURE SENSOR
	PRESSURE SENSOR
	CO2 SENSOR
	AIR FLOW
	THERMOSTAT

PLUMBING / PIPE

	FLOOR MOUNTED FLUSH VALVE WATER CLOSET
	WALL MOUNTED FLUSH VALVE WATER CLOSET
	TANK TYPE WATER CLOSET
	URINAL
	WALL MOUNTED LAVATORY
	COUNTER TOP LAVATORY
	JANITORS BASIN
	DOUBLE COMPARTMENT SINK
	SINGLE COMPARTMENT SINK
	SHOWER
	BI-LEVEL DRINKING FOUNTAIN
	SINGLE DRINKING FOUNTAIN
	BATH TUB
	EMERGANCY SHOWER
	FLOOR DRAIN
	SHOWER HEADS
	SHOWER ENCLOSURE
	FLUSH FLOOR CLEANOUT
	FLUSH GRADE CLEANOUT
	PLUMBING FIXTURE ID TAG
	DOMESTIC COLD WATER
	DOMESTIC HOT WATER
	DOMESTIC HOT WATER CIRCULATING
	TEMPERED WATER
	STORM DRAIN
	OVERFLOW STORM DRAIN
	SHUT-OFF VALVE
	MODULATING CONTROL VALVE
	CHECK VALVE
	THREE WAY VALVE
	BALANCING VALVE W/ PRESSURE PORTS
	TRIPLE DUTY VALVE W/ PRESSURE PORTS
	STRAINER
	RELIEF VALVE
	SOLENOID VALVE
	PRESSURE REDUCING VALVE
	REDUCER
	PIPE ANCHOR
	SLIDING EXPANSION JOINT
	PRESSURE GAUGE
	F & T TRAP
	BUCKET TRAP
	THERMOSTATIC TRAP
	FLOAT TRAP
	BACKFLOW PREVENTER
	THERMOMETER
	UNION
	WALL HYDRANT
	HOSE BIBB
	CLEANOUT
	CAP
	ELBOW UP W/OUT SHUT-OFF VALVE
	ELBOW DOWN W/OUT SHUT-OFF VALVE
	ELBOW TEE DOWN
	TEE
	TEE UP
	ELBOW UP WITH SHUT-OFF VALVE
	ELBOW DOWN WITH SHUT-OFF VALVE
	TEE UP WITH SHUT-OFF VALVE
	TEE DOWN WITH SHUT-OFF VALVE
	SANITARY TEE
	45 ELBOW
	P-TYPE TRAP
	PIPE GUIDE

LIGHTING / ELECTRICAL

	POLE MOUNTED LIGHTING FIXTURE
	CEILING MOUNTED LIGHTING FIXTURE 1x4 AND ID TAG
	CEILING MOUNTED LIGHTING FIXTURE 2x2 AND ID TAG
	CEILING MOUNTED LIGHTING FIXTURE 2x4 AND ID TAG
	EMERGENCY LIGHTING FIXTURE
	CEILING MOUNTED MULTI SWITCHING
	CEILING MOUNTED WITH EMERGENCY BALLAST
	CEILING MOUNTED LIGHT FIXTURE WITH NIGHT LIGHT
	PADDLE CEILING FAN
	CEILING MOUNTED EXIT LIGHT
	EXIT LIGHT (WALL MOUNTED)
	CEILING MOUNT
	WALL MOUNT
	LIGHT TRACK WITH LIGHT TYPES AS INDICATED
	SINGLE RECEPTACLE
	DUPLEX RECEPTACLE
	FOURPLEX RECEPTACLE
	RECESSED FLOOR MOUNTED JUNCTION BOX
	SURFACE MOUNTED JUNCTION BOX
	CEILING MOUNTED JUNCTION BOX
	PHOTOCELL
	JUNCTION BOX
	TYPE 1 JUNCTION BOX
	TYPE 2 JUNCTION BOX
	PLUGMOLD - OUTLETS AT 12" O.C. UNLESS OTHERWISE NOTED
	TIME SWITCH
	LIGHTING CONTACTOR
	SPRING WOUND TIMER
	HAND-OFF-AUTO SELECTOR SWITCH
	MANUAL STARTER WITH THERMAL OVERLOADS
	LIGHTING PANEL
	DISTRIBUTION PANEL
	TELEPHONE TERMINAL PANEL
	THERMOSTAT
	HUMIDISTAT
	(1) RJ-45 COMMUNICATION/DATA OUTLET
	(2) RJ-45 COMMUNICATION/DATA OUTLET
	(4) RJ-45 COMMUNICATION/DATA OUTLET
	CEILING MOUNTED COMMUNICATION/DATA OUTLET
	FLOOR MOUNTED COMMUNICATION/DATA OUTLET
	TELEVISION OUTLET
	MASTER CLOCK
	SECONDARY CLOCK
	WALL SPEAKER
	CEILING SPEAKER
	COLUMN SPEAKER
	HORN SPEAKER
	CALL-IN STATION
	MOTION DETECTOR
	CLOSED CIRCUIT TELEVISION OUTLET
	PUSHBUTTON STATION
	RELAY CABINET
	CLOCK SPEAKER
	CARD READER
	MAGNETIC LOCK
	ALARM CONTACTS
	SECURITY CAMERA
	SINGLE SWITCH
	DOUBLE POLE SWITCH
	3-WAY SWITCH
	4-WAY SWITCH
	SINGLE POLE SWITCH WITH PILOT LAMP
	MOMENTARY CONTACT
	SINGLE POLE SWITCH, KEY OPERATED
	DIMMER SWITCH
	LOW VOLTAGE SWITCH
	VACANCY SENSOR SWITCH
	OCCUPANCY SENSOR
	BRANCH CIRCUIT IN CONDUIT CONCEALED IN CEILING OR WALL
	BRANCH CIRCUIT BELOW GRADE OR SLAB
	BRANCH CIRCUIT IN EXPOSED CONDUIT
	BRANCH CIRCUIT HOMERUN TO PANEL
	DIAGONAL LINES INDICATE NUMBER OF CONDUCTORS OTHERWISE NOTED
	#18 WIRE
	#16 WIRE
	#14 WIRE
	#12 WIRE
	BRANCH CIRCUIT OR FEEDER - SEE SCHEDULE FOR CONDUCTOR & CONDUIT QUANTITY & SIZE
	FLEXIBLE CONDUIT
	TWISTED PAIR
	LIGHTING CONTROL WIRING
	MOTOR CONTROLLER
	MANUAL MOTOR CONTROLLER
	COMBINATION MOTOR CONTROLLER
	DISCONNECT SWITCH
	EQUIPMENT MOTOR
	UTILITY METER

FIRE ALARM / PROTECTION

	FIRE ALARM CONTROL PANEL
	FIREMAN'S SMOKE CONTROL SYSTEM
	FIREFIGHTER'S TELEPHONE PANEL
	VOICE EVACUATION CONTROL UNIT
	AMPLIFIER PANEL
	FIRE ALARM ANNUNCIATOR PANEL
	REMOTE POWER SUPPLY
	REMOTE INDICATING LIGHT
	REMOTE TEST STATION
	FAN SHUTDOWN RELAY
	DOOR HOLD-OPEN DEVICE
	ADDRESSABLE CONTROL RELAY
	KNOX BOX
	FIRE ALARM PULL STATION
	SMOKE DETECTOR
	SMOKE DETECTOR WITH SOUNDER BASE
	HEAT DETECTOR
	FLAME DETECTOR
	DUCT SMOKE DETECTOR
	WALL MOUNTED FIRE ALARM HORN
	WALL MOUNTED FIRE ALARM BELL
	WALL MOUNTED FIRE ALARM HORN/STROBE COMBINATION
	CEILING MOUNTED FIRE ALARM STROBE LIGHT
	CEILING MOUNTED FIRE ALARM SPEAKER/STROBE.
	CEILING MOUNTED FIRE ALARM STROBE LIGHT
	WALL MOUNTED FIRE ALARM WALL STROBE LIGHT
	WALL MOUNTED FIRE ALARM SPEAKER
	WALL MOUNTED FIRE ALARM SPEAKER/STROBE
	BEAM DETECTOR - RECEIVER
	BEAM DETECTOR - TRANSMITTER
	COMBINATION SMOKE AND FIXED TEMPERATURE THERMAL DETECTOR
	GAS DETECTOR
	FIREMANS PHONE JACK, MASTER PHONE STATION
	POST INDICATING VALVE
	TAMPER SWITCH
	FLOW SWITCH
	AIR SAMPLING SMOKE DETECTOR
	SINGLE POLE SWITCH, KEY OPERATED
	THESE LETTERS ADJACENT TO ANY SYMBOL INDICATES WATTAGE
	THESE LETTERS ADJACENT TO ANY SYMBOL INDICATES CANDELA RATING

GENERAL SYMBOLS

	INDICATES DIRECTION OF PLAN NORTH
	DETAIL REFERENCE - UPPER NUMBER INDICATES DETAIL NUMBER, LOWER NUMBER INDICATES SHEET NUMBER
	PLAN NOTE REFERENCE
	REVISION DELTA
	ROOM NUMBER REFERENCE
	SECTION CUT REFERENCE - UPPER NUMBER INDICATES DETAIL NUMBER, LOWER NUMBER INDICATES SHEET NUMBER
	CONTINUATION
	INDICATES CONNECTION TO EXISTING SYSTEM
	BREAK LINE
	MATCHLINE

ABBREVIATIONS

GENERAL:	
AF	ABOVE FINISHED FLOOR
AFG	ABOVE FINISHED GRADE
EX	EXISTING
DN	DOWN
PLUMBING:	
CA	COMPRESSED AIR
CW	DOMESTIC COLD WATER
FD	FLOOR DRAIN
HW	DOMESTIC HOT WATER
HWC	HOT WATER CIRCULATING
T	TEMPERED WATER
V	VENT
VTR	VENT THRU ROOF
W	WASTE
MECHANICAL:	
AHU	AIR HANDLING UNIT
CU	CONDENSING UNIT
CUH	CABINET UNIT HEATER
CWR	CHILLED WATER RETURN
CWS	CHILLED WATER SUPPLY
EF	EXHAUST FAN
FCU	FAN COIL UNIT
FTU	FAN TERMINAL UNIT
G	GAS
HWR	HOT WATER RETURN
HWS	HOT WATER SUPPLY
LV	LOUVER
MA	MIXED AIR
MUA	MAKE UP AIR
OA	OUTSIDE AIR
RA	RETURN AIR
SA	SUPPLY AIR
UH	UNIT HEATER
UV	UNIT VENTILATOR
VAV	VARIABLE AIR VOLUME
ELECTRICAL:	
AC	ALTERNATING CURRENT
BKR	BREAKER
CTCB	CONTROL TRANSFORMER CIRCUIT BREAKER
DISC	DISCONNECT SWITCH
DR	DUPLEX RECEPTACLE, GFI
DCB	DISCONNECT CIRCUIT BREAKER
GFCB	GROUND FAULT CIRCUIT BREAKER
HBCB	HOT BOX CIRCUIT BREAKER
LCB	LIGHT CIRCUIT BREAKER
MCB	MAIN CIRCUIT BREAKER
MD	MOTORIZED DAMPER
MPCB	MOTOR POWER CIRCUIT BREAKER
PCB	PUMP CIRCUIT BREAKER
PHCB	PANEL HEATER CIRCUIT BREAKER
RCB	RECEPTACLE CIRCUIT BREAKER
SCB	SPARE CIRCUIT BREAKER
TR	TRANSFORMER
TCB	TRANSFORMER CIRCUIT BREAKER
TR	TELEMETRY RADIO
VCCB	VALVE CONTROLS CIRCUIT BREAKER
VFD	VARIABLE FREQUENCY DRIVE
*	THESE LETTERS ADJACENT TO ANY SYMBOL INDICATES DEVICE BOTTOM TO BE MOUNTED 4" ABOVE COUNTER TOP BACKPLASH
GFCI	THESE LETTERS ADJACENT TO ANY SYMBOL INDICATES GROUND FAULT INTERRUPTER
IG	THESE LETTERS ADJACENT TO ANY SYMBOL INDICATES ISOLATED GROUND SERVICE
TL	THESE LETTERS ADJACENT TO ANY SYMBOL INDICATES LOCKING OR TWIST-LOCK TYPE DEVICE
WP	THESE LETTERS ADJACENT TO ANY SYMBOL INDICATES WEATHER-PROOF ENCLOSURE
XP	THESE LETTERS ADJACENT TO ANY SYMBOL INDICATES EXPLOSION-PROOF ENCLOSURE
#"	THESE NUMBERS ADJACENT TO ANY SYMBOL INDICATES THE MOUNTING HEIGHT AFF TO TOP OF DEVICE
TP	THESE LETTERS ADJACENT TO ANY SYMBOL INDICATES TAMPER PROOF

BARTLETT & WEST

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WWW.BARTWEST.CO

MEP SYMBOLS

RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO

DESIGNED BY: JWB
DRAWN BY: RCS
APPROVED BY: TJD
DESIGN PROJ: 17865.005
CONST PROJ: ----
SCALE: AS NOTED
DATE: OCT 2015

DRAWING NO: **MEP000**
SHEET NO: 102 of 114

Drawing Name: W:\Proj\17000\17865\17865.005\AutoCad\Raw Water Project\05 MEP\17865.005 MEP100 Intake Site Plan.dwg Layout Name: Layout1 Plotted on: 10/14/2015 9:37:20 AM
Last edit on: 00/00/00



INTAKE BUILDING MEP SITE PLAN
SCALE: 1/8"=1'-0"



REFERENCE NOTES:

- UTILITY TRANSFORMER, PAD, CT CABINET AND METER PROVIDED BY UTILITY. COORDINATE EXACT LOCATION WITH UTILITY.
- PROVIDE POWER CONNECTION FROM UTILITY TRANSFORMER BELOW GRADE TO "DS1". REFER TO ELECTRICAL RISER DIAGRAM.
- PROVIDE TRENCHING FOR ELECTRICAL UTILITY PRIMARY SERVICE FEEDERS TO UTILITY TRANSFORMER. REFER TO CIVIL PLANS FOR TRENCH LOCATION AND DETAILS.
- ROUTE METER VAULT POWER CIRCUIT BELOW GRADE FROM "PP1" TO VAULT.
- ROUTE CONTROLS CONDUIT BELOW GRADE FROM INTAKE BUILDING TO METER VAULT. TERMINATE AND CAP IN ACCESSIBLE LOCATION INSIDE INTAKE BUILDING.
- CONNECT METER VAULT POWER CIRCUIT TO 50A2P MAIN CIRCUIT BREAKER IN METER VAULT.
- CONNECT CONTROLS CONDUIT TO INTERFACE PANEL IN METER VAULT.

GENERAL NOTES:

- COORDINATE ALL UTILITY SERVICE ENTRANCE REQUIREMENTS WITH UTILITY. PROVIDE ALL NECESSARY FEEDERS, CONDUIT, TRENCHING, AND GROUNDING AS REQUIRED.

LA PLATA ELECTRIC ASSOCIATION
ATTN: MONTY CAUDLE
P.O. BOX 2750
DURANGO, CO 81302
(970) 382-7191

FEEDER SCHEDULE:

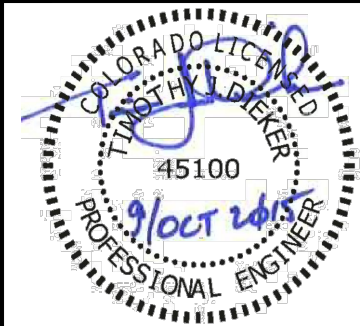
- 1-1/2" CONDUIT WITH PULL STRING.
- 2-6 & 1-10G IN 1-1/2"C.

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**INTAKE BUILDING
SITE PLAN**

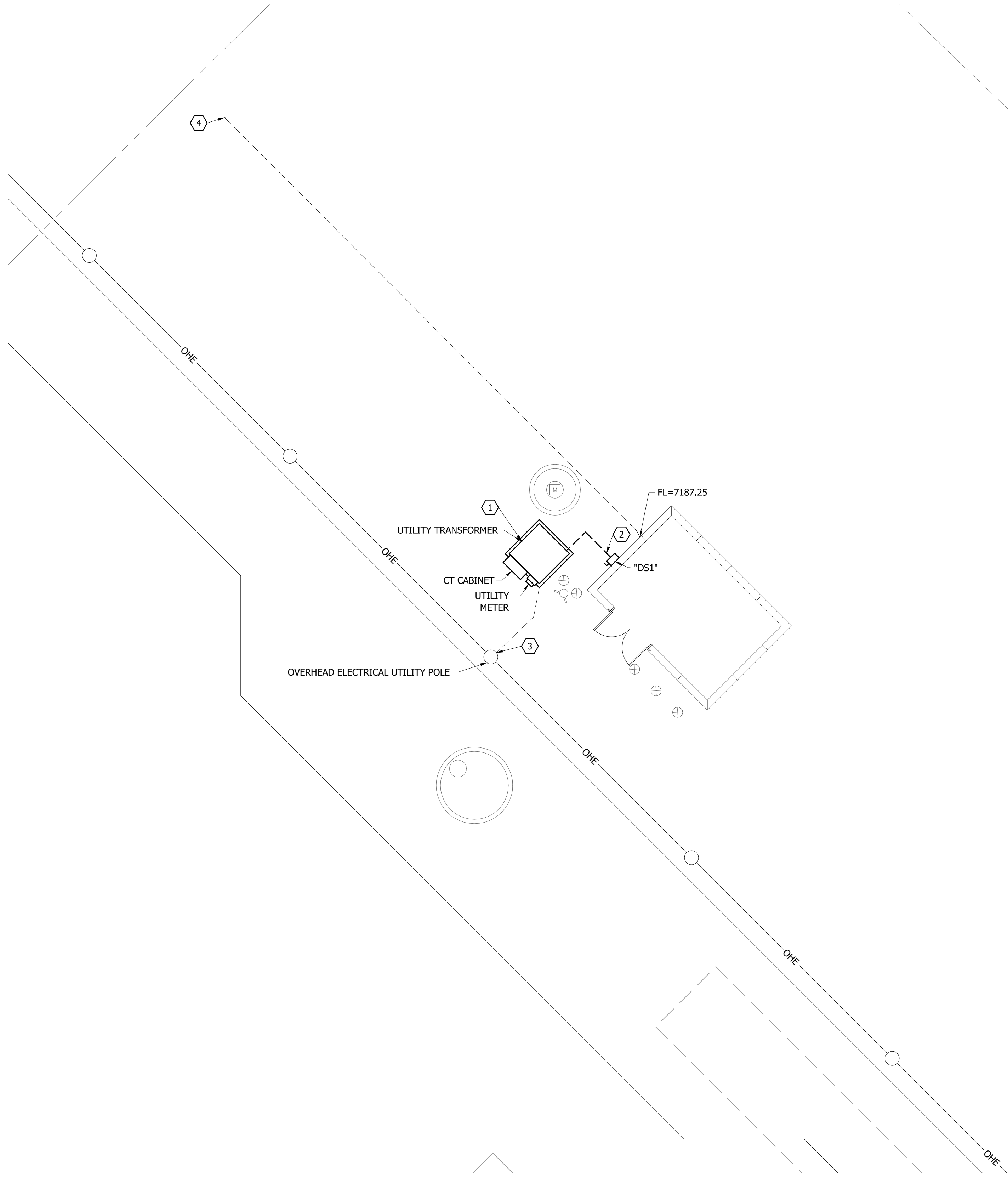
RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO



DESIGNED BY:	JWB
DRAWN BY:	RCS
APPROVED BY:	TJD
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SHEET NO:	103 of 114

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BOOSTER BUILDING MEP SITE PLAN
SCALE: 1/8"=1'-0"

BAR IS ONE INCH ON OFFICIAL DRAWINGS. 0 1" IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.

REFERENCE NOTES:

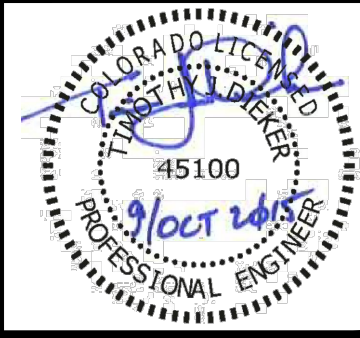
- UTILITY TRANSFORMER, PAD, CT CABINET AND METER PROVIDED BY UTILITY. COORDINATE EXACT LOCATION WITH UTILITY.
- PROVIDE POWER CONNECTION FROM UTILITY TRANSFORMER BELOW GRADE TO "DS1". REFER TO ELECTRICAL RISER DIAGRAM.
- PROVIDE TRENCHING FOR ELECTRICAL UTILITY PRIMARY SERVICE FEEDERS TO UTILITY TRANSFORMER. REFER TO CIVIL PLANS FOR TRENCH LOCATION AND DETAILS.
- PROVIDE 4" SCHD. 40 PVC DRAIN PIPING. PROVIDE MINIMUM 1/8" PER FT SLOPE. ROUTE TO DAYLIGHT AT ELEV 7186.5' AND PROVIDE 4" FLAP GATE AT DAYLIGHT END. REFER TO BOOSTER BUILDING MECHANICAL PLAN.

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190 TALISMAN DR. UNIT D-1 PAGOOSA SPRINGS, CO 81447
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GENERAL NOTES:

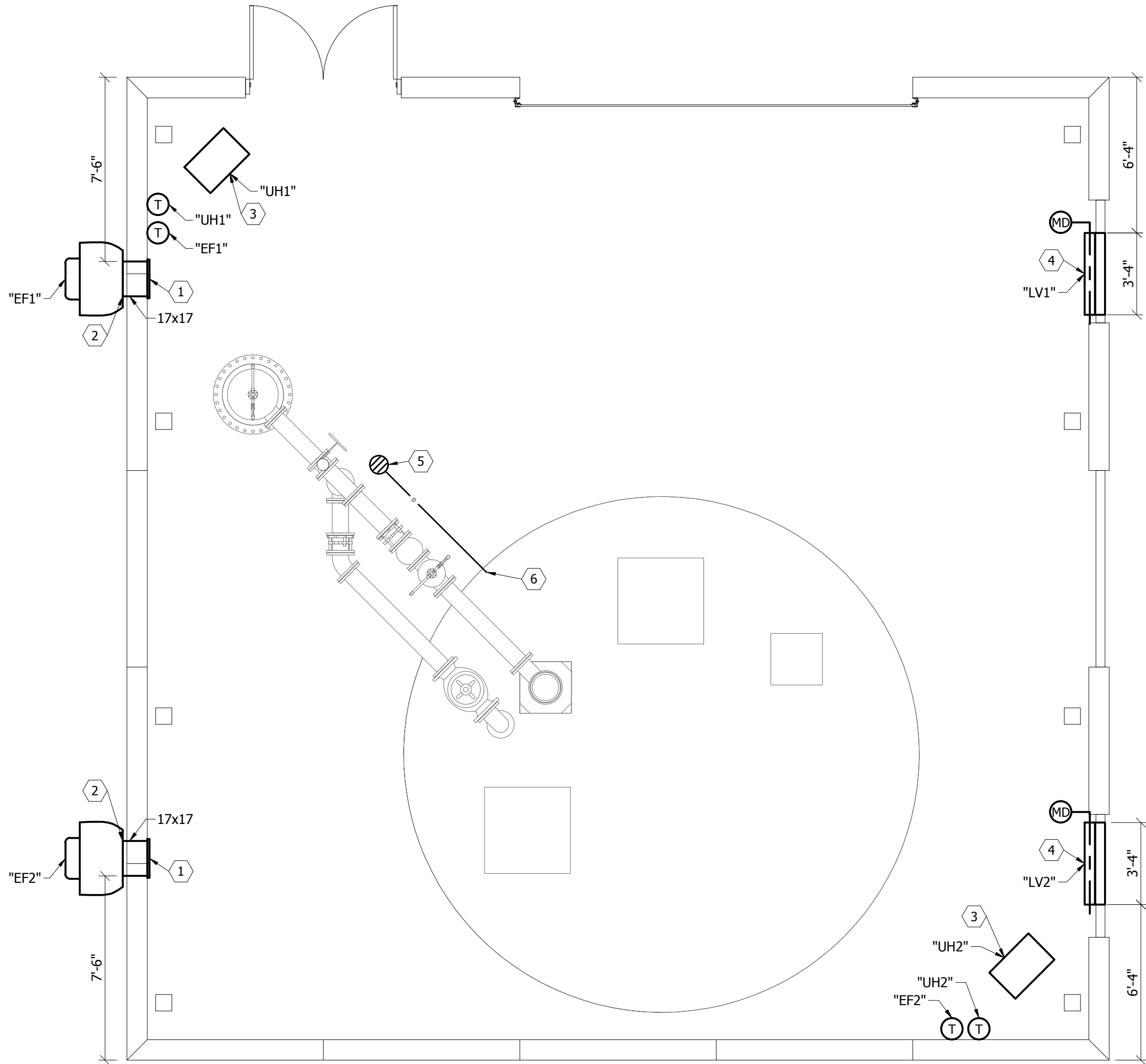
- COORDINATE ALL UTILITY SERVICE ENTRANCE REQUIREMENTS WITH UTILITY. PROVIDE ALL NECESSARY FEEDERS, CONDUIT, TRENCHING, AND GROUNDING AS REQUIRED.
- LA PLATA ELECTRIC ASSOCIATION
ATTN: MONTY CAUDLE
P.O. BOX 2750
DURANGO, CO 81302
(970) 382-7191

**BOOSTER BUILDING
SITE PLAN**
**RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO**



DESIGNED BY:	JWB
DRAWN BY:	RCS
APPROVED BY:	TJD
DESIGN PROJ:	17865.005
CONST PROJ:	----
SCALE:	AS NOTED
DATE:	OCT 2015
DRAWING NO:	MEP101
SHEET NO:	104 of 114

Drawing Name: W:\Proj\17000\17865\AutoCad\Raw Water Project\05 MEP\17865.005 M200 Intake Mechanical Plan.dwg Layout Name: Layout1 Plotted By: MKA00889 Plotted on: 10/14/2015 9:38:08 AM Last edit on: 00/00/00



INTAKE BUILDING MECHANICAL PLAN
SCALE: 1/4"=1'-0"

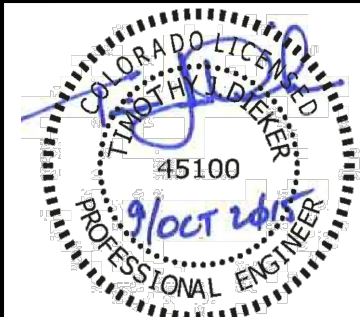


REFERENCE NOTES:

- 1 PROVIDE 17" x 17" PRICE MODEL 95 GRILLE ON DUCT OPENING.
- 2 MOUNT BOTTOM OF EXHAUST FAN AT 22'-0" AFF.
- 3 MOUNT TOP OF UNIT HEATER AT 12'-0" AFF.
- 4 MOUNT BOTTOM OF LOUVER AT 4'-0" AFF.
- 5 PROVIDE ZURN MODEL Z415B WITH 6" STRAINER. SLOPE CONCRETE TO DRAIN.
- 6 PROVIDE 4" SCHD. 40 PVC DRAIN PIPING, ROUTE TO 36" BELOW GRADE. PROVIDE MINIMUM 1/8" PER FT SLOPE. EXTEND PIPE TO WET WELL AND TERMINATE 1" BEYOND WALL OF WET WELL.

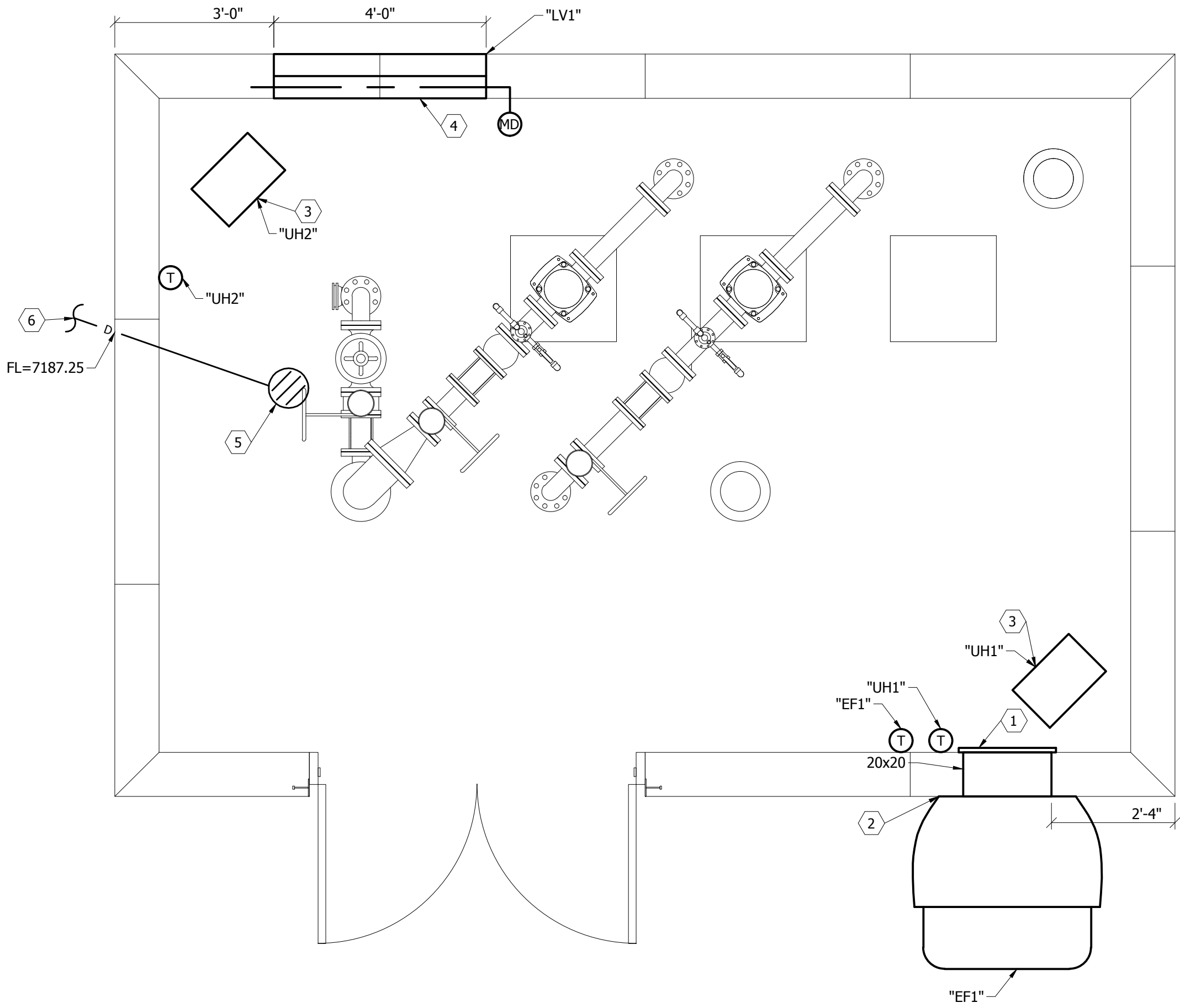


INTAKE BUILDING
MECHANICAL PLAN
RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO

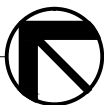


DESIGNED BY:	JWB
DRAWN BY:	RCS
APPROVED BY:	TJD
DESIGN PROJ:	17865.005
CONST PROJ:	----
SCALE:	AS NOTED
DATE:	OCT 2015
DRAWING NO:	M200
SHEET NO:	105 of 114

Drawing Name: W:\Proj\17000\17865\AutoCad\Raw Water Project\05 MEP\17865.005 M201 Booster Mechanical Plan.dwg Layout Name: Layout1 Plotted on: 10/14/2015 9:38:19 AM Last edit on: 00/00/00



BOOSTER BUILDING MECHANICAL PLAN
SCALE: 1/2"=1'-0"



BAR IS ONE INCH ON OFFICIAL DRAWINGS. 0 1" IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.

REFERENCE NOTES:

- 1 PROVIDE PRICE MODEL 95 20" x 20" GRILLE ON DUCT OPENING.
- 2 MOUNT BOTTOM OF WALL OPENING AT 12'-0" AFF.
- 3 MOUNT TOP OF UNIT HEATER AT 10'-0" AFF.
- 4 MOUNT BOTTOM OF LOUVER AT 4'-0" AFF.
- 5 PROVIDE ZURN MODEL Z415B WITH 6" STRAINER. SLOPE CONCRETE TO DRAIN.
- 6 PROVIDE 4" SCHD. 40 PVC DRAIN PIPING, ROUTE BOTTOM OF PIPE TO 48" BELOW FF. PROVIDE MINIMUM 1/8" PER FT SLOPE. EXTEND PIPE TO DRAINAGE DITCH AND DRAIN TO DAYLIGHT. REFER TO BOOSTER BUILDING SITE PLAN.

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BOOSTER BUILDING
MECHANICAL PLAN

RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO

DESIGNED BY:	JWB
DRAWN BY:	RCS
APPROVED BY:	TJD
DESIGN PROJ:	17865.005
CONST PROJ:	----
SCALE:	AS NOTED
DATE:	OCT 2015
DRAWING NO:	M201
SHEET NO:	106 of 114

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Drawing Name: W:\Proj\17000\17865\17865.005\AutoCad\Raw Water Project\05 MEP\17865.005 M410 Mechanical Details and Schedules.dwg Layout Name: Layout1 Plotted By: MKAC0899 Plotted on: 10/14/2015 9:38:27 AM Last edit on: 00/00/00

INTAKE BUILDING - ELECTRIC UNIT HEATER SCHEDULE										
MARK	MFGR	MODEL	FAN AIRFLOW (CFM)	HP	HEATING CAPACITY		ELECTRICAL			NOTES
					ELECTRIC (KW)	MIN. OUTPUT (MBH)	VOLTS/ PHASE	MCA (AMPS)	MOCp (AMPS)	
UH1	BERKO	HUH-2048M	1000	0.10	20	68	480 / 3	25	30	1, 2, 3
UH2	BERKO	HUH-2048M	1000	0.10	20	68	480 / 3	25	30	1, 2, 3
NOTES: 1. WALL MOUNTED THERMOSTAT 2. INTEGRAL DISCONNECT SWITCH 3. SINGLE POINT ELECTRICAL CONNECTION										

INTAKE BUILDING - LOUVER SCHEDULE								
MARK	MFGR	MODEL	AIRFLOW (CFM)	SIZE (IN x IN)	MIN. FREE AREA (SF)	MAX. VEL. (FPM)	MAX APD (IN WC)	NOTES
LV1	GREENHECK	EDJ-401	3700	40X40	5.5	700	0.15	1
LV2	GREENHECK	EDJ-401	3700	40X40	5.5	700	0.15	1
NOTES: 1. MOTORIZED CONTROL DAMPER (GREENHECK VCD-40) WITH 120 VOLT MOTOR OPERATOR (HEAVY DUTY / FAST ACTING)								

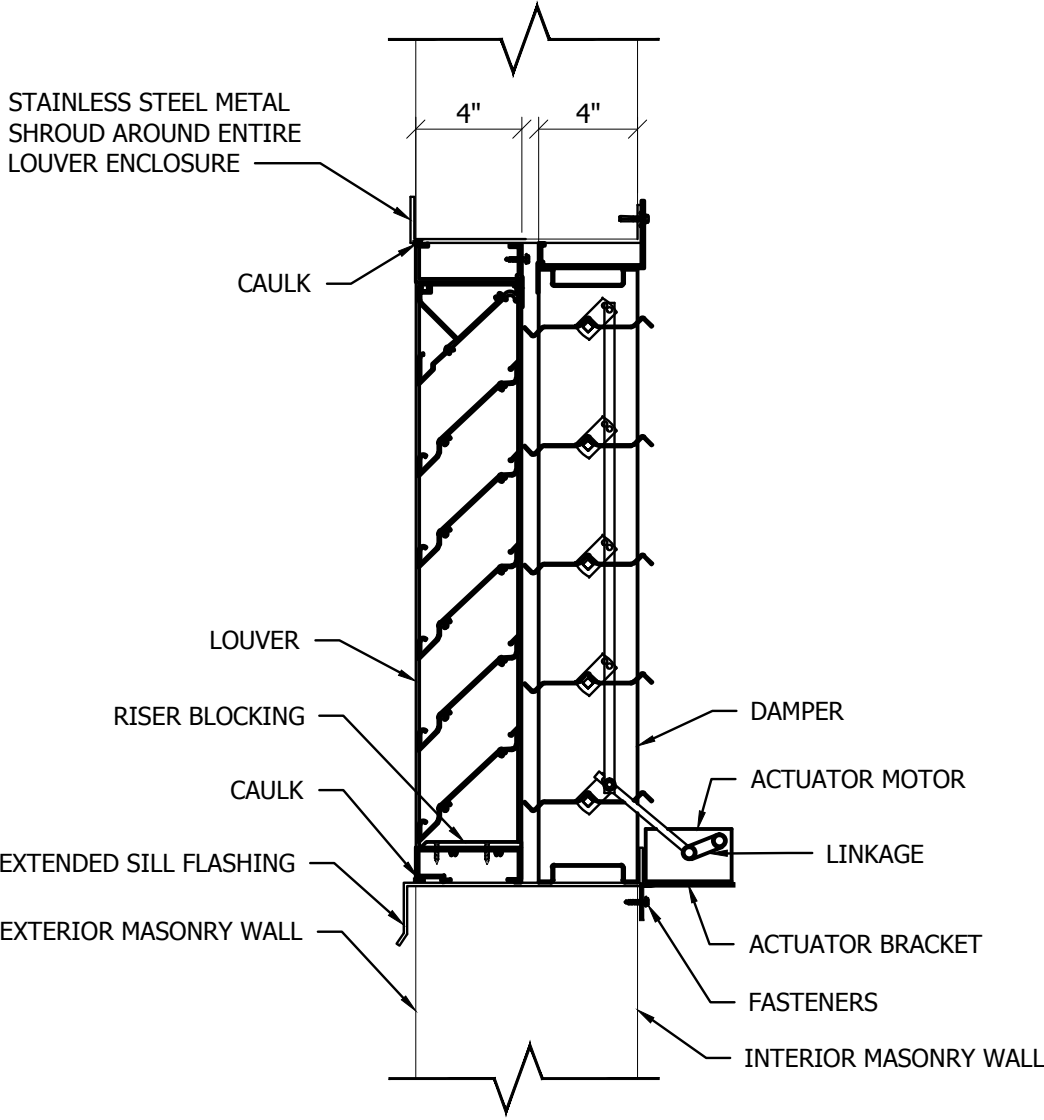
INTAKE BUILDING - FAN SCHEDULE								
MARK	MFGR	MODEL	AIRFLOW (CFM)	E.S.P. (IN. WC.)	MOTOR HP	VOLTS	PHASE	NOTES
EF1	GREENHECK	CWB-200-5	3700	0.15	1/2	120	1	1, 2, 3
EF2	GREENHECK	CWB-200-5	3700	0.15	1/2	120	1	1, 2, 3
NOTES: 1. DISCONNECT SWITCH 2. GRAVITY BACKDRAFT DAMPER WITH COUNTER WEIGHT 3. BIRD SCREEN								

BOOSTER BUILDING - FAN SCHEDULE								
MARK	MFGR	MODEL	AIRFLOW (CFM)	E.S.P. (IN. WC.)	MOTOR HP	VOLTS	PHASE	NOTES
EF1	GREENHECK	CWB-240-7	5000	0.15	3/4	120	1	1, 2, 3
NOTES: 1. DISCONNECT SWITCH 2. GRAVITY BACKDRAFT DAMPER WITH COUNTER WEIGHT 3. BIRD SCREEN								

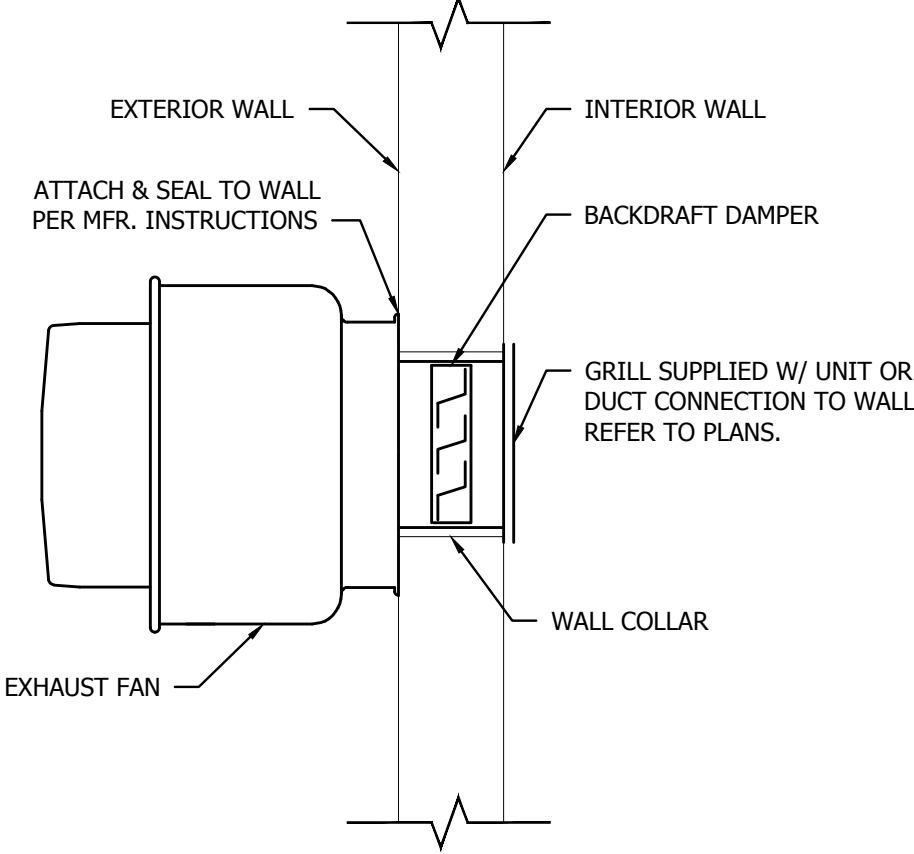
BOOSTER BUILDING - LOUVER SCHEDULE								
MARK	MFGR	MODEL	AIRFLOW (CFM)	SIZE (IN x IN)	MIN. FREE AREA (SF)	MAX. VEL. (FPM)	MAX APD (IN WC)	NOTES
LV1	GREENHECK	EDJ-401	5000	48X48	7	700	0.15	1
NOTES: 1. MOTORIZED CONTROL DAMPER (GREENHECK VCD-40) WITH 120 VOLT MOTOR OPERATOR (HEAVY DUTY / FAST ACTING)								

BOOSTER BUILDING - ELECTRIC UNIT HEATER SCHEDULE										
MARK	MFGR	MODEL	FAN AIRFLOW (CFM)	HP	HEATING CAPACITY		ELECTRICAL			NOTES
					ELECTRIC (KW)	MIN. OUTPUT (MBH)	VOLTS/ PHASE	MCA (AMPS)	MOCp (AMPS)	
UH1	BERKO	HUH-548SA	270	6W	5	17	480 / 3	7.5	15	1, 2, 3
UH2	BERKO	HUH-548SA	270	6W	5	17	480 / 3	7.5	15	1, 2, 3
NOTES: 1. WALL MOUNTED THERMOSTAT 2. INTEGRAL DISCONNECT SWITCH 3. SINGLE POINT ELECTRICAL CONNECTION										

BAR IS ONE INCH ON OFFICIAL DRAWINGS. 0 1" IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.



LOUVER DAMPER DETAIL 1
SCALE: NONE
M410



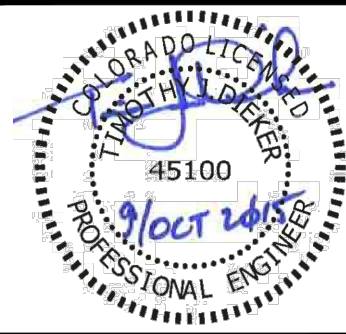
WALL EXHAUST FAN DETAIL 2
SCALE: NONE
M410

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PACOSA, CO 81447
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**MECHANICAL
DETAILS AND SCHEDULES**

**RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO**



DESIGNED BY: JWB
DRAWN BY: RCS
APPROVED BY: TJD
DESIGN PROJ: 17865.005
CONST PROJ: ----
SCALE: AS NOTED
DATE: OCT 2015
DRAWING NO: **M410**
SHEET NO: 107 of 114



- ① SUSPEND TOP OF FIXTURE AT 27'-0" AFF.
- ② MOUNT LIGHT FIXTURE AT 10'-0" AFF.
- ③ MOUNT PHOTOCELL AT 12'-0" AFF.
- ④ LABEL COVER PLATE "EXTERIOR LIGHTING OVERRIDE". REFER TO DETAIL 1/E420.
- ⑤ EXTEND AND CONNECT TO "EF1" CONTROLS CIRCUIT. REFER TO DETAIL 2/E410.
- ⑥ EXTEND AND CONNECT TO "EF2" CONTROLS CIRCUIT. REFER TO DETAIL 2/E420.
- ⑦ PROVIDE SINGLE POINT ELECTRICAL CONNECTION TO OVERHEAD CRANE. COORDINATE WITH MANUFACTURERS WIRING INSTRUCTIONS.
- ⑧ PROVIDE SINGLE POINT CONNECTION TO AIR COMPRESSOR. COORDINATE WITH MANUFACTURERS WIRING INSTRUCTIONS.
- ⑨ ROUTE (2'-4" CONDUITS BELOW GRADE A MINIMUM OF 3'-0" BEYOND BUILDING FOUNDATION. TERMINATE 6" AFF AND CAP BOTH ENDS FOR FUTURE USE.
- ⑩ PROVIDE 20A MOTOR RATED TOGGLE DISCONNECT SWITCH.
- ⑪ ROUTE 2" CONDUIT FROM 3" AFF NEAR WALL BELOW VFD. COORDINATE EXACT LOCATION WITH VFD INSTALLATION.
- ⑫ ROUTE CONDUIT IN SLAB AND TERMINATE 3" AFF NEAR PUMP PEDESTAL. PROVIDE 2" LIQUID TIGHT FLEX CONDUIT FOR CONNECTION TO PUMP.
- ⑬ PROVIDE (1'-3" CONDUIT AND (1'-1") CONDUIT WITH PULL STRING IN SLAB FOR FUTURE PUMP LEADS AND CONTROL WIRING. ROUTE TO 3" AFF AND CAP AT BOTH ENDS. COORDINATE WITH FUTURE PUMP PEDESTAL LOCATION.

1. PROVIDE (1)-1" CONDUIT WITH PULL STRING IN SLAB TO EACH PUMP PEDESTAL AND PIPE RISER FOR INSTRUMENTATION CONTROL WIRING INCLUDING FUTURE LOCATIONS. TERMINATE AT 3" AFF NEAR PUMP CONTROL PANEL AND INSTRUMENTATION EQUIPMENT. CAP ENDS AT FUTURE LOCATIONS. REFER TO PROCESS AND INSTRUMENTATION PLANS.

① 3-10 & 1-10G IN 3/4"C.

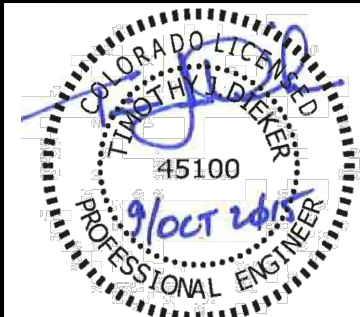
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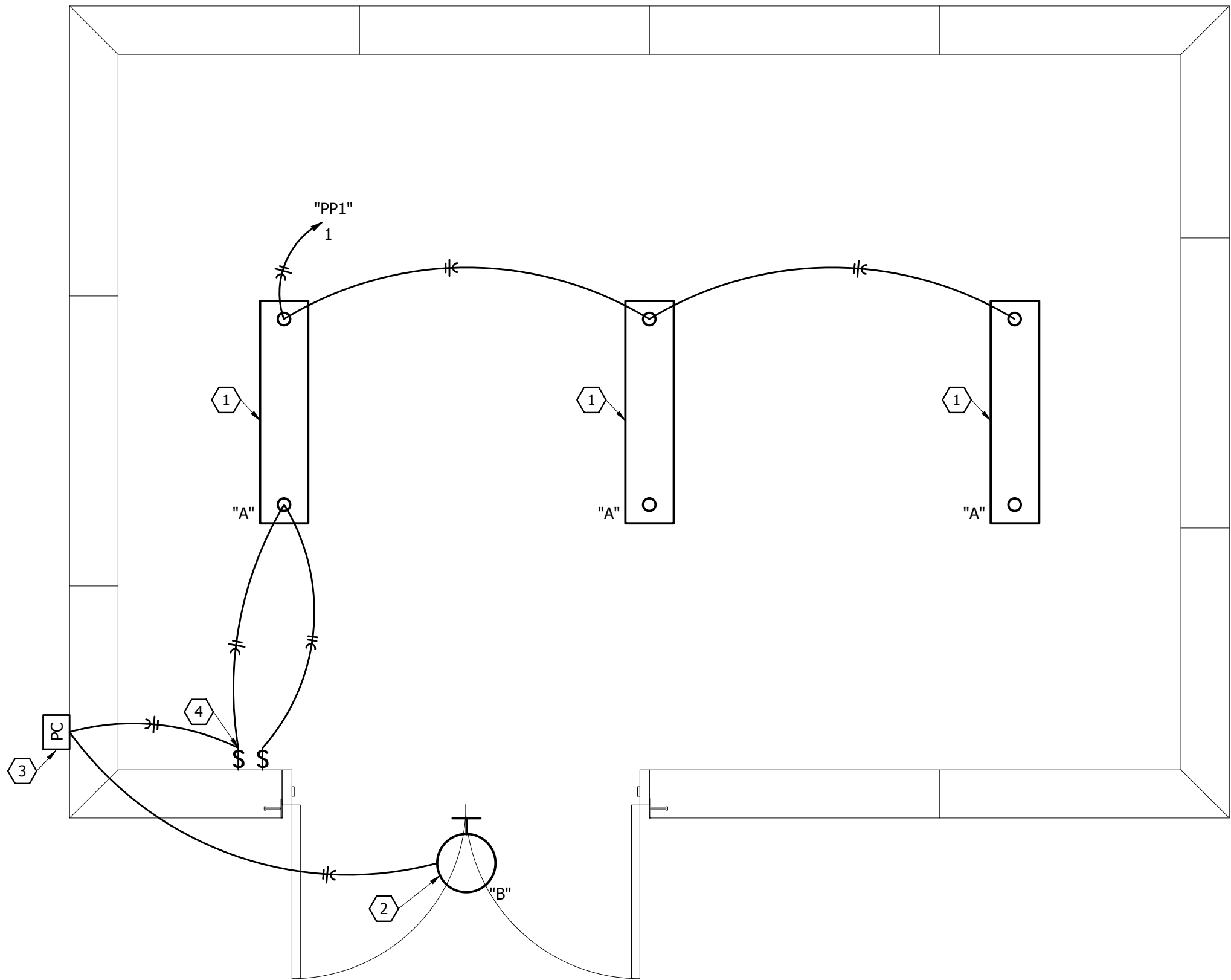
INTAKE BUILDING ELECTRICAL PLAN

**RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO**

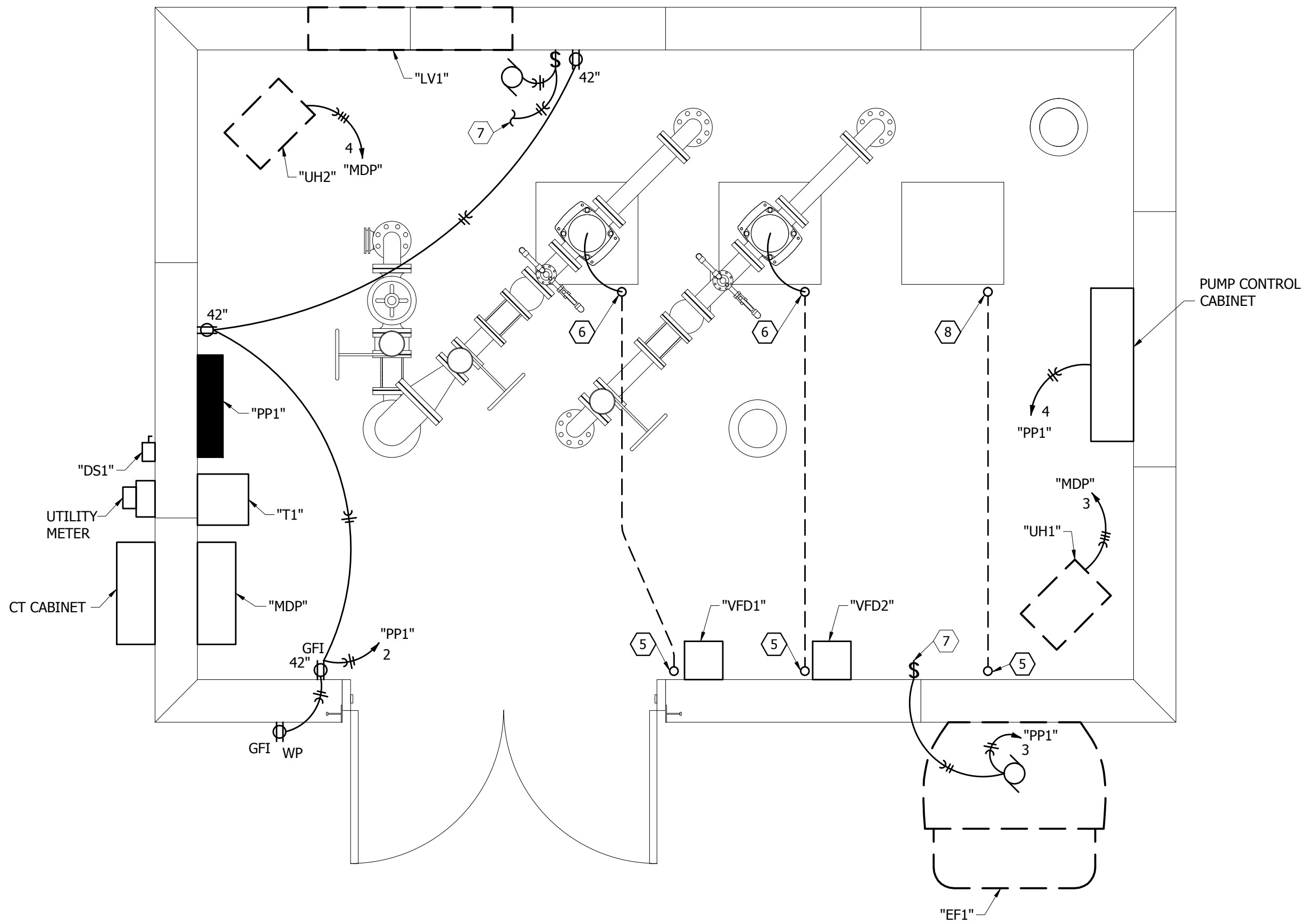


DESIGNED BY:	JWB
DRAWN BY:	RCS
APPROVED BY:	TJD
DESIGN PROJ:	17865.005
CONST PROJ:	----
SCALE:	AS NOTED
DATE:	OCT 2015
DRAWING NO:	E200
SHEET NO:	

Drawing Name: W:\Proj\17000\17865\AutoCad_Raw Water Project\05 MEP\17865.005 E201 Booster Electrical Plan.dwg Layout Name: Layout1 Plotted By: MKAO0889 Plotted on: 10/14/2015 9:38:58 AM
Last edit on: 00/00/00



BOOSTER BUILDING LIGHTING PLAN
SCALE: 1/2"=1'-0"



BOOSTER BUILDING POWER PLAN
SCALE: 1/2"=1'-0"

REFERENCE NOTES:

- 1 SUSPEND TOP OF LIGHT FIXTURE AT 10'-0" AFF.
- 2 MOUNT TOP OF LIGHT FIXTURE 10'-0" AFF.
- 3 MOUNT PHOTOCELL 12'-0" AFF.
- 4 LABEL COVER PLATE "EXTERIOR LIGHTING OVERRIDE".
- 5 ROUTE 1-1/2" CONDUIT IN CONCRETE SLAB FROM 3" ABOVE SLAB NEAR WALL TO PUMP PEDESTAL.
- 6 TERMINATE 3" ABOVE SLAB NEAR PUMP PEDESTAL. PROVIDE 1-1/2" LIQUID TIGHT FLEX CONDUIT FOR CONNECTION TO PUMP LEADS.
- 7 EXTEND TO EXHAUST FAN CONTROL CIRCUIT. REFER TO EXHAUST FAN/LOUVER CONNECTION DETAIL.
- 8 TERMINATE 3" ABOVE SLAB NEAR PUMP PEDESTAL. CAP BOTH ENDS FOR FUTURE USE.

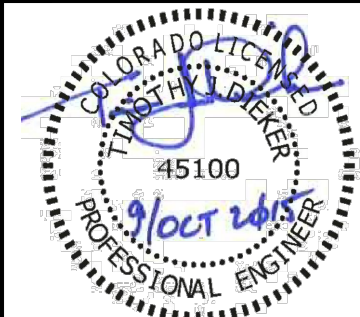
GENERAL NOTES:

1. PROVIDE (1)-1" CONDUIT WITH PULL STRING IN SLAB TO EACH PUMP PEDESTAL AND PIPE RISER FOR INSTRUMENTATION CONTROL WIRING INCLUDING FUTURE LOCATIONS. TERMINATE AT 3" AFF NEAR PUMP CONTROL PANEL AND INSTRUMENTATION EQUIPMENT. CAP ENDS AT FUTURE LOCATIONS. REFER TO PROCESS AND INSTRUMENTATION PLANS.
2. BOOSTER STATION BASE BID IS FOR 60HP BOOSTER PUMPS.
3. BOOSTER STATION BID ALT. 1 IS FOR 50HP BOOSTER PUMPS.
4. BOOSTER STATION BID ALT. 2 IS FOR 40HP BOOSTER PUMPS.
5. ALL MECHANICAL EQUIPMENT IS TO BE PRICED AS BASE BID ONLY.
6. ALL ELECTRICAL EQUIPMENT IS TO BE PRICED AS BASE BID ONLY, UNLESS NOTED OTHERWISE. AFFECTED EQUIPMENT AS FOLLOWS:
A. MAIN DISTRIBUTION PANEL (MDP)
B. MAIN SERVICE DISCONNECT (DS1)
C. VARIABLE FREQUENCY DRIVES (VFD)
D. ELECTRICAL EQUIPMENT FEEDERS
7. REFER TO BID ALTERNATE ELECTRICAL RISER DIAGRAMS FOR FOR ALTERNATE BID EQUIPMENT AND FEEDER SCHEDULES.



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BOOSTER BUILDING
ELECTRICAL PLAN
RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO



DESIGNED BY:	JWB
DRAWN BY:	RCS
APPROVED BY:	TJD
DESIGN PROJ:	17865.005
CONST PROJ:	----
SCALE:	AS NOTED
DATE:	OCT 2015
DRAWING NO:	E201
SHEET NO:	109 of 114

INTAKE BUILDING - VARIABLE FREQUENCY DRIVE SCHEDULE										
MARK	EQUIPMENT SERVED	LOAD			DRIVE		MOUNTING TYPE			NOTES
		HP	VOLT	PHASE	FLA*	TYPE	FLOOR	WALL	MCC	
VFD1	150HP INTAKE PUMP	150	480	3	180	PWM		X		
NOTES:										
NEMA 12 ENCLOSURE DELUXE KEYPAD (NO CODE NUMBERING)										
*VERIFY FLA WITH PUMP MANUFACTURER										

INTAKE BUILDING - TRANSFORMER SCHEDULE										
MARK	RATING		TYPE MOUNTING			TEMP. RISE (°C)	PRIMARY		SECONDARY	
	KVA	PHASE	FLOOR	WALL	PAD		VOLTAGE	CONNECTION	VOLTAGE	CONNECTION
T1	45	3	X			150	480	DELTA	120 / 208	WYE
NOTES:										

INTAKE BUILDING - DISCONNECT SWITCH SCHEDULE									
MARK	EQUIPMENT SERVED	SWITCH		AMP	POLE	FUSE		TYPE	ENCLOSURE NEMA TYPE
		VOLTAGE	VOLTAGE			AMP	AMP		
DS1	SERVICE ENTRANCE	480	400	3	3	400	400	FRSRK	3R
DS2	7.5 HP CRANE	480	30	3	3	-	-	-	12
DS3	30 HP AIR COMP.	480	60	3	3	-	-	-	12
NOTES:									

INTAKE BUILDING - CIRCUIT BREAKER PANELBOARD SCHEDULE													
MARK: "PP1"						MOUNTING: SURFACE							
VOLTAGE: 120/208		PHASE: 3		WIRE: 4		POLES: 30		MAIN LUGS: 100 AMP		MAIN C/B: 100 AMP			
CIRC. NO.	LOAD DESCRIPTION	CIRC. BRKR	LOAD (VA)	PHASE LOAD IN VA			LOAD (VA)	CIRC. BRKR.	LOAD DESCRIPTION	CIRC. NO.			
				A	B	C							
1	LIGHTS	20A1P	1200	2400			1200	20A1P	EF1 (1/2 HP), LV1	2			
3	RECEPTACLES	20A1P	900		2100		1200	20A1P	EF2 (1/2 HP), LV2	4			
5	RECEPTACLES	20A1P	900			1900	1000	20A1P	PUMP CONTROL PANEL	6			
7	METER VAULT	20A1P	400	1060			660	20A1P	OVERHEAD DOOR CIRCUIT	8			
9	SPARE	20A1P			0			20A1P	SPARE	10			
11	SPARE	20A1P				0		20A1P	SPARE	12			
13	SPARE	20A1P		0				20A1P	SPARE	14			
15	SPARE	20A1P			0			20A1P	SPARE	16			
17	SPARE	20A1P				0		20A1P	SPARE	18			
19	SPARE	20A1P		0				20A1P	SPARE	20			
21	SPACE				0				SPACE	22			
23	SPACE					0			SPACE	24			
25	SPACE			0					SPACE	26			
27	SPACE				0				SPACE	28			
29	SPACE					0			SPACE	30			
TOTALS:				3460	2100	1900							
MAX. PHASE VA: 3460		MAX. PHASE AMPS: 29		MAX. PHASE DIVERSIFIED VA: 3460		MAX. PHASE DIVERSIFIED AMPS: 29							

INTAKE BUILDING - CB DISTRIBUTION PANEL SCHEDULE						
MARK: MDP				MAIN BUSS: 400 AMP		
VOLTAGE: 480 / 277		PHASE: 3	WIRE: 4	GROUND BUS: 200		AMP
				CIRCUIT BREAKER		
UNIT NO.	EQUIPMENT SERVED			AMP	POLE	
1	MAIN			400	3	
2	T1 (45KVA)			70	3	
3	DS2 (7.5HP OVERHEAD CRANE)			20	3	
4	DS3 (30HP AIR COMPRESSOR)			80	3	
5	UH1 (20KW)			30	3	
6	UH2 (20KW)			30	3	
7	VFD1 (150HP)			250	3	
8	SPARE			15	3	
9	SPARE			30	3	
10						
11						
12						
ACCESSORIES:				SURGE PROTECTION DEVICE		

INTAKE BUILDING - LIGHTING FIXTURE SCHEDULE												
MARK	MANUFACTURER	CATALOG NUMBER	MOUNTING			FINISH	LAMP					NOTES
			REC	SURF	WALL		TYPE	QTY.	INC.	FLUOR.	LED	
A	WILLIAMS	EGL2-4-L191/835-HIAFR-WET/2-DRV-UNV		X		WH	LED	-			X	1
B	COOPER	XTOR3A-N			X	BZ	LED	-			X	
NOTES:												
1. PROVIDE CHAIN MOUNTING KIT.												

BOOSTER BUILDING - LIGHTING FIXTURE SCHEDULE (BASE BID, NO ALTERNATES)													
MARK	MANUFACTURER	CATALOG NUMBER	MOUNTING			FINISH	LAMP	TYPE	QTY.	INC.	FLUOR.	H.I.D.	NOTES
			REC	SURF	WALL								
A	WILLIAMS	96-4-L62/835-HIAFR-WET/2-DRV-UNV		X		WH		LED	-			X	1
B	COOPER	XTOR2A-N			X	BZ		LED	-			X	
NOTES:													
1. PROVIDE CHAIN MOUNTING KIT.													

BOOSTER BUILDING - DISCONNECT SWITCH SCHEDULE (BASE BID)									
MARK	EQUIPMENT SERVED	SWITCH		AMP	POLE	FUSE		TYPE	ENCLOSURE NEMA TYPE
		VOLTAGE	VOLTAGE			AMP	AMP		
DS1	SERVICE ENTRANCE	480	400	3	3	300	300	FRSRK	3R
NOTES:									

BOOSTER BUILDING- TRANSFORMER SCHEDULE (BASE BID, NO ALTERNATES)										
MARK	RATING		TYPE MOUNTING			TEMP. RISE (°C)	PRIMARY		SECONDARY	
	KVA	PHASE	FLOOR	WALL	PAD		VOLTAGE	CONNECTION	VOLTAGE	CONNECTION
T1	45	3	X			150	480	DELTA	120 / 208	WYE
NOTES:										

BOOSTER BUILDING - VARIABLE FREQUENCY DRIVE SCHEDULE (BASE BID)										
MARK	EQUIPMENT SERVED	LOAD			DRIVE		MOUNTING TYPE			NOTES
		HP	VOLT	PHASE	FLA*	TYPE	FLOOR	WALL	MCC	
VFD1	PUMP 1	60	480	3	77	PWM		X		
VFD2	PUMP 2	60	480	3	77	PWM		X		
NOTES:										
NEMA 12 ENCLOSURE DELUXE KEYPAD (NO CODE NUMBERING)										
*VERIFY FLA WITH PUMP MANUFACTURER										

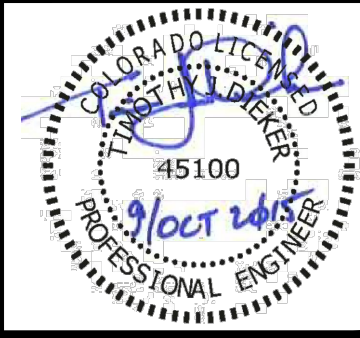
BOOSTER BUILDING - CIRCUIT BREAKER PANELBOARD SCHEDULE (BASE BID, NO ALTERNATES)													
MARK: "PP1"							MOUNTING: SURFACE						
VOLTAGE: 120/208		PHASE: 3		WIRE: 4		POLES: 30		MAIN LUGS: 100 AMP		MAIN C/B: 100 AMP			
CIRC. NO.	LOAD DESCRIPTION	CIRC. BRKR	LOAD (VA)	PHASE LOAD IN VA			LOAD (VA)	CIRC. BRKR.	LOAD DESCRIPTION	CIRC. NO.			
				A	B	C							
1	LIGHTING	20A1P	600	1400			800	20A1P	RECEPTICALS	2			
3	EF1 (3/4HP), LV1	20A1P	1650		2650		1000	20A1P	PUMP CONTROL PANEL	4			
5	SPARE	20A1P				0		20A1P	SPARE	6			
7	SPARE	20A1P		0				20A1P	SPARE	8			
9	SPARE	20A1P			0			20A1P	SPARE	10			
11	SPARE	20A1P				0		20A1P	SPARE	12			
13	SPARE	20A1P		0				20A1P	SPARE	14			
15	SPACE				0				SPACE	16			
17	SPACE					0			SPACE	18			
19	SPACE			0					SPACE	20			
21	SPACE				0				SPACE	22			
23	SPACE					0			SPACE	24			
25	SPACE			0					SPACE	26			
27	SPACE				0				SPACE	28			
29	SPACE					0			SPACE	30			
TOTALS:				1400	2650	0							
MAX. PHASE VA: 2650		MAX. PHASE AMPS: 22		MAX. PHASE DIVERSIFIED VA: 2650		MAX. PHASE DIVERSIFIED AMPS: 22							

BOOSTER BUILDING - CB DISTRIBUTION PANEL SCHEDULE					
MARK: MDP (BASE BID)				MAIN BUSS: 400 AMP	
VOLTAGE: 480 / 277		PHASE: 3	WIRE: 4	GROUND BUS: 200 AMP	
				CIRCUIT BREAKER	
UNIT NO.	EQUIPMENT SERVED			AMP	POLE
1	MAIN			300	3
2	T1 (45KVA)			70	3
3	UH1 (5KW)			15	3
4	UH2 (5KW)			15	3
5	VFD1 (60HP)			125	3
6	VFD2 (60HP)			125	3
7	SPARE			15	3
8	SPACE				
9	SPACE				
10	SPACE				
11	SPACE				
12	SPACE				
ACCESSORIES:					

BARTLETT & WEST

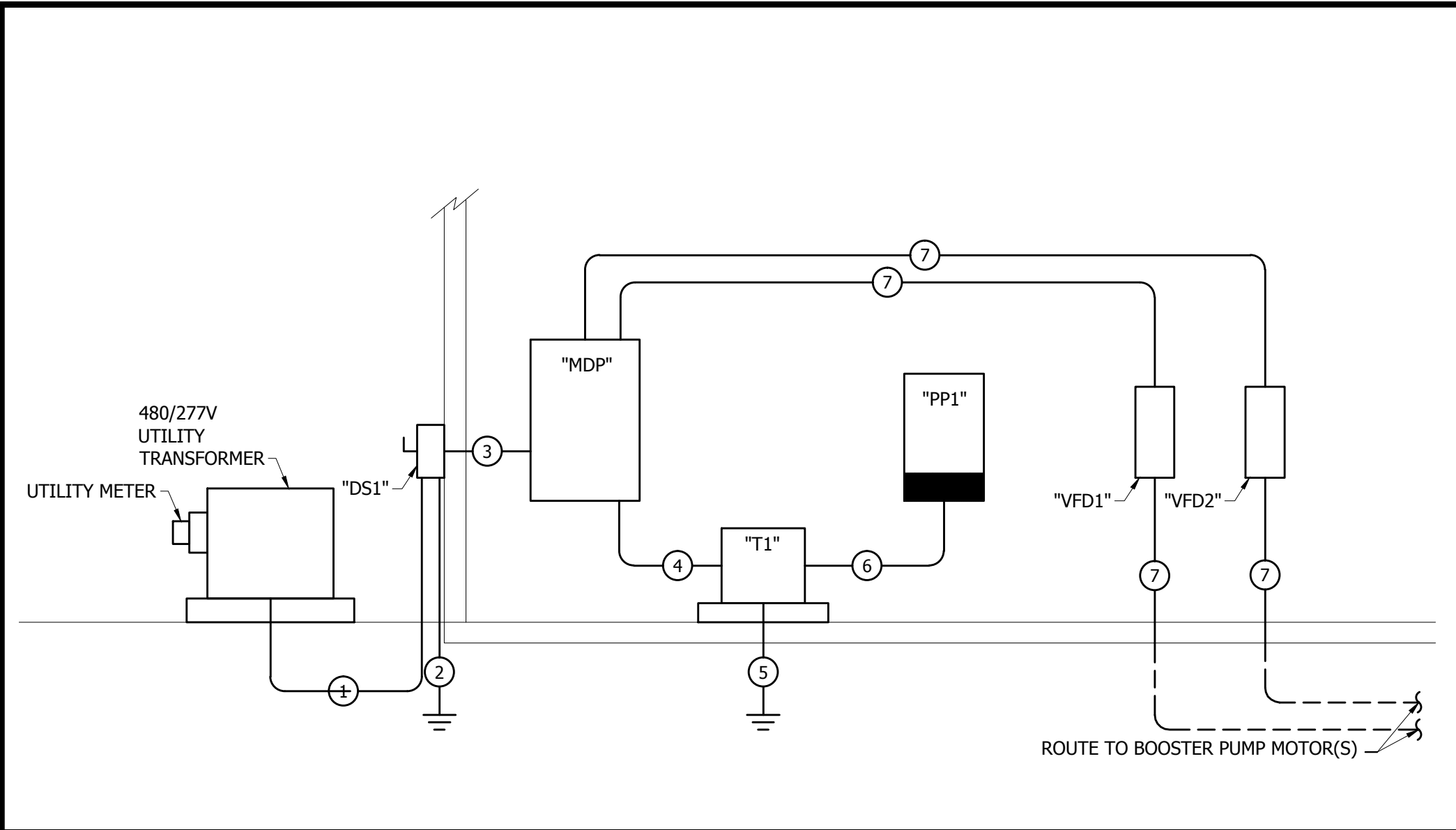
180 TALSMAN DR. UNIT D-1 PAGOSA SPRINGS, CO 81147
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ELECTRICAL SCHEDULES
RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO



DESIGNED BY: JWB
DRAWN BY: RCS
APPROVED BY: TJD
DESIGN PROJ: 17865.005
CONST PROJ: ----
SCALE: AS NOTED
DATE: OCT 2015
DRAWING NO:
E410
SHEET NO:

Drawing Name: W:\Proj\17000\17865\17865.005\AutoCad\Raw Water Project\05 MEP\17865.005 E420 Electrical Details.dwg Layout Name: Layout1 Plotted on: 10/14/2015 9:39:17 AM
Last edit on: 00/00/00



BOOSTER BUILDING (BID ALT. 2)- ELECTRICAL RISER DIAGRAM

SCALE: NONE

6
E410

FEEDER SCHEDULE:

- 4-250 IN 3"C.
- 1-2G IN 3/4"C.
- 4-250 & 1-4G IN 3"C.
- 3-4 & 1-8G IN 1"C.
- 1-6G IN 3/4"C.
- 4-1 & 1-8G IN 1-1/2"C.
- 3-1 & 1-8G IN 1"C.

BOOSTER - MDP (BID ALT. 2)

MARK: MDP			MAIN BUSS: 400 AMP	
VOLTAGE: 480 / 277		PHASE: 3	WIRE: 4	GROUND BUS: 200 AMP
				CIRCUIT BREAKER
UNIT NO.	EQUIPMENT SERVED			AMP POLE
1	MAIN			250 3
2	T1 (45KVA)			70 3
3	UH1 (5KW)			15 3
4	UH2 (5KW)			15 3
5	VFD1 (40HP)			100 3
6	VFD2 (40HP)			100 3
7	SPARE			15 3
8	SPACE			
9	SPACE			
10	SPACE			

BOOSTER - VARIABLE FREQUENCY DRIVE SCHEDULE (BID ALT. 2)

MARK	EQUIPMENT SERVED	LOAD		VOLT	PHASE	DRIVE		MOUNTING TYPE			NOTES
		HP				FLA*	TYPE	FLOOR	WALL	MCC	
VFD1	PUMP 1	40		480	3	52	PWM		X		
VFD2	PUMP 2	40		480	3	52	PWM		X		

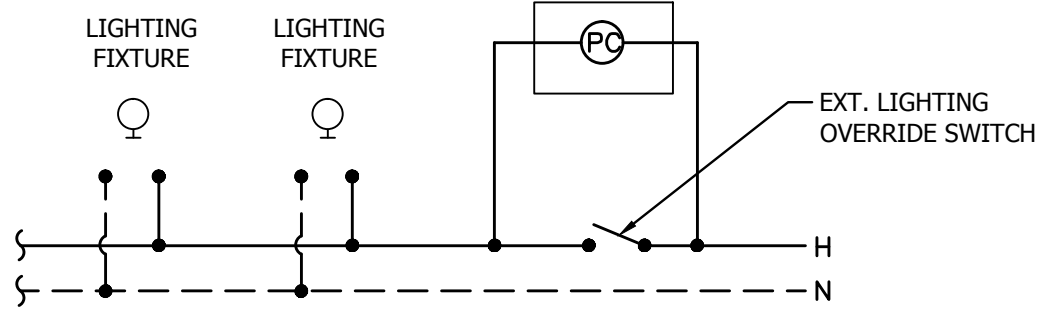
NOTES:
NEMA 12 ENCLOSURE
DELUXE KEYPAD (NO CODE NUMBERING)

*VERIFY FLA WITH PUMP MANUFACTURER

BOOSTER - DS1 (BID ALT. 2)

MARK	EQUIPMENT SERVED	SWITCH		VOLTAGE	AMP	POLE	FUSE		ENCLOSURE NEMA TYPE
		DS1	SERVICE ENTRANCE				AMP	TYPE	
				480	400	3	250	FRSRK	3R

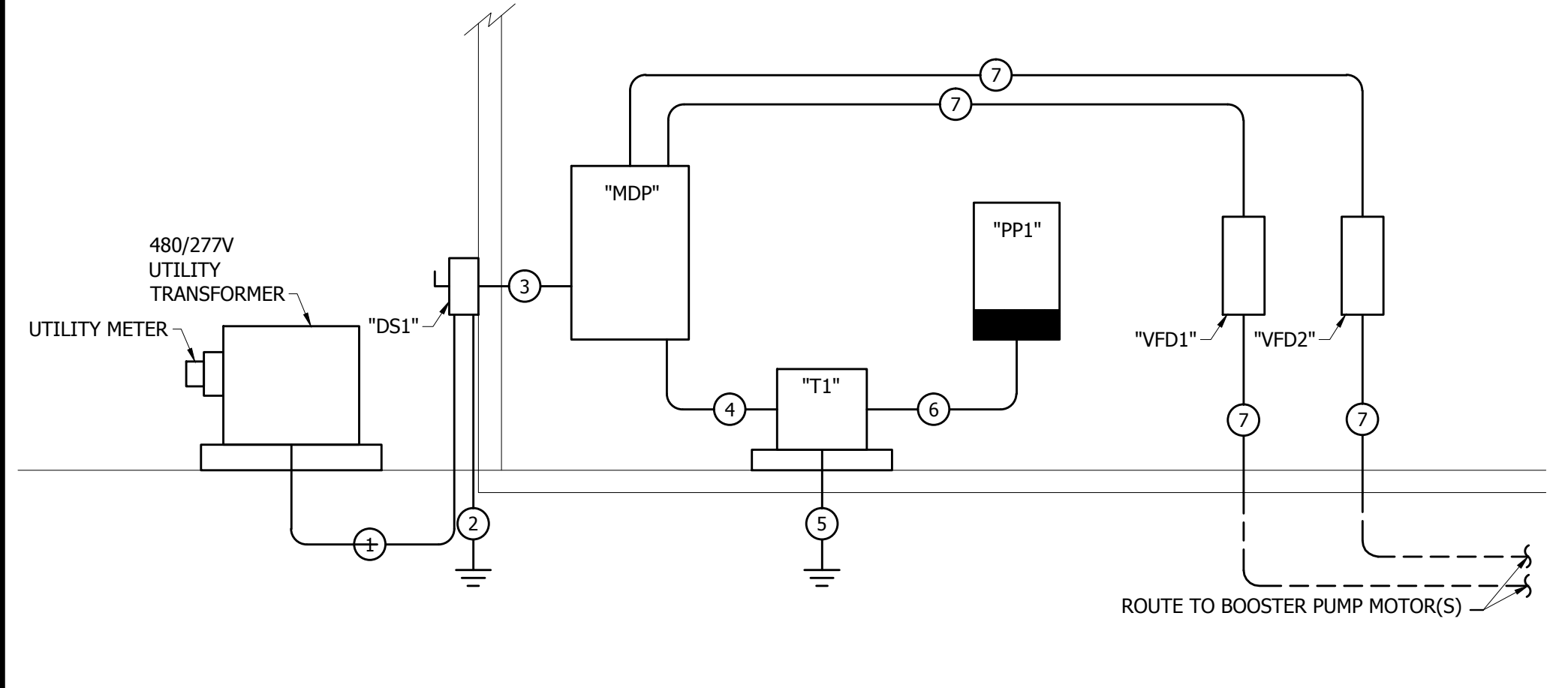
NOTES:



PHOTOCELL WIRING DETAIL

SCALE: NONE

1
E410



BOOSTER BUILDING (BID ATL. 1)- ELECTRICAL RISER DIAGRAM

SCALE: NONE

5
E410

FEEDER SCHEDULE:

- 4-350 IN 3"C.
- 1-2G IN 3/4"C.
- 4-350 & 1-4G IN 3"C.
- 3-4 & 1-8G IN 1"C.
- 1-6G IN 3/4"C.
- 3-1 & 1-8G IN 1-1/2"C.

BOOSTER - MDP (BID ALT. 1)

*VERIFY FLA WITH PUMP MANUFACTURER	

BOOSTER - VARIABLE FREQUENCY DRIVE SCHEDULE (BID ALT. 1)

MARK	EQUIPMENT SERVED	LOAD		VOLT	PHASE	DRIVE		MOUNTING TYPE			NOTES
		HP				FLA*	TYPE	FLOOR	WALL	MCC	
VFD1	PUMP 1	50		480	3	65	PWM		X		
VFD2	PUMP 2	50		480	3	65	PWM		X		

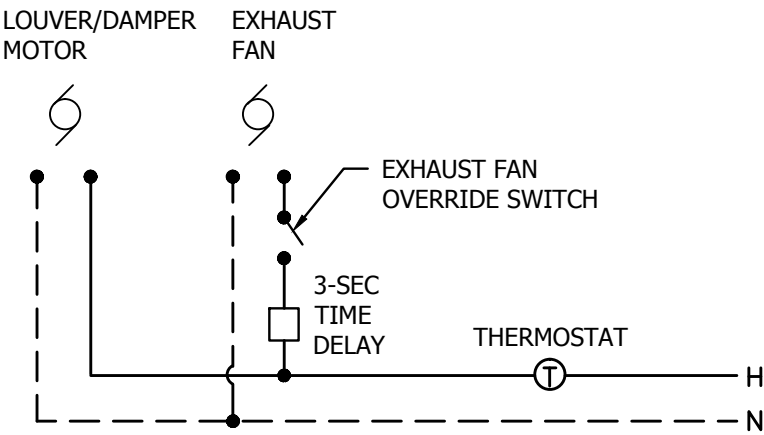
NOTES:
NEMA 12 ENCLOSURE
DELUXE KEYPAD (NO CODE NUMBERING)

*VERIFY FLA WITH PUMP MANUFACTURER

BOOSTER - DS1 (BID ALT. 1)

MARK	EQUIPMENT SERVED	SWITCH		VOLTAGE	AMP	POLE	FUSE		ENCLOSURE NEMA TYPE
		DS1	SERVICE ENTRANCE				AMP	TYPE	
				480	400	3	300	FRSRK	3R

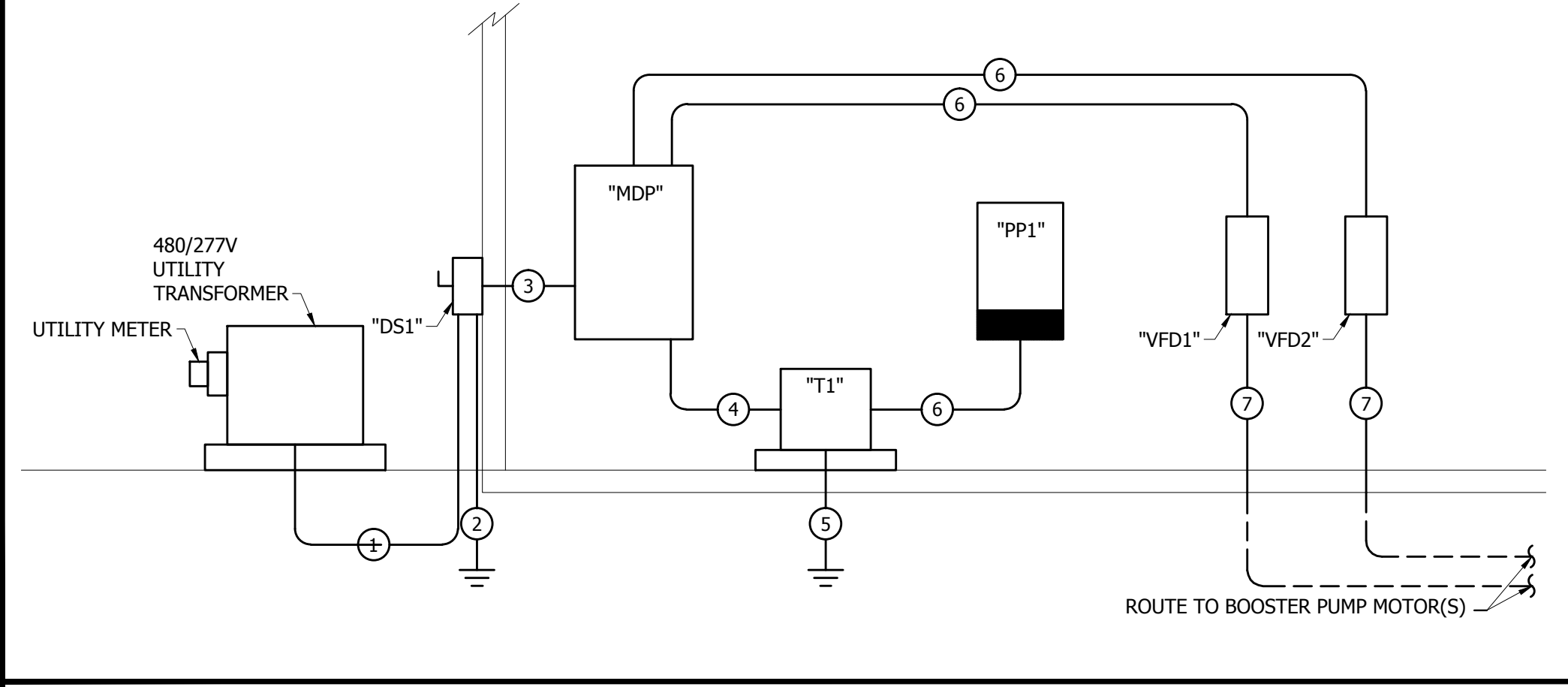
NOTES:



EXHAUST FAN / LOUVER WIRING DETAIL

SCALE: NONE

2
E410



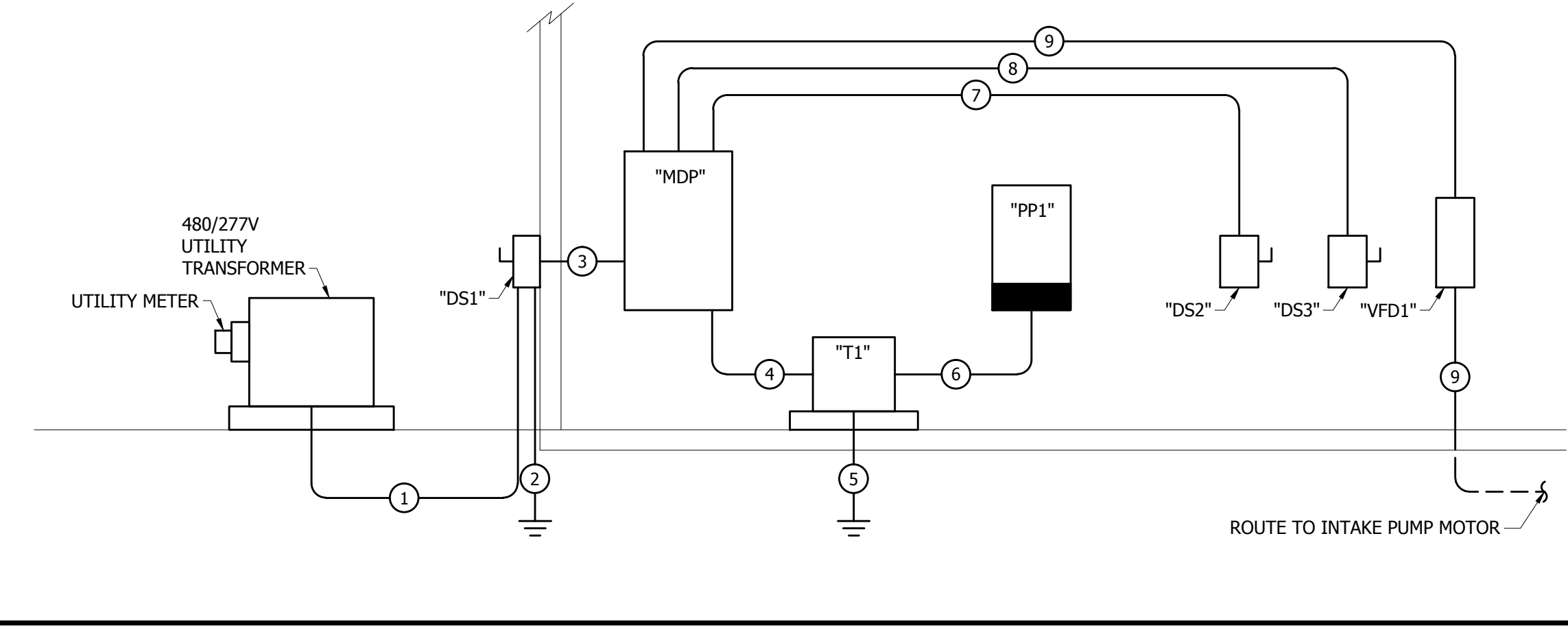
BOOSTER BUILDING (BASE BID)- ELECTRICAL RISER DIAGRAM

SCALE: NONE

4
E410

FEEDER SCHEDULE:

- 4-350 IN 3"C.
- 1-2G IN 3/4"C.
- 4-350 & 1-3G IN 3"C.
- 3-4 & 1-8G IN 1"C.
- 1-6G IN 3/4"C.
- 3-1 & 1-6G IN 1-1/2"C.



INTAKE BUILDING - ELECTRICAL RISER DIAGRAM

SCALE: NONE

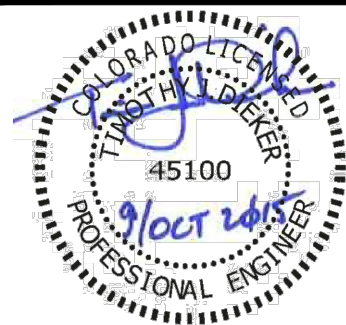
3
E410

FEEDER SCHEDULE:

- 4-3/0 IN EACH OF (2)-2"C.
- 1-1/0G IN 3/4"C.
- 4-3/0 & 1-3G IN EACH OF (2)-2"C.
- 3-4 & 1-8G IN 1"C.
- 1-6G IN 3/4"C.
- 4-1 & 1-8G IN 1-1/2"C.
- 3-10 & 1-10G IN 3/4"C.
- 3-3 & 1-8G IN 1-1/2"C.
- 3-4/0 & 1-4G IN 2"C.

BARTLETT & WEST

ELECTRICAL
DETAILS
RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO

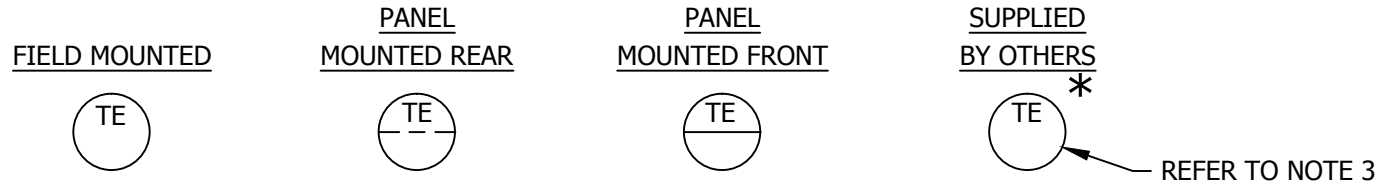


DESIGNED BY:	JWB
DRAWN BY:	RCS
APPROVED BY:	TJD
DESIGN PROJ:	17865.005
CONST PROJ:	----
SCALE:	AS NOTED
DATE:	OCT 2015
DRAWING NO:	E420
SHEET NO:	111 of 114

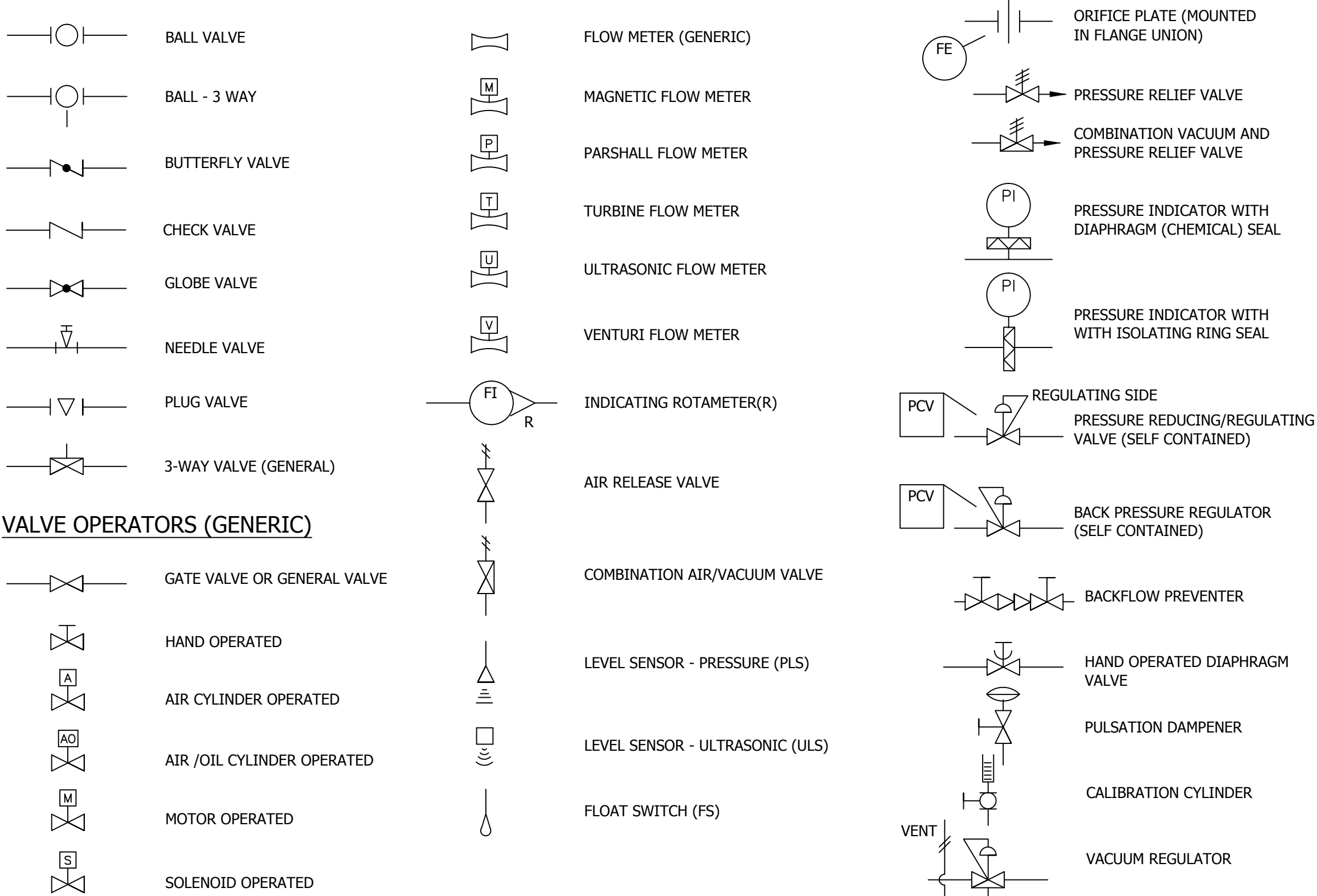
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BAR IS ONE INCH ON OFFICIAL DRAWINGS. 0 1" IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.

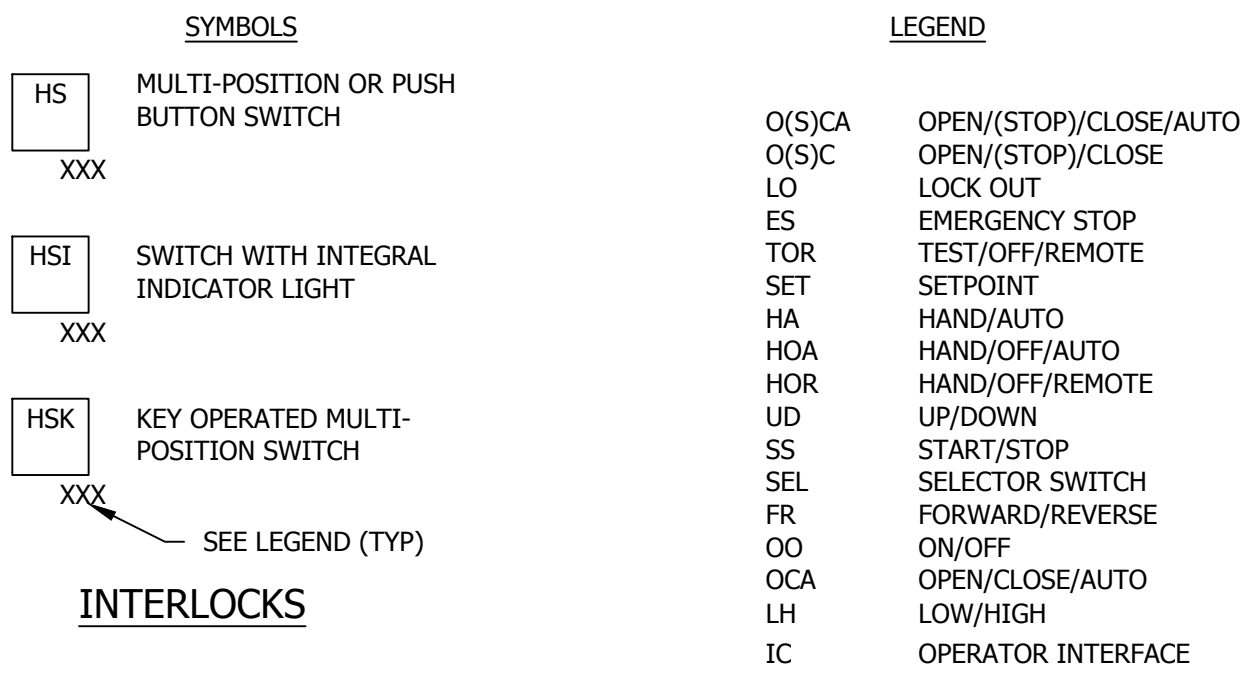
GENERAL INSTRUMENT SYMBOLS



SPECIFIC INSTRUMENT AND CONTROL SYMBOLS

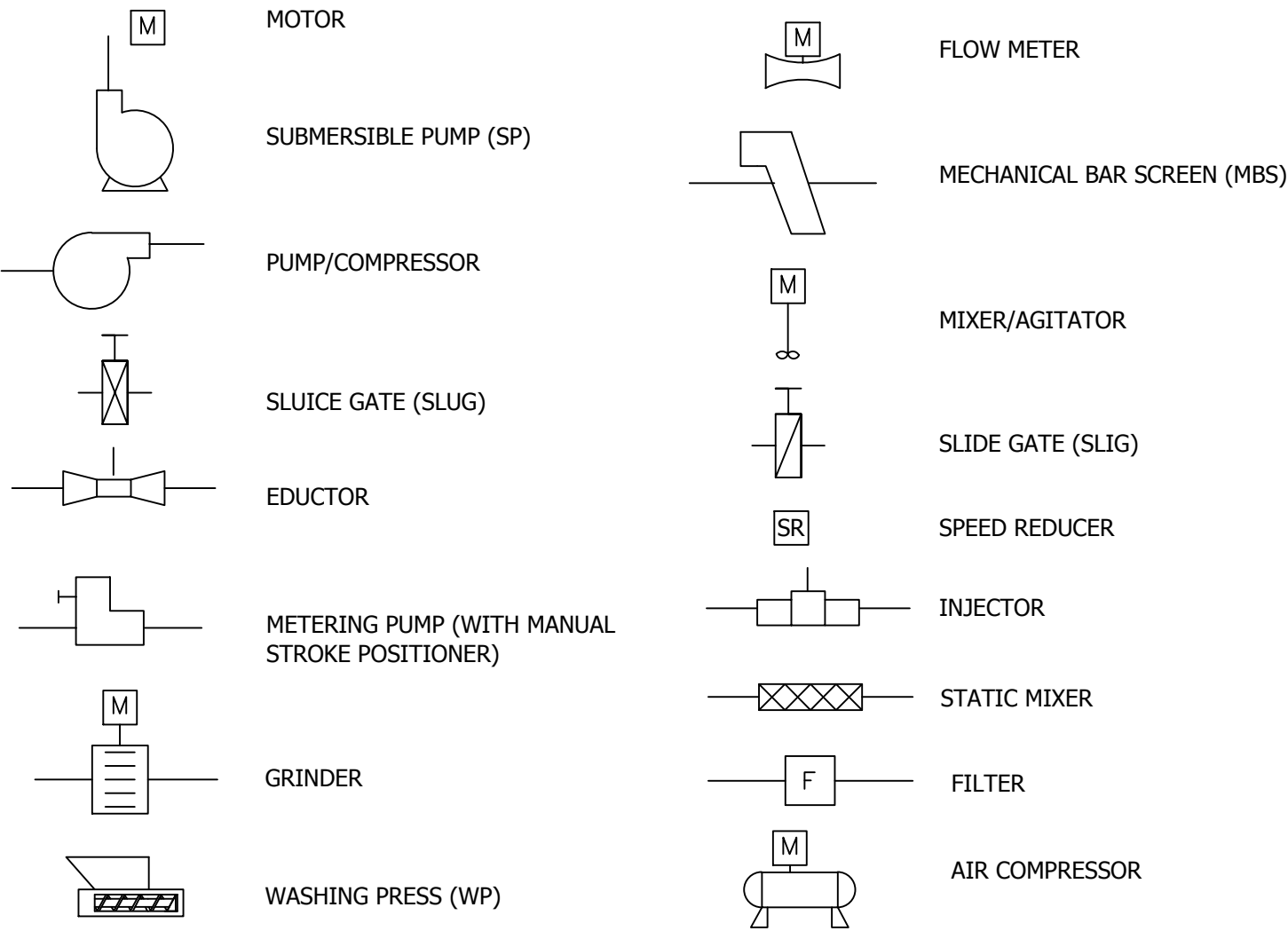


HAND SWITCH SYMBOLS AND LEGEND



- NOTES:
1. RUN INDICATION SHALL BE PROVIDED FOR ALL EQUIPMENT MANUALLY CONTROLLED FROM THE LOCAL CONTROL PANELS.
 2. APPURTENANCES SHOWN ON VALVES ARE EXAMPLES ONLY AND MAY BE INTERCHANGED WITH OTHER VALVES.
 3. ASTERISK (*) INDICATES INSTRUMENT FURNISHED BY EQUIPMENT MANUFACTURER AND/OR UNDER OTHER DIVISIONS OF THE SPECIFICATIONS.

EQUIPMENT SYMBOLS



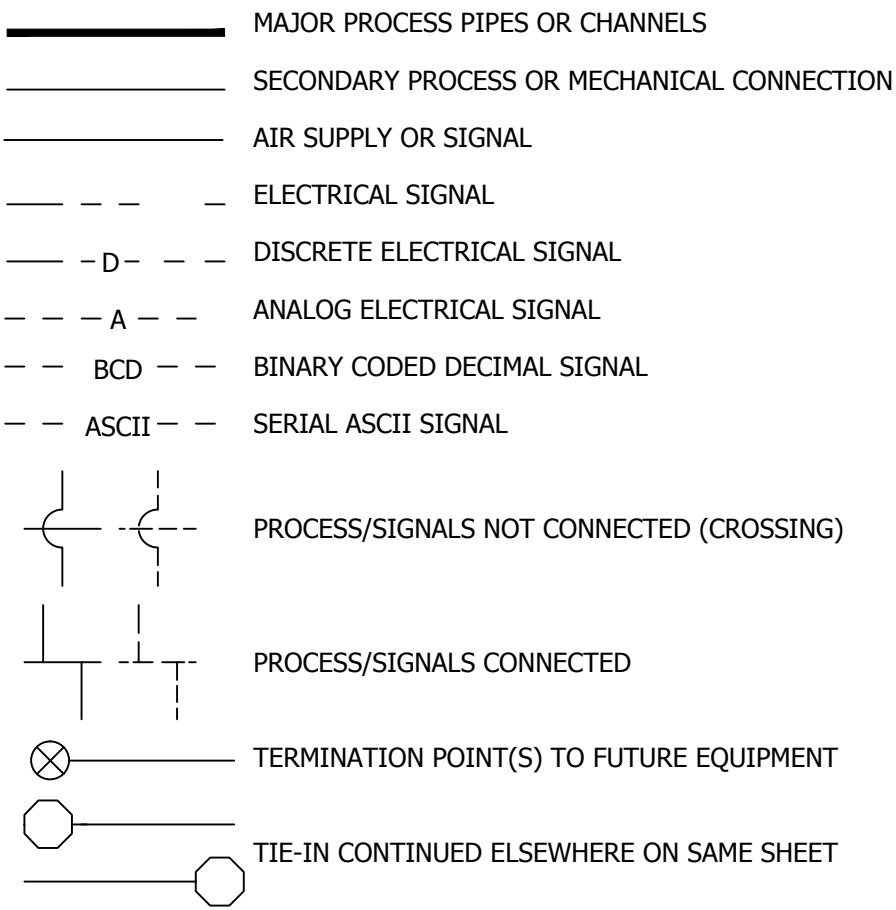
DISCRETE INPUT AND OUTPUT NUMBER SUFFIXES

SUFFIX	STATUS	COMMAND	DESCRIPTION
A	X		RUNNING; ON; ENERGIZED
B	X		AVAILABLE; READY TO RUN
C	X		OPEN POSITION
D	X		CLOSE POSITION
F	X		FAULT; ALARM
G	X		RUNNING FORWARD; LOW SPEED OR VALVE
H	X		RUNNING REVERSE; HIGH SPEED OR VALVE
J		X	START/STOP (SINGLE SPEED ELECTRIC MOTORS)
			OPEN/CLOSE (SOLENOID VALVES, ETC.)-MAINTAINED
K		X	START (FORWARD OR LOW SPEED); OPEN-MOMENTARY OR MAINTAINED
L		X	START (REVERSE OR HIGH SPEED); CLOSE-MOMENTARY OR MAINTAINED
S		X	STOP/SHUTDOWN-MOMENTARY
W	X		HAND/AUTO SWITCH IN "AUTO" POSITION
X,Y,Z	X		STATUS (AS SPECIFIED)

PROCESS CONTROL MODULE LEGEND

ACC-(A,C,I)	ACCUMULATION MODULE-(A)VERAGE, (C)OUNTER, (I)NTEGRATE
ADS	ANALOG DATA SCALING
ALC	AMPLITUDE LIMIT CHECK
AND	AND
AR	ANALOG RECORD
	FR-FLOW RECORD
	PR-PRESSURE RECORD
	ZR-POSITION RECORD
	ETC.
ASIM	ANALOG INPUT SIMULATION
AVE	AVERAGE
CALC	CALCULATION
DEC	DECISION
DEL	DELAY
DEVAL	DEVIATION ALARM
DIFF	DIFFERENCE
DIFIL	DIGITAL FILTER
DIV	DIVIDER
EOR	EXCLUSIVE OR
EUC	ENGINEERING UNIT CONVERSION
HC	HAND CONTROL
LDFW1/5	LEAD/FOLLOW SEQUENCE CONTROL MODULE, TYPES 1-5
LIN	LINEAR
MAXMIN	MAXIMUM/MINIMUM IDENTIFICATION
MINT	MOTOR INTERFACE
MSIM	MOTOR SIMULATION
MUL	MULTIPLIER
NOT	NOT
OR	OR
PFRST	POWER FAILURE RESTART
PID	PROPORTIONAL+INTEGRAL+DERIVATIVE
PID-G	PID + GAP (DEADBAND)
PIDOUT	PID OUTPUT PROCESSING
RAT	RATIO
ROC	RATE OF CHANGE LIMIT CHECK
SEL	SELECTOR
SG	SIGNAL GENERATOR
SGAR	SIGNAL GENERATOR - RAMPING OUTPUT
SGT	SIGNAL GENERATOR TIME BASED
SH	SAMPLE AND HOLD
SQRT	SQUARE ROOT
SUM	SUM
SW	SWITCH
TP	TIMING PROGRAM
TSDP	TOUCH SCREEN DISPLAY PANEL
VSIM	VALVE SIMULATION
XR	DISCRETE EVENT RECORD
XTON	POWER FUNCTION

LINE SYMBOLS AND LEGEND



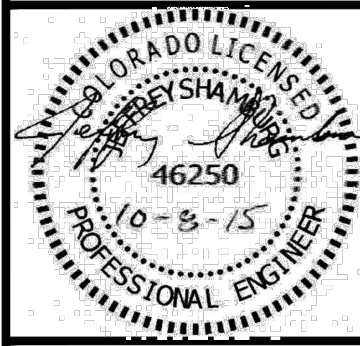
INSTRUMENT IDENTIFICATION LETTERS

MEASURED OR INITIATING VARIABLE	SUCCEEDING LETTERS																			
	FIRST LETTER MEAS. VAR.	SWITCH/ALO OPEN,CLOSE	PRIM. ELEM. (SENSOR)	INDICATOR	INDICATING CONTROLLER	CONTROL OR CONTR.(BLND)	REORDER (INDICATING)	INTEGRATOR	COUNTER (INTEGRATOR)	TRANSMITTER (INDICATING)	TRANSMITTER	VALVE OR ACTUATOR	RELAY	SOURCE	ALARM(HIGH & OR LOW)	SIGHT GLASS	GATE			
ANALYSIS	A	ASL	AE	AI			AR			AIT	AT		AY		AAL					
BURN.FL.	B		BE			BC							BY		BA					
CONDUCT.	C	CSH	CE	CI	CIC	CC	CR			CIT	CT		CY		CAH					
DENSITY	D	DSH	DE	DI	DIC	DC	DR			DIT	DT		DY	DX	DAL					
VOLTAGE	E		EE	EI						EIT	ET		EY							
FLOW	F	FSHL	FE	FI	FIC	FC	FR	FQ	FIQ	FIT	FT	FV	FY		FAL					
HAND	H	HS			HIC							HV						FG		HG
CURRENT	I	IS	IE	II	IIC	IC					IT		IY		IAH					
POWER	J	JSH	JE	JI	JIC	JC	JR	JQ	JQI				JY							
TIME	K			KI	KIC	KC		KQ	KQI				KY	KS		LS				
LEVEL	L	LSH	LE	LI	LIC	LC	LIR			LIT	LT	LV	LY		LAL					
HUMIDITY	M		ME	MI	MIC	MC	MR			MIT	MT		MY							
VEND.OPT.	N					NC														
* VEND.OPT.	O												OY							
PRES.VAC	P	PSH	PE	PI	PIC	PC	PR			PIT	PT	PCV	PY		PAH					
VOLUME	Q						QR													
SPEED	S	SS	SE	SI		SC				SIT	ST		SY		SAL					
TEMPER.	T	TSL	TE	TI	TIC	TC	TR			TIT	TT	TV	TY		TAH					
MULTIFUN	U			UI			UR						UY		UA					
WEIGHT	W	WS	WE	WI	WIC		WR				WT									
VIBRATION	X		XE	XI									XY		XAH					
ROTATION	Y	YS	YE	YI							YT		YY		YAH					
POSITION	Z	ZSO	ZE	ZI			ZR			ZIT	ZT		ZY		ZAH					

*OY = PUMP SEAL ALARM

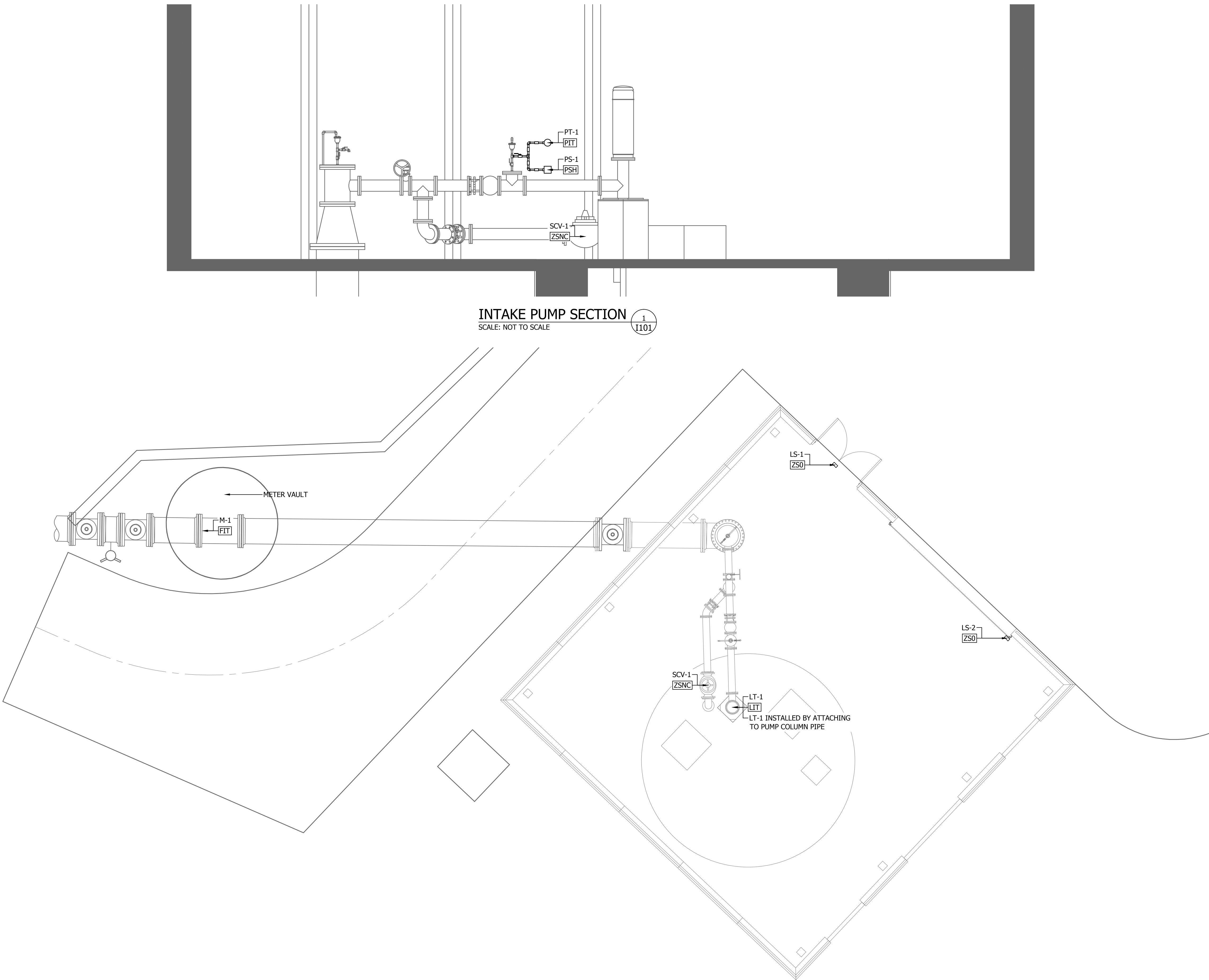
BARTLETT & WEST

INSTRUMENTATION SYMBOLS & LEGEND
RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO



DESIGNED BY:	JAS
DRAWN BY:	MKA
APPROVED BY:	JAS
DESIGN PROJ:	17865.005
CONST PROJ:	----
SCALE:	AS NOTED
DATE:	OCT 2015
DRAWING NO:	I100
SHEET NO:	112 of 114

Drawing Name: W:\Proj\17000\17865\17865.005\AutoCad\Raw Water Project\04 Process\17865.005 Instrumentation Sheets.dwg Layout Name: Intake Diagram Plotted on: 10/12/2015 9:30:23 AM Last edit on: 00/00/00



INTAKE PUMP SECTION
SCALE: NOT TO SCALE

INTAKE
SCALE: 1"=5'

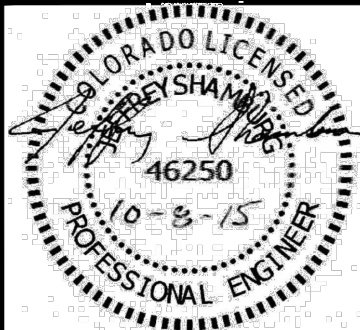
- GENERAL NOTES**
- ALL SYMBOLS AND ABBREVIATIONS MAY NOT APPLY TO THIS PROJECT.
 - ALL CONTROL AND INTERLOCK REQUIREMENTS FOR EQUIPMENT SHOWN. REFER TO THE SPECIFICATIONS AND OTHER DRAWINGS FOR ADDITIONAL REQUIREMENTS.
 - RUN INDICATION SHALL BE PROVIDED FOR ALL EQUIPMENT MANUALLY CONTROLLED FROM LOCAL CONTROL PANELS.
 - ASTERISK (*) INDICATES INSTRUMENT FURNISHED BY EQUIPMENT MANUFACTURER AND/OR UNDER OTHER DIVISIONS OF THE SPECIFICATIONS.
 - IF DISCREPANCIES EXIST BETWEEN THE SPECIFICATIONS PROCESS AND THE INSTRUMENTATION DIAGRAMS AND LOOP DIAGRAMS, THE MORE EXPENSIVE SCENARIO SHALL BE USED FOR BIDDING PURPOSES AND THE ENGINEER SHALL DETERMINE WHICH SOLUTION SHALL BE USED.
 - ALL PROCESS ITEMS, SUCH AS RELAYS, INTERLOCKS, ISOLATION VALVES, ETC., THAT ARE NOT CRITICAL FOR A GENERAL UNDERSTANDING OF THE EQUIPMENT AND INSTRUMENTATION FUNCTIONS ARE NOT SHOWN. REFER TO THE INDIVIDUAL SPECIFICATIONS FOR SPECIFIC REQUIREMENTS.
 - THE PUMP CONTROL VALVES AND PRESSURE SWITCHES, VIBRATION RELAYS, MOTOR TEMP SWITCHES (3). SEAL SENSOR RELAYS (3) FOR EACH PUMP SHALL BE HARDWIRED TO THE ASSOCIATED VFD. THE CONTROL LOGIC, RELAYS, INTERLOCKS, ETC. SHALL BE PROVIDED INTERNAL TO THE VFD TO ALLOW THE PUMP CONTROL VALVE TO OPERATE WHEN THE PUMP IS MANUALLY OR AUTOMATICALLY OPERATED.

BARTLETT & WEST

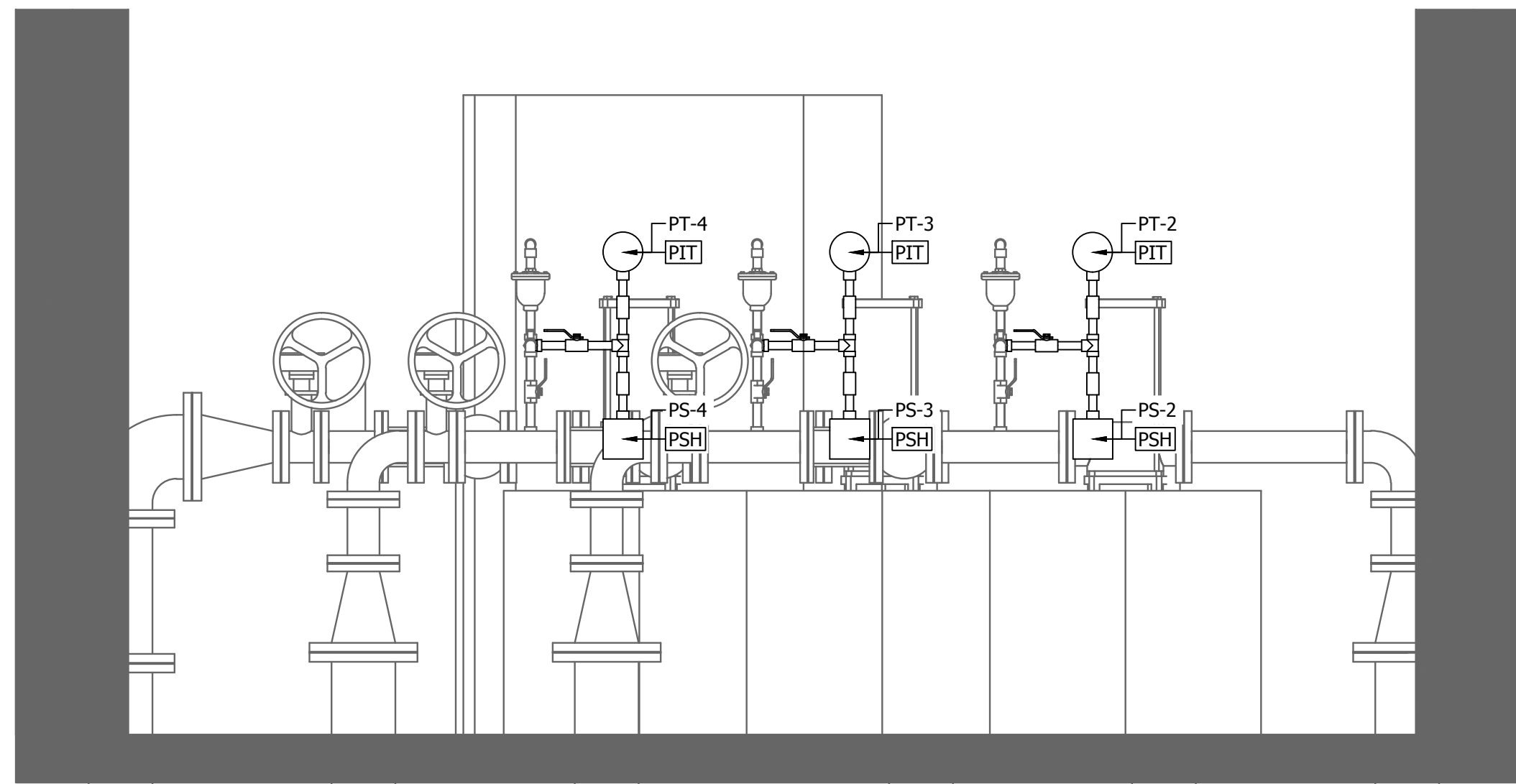
190 TALSMAN DR., UNIT D-1, PACOSA SPRINGS, CO 81447
PH: 970.263.4444
WWW.BARTLETTWEST.COM

**PROCESS & INSTRUMENTATION
INTAKE**

RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO



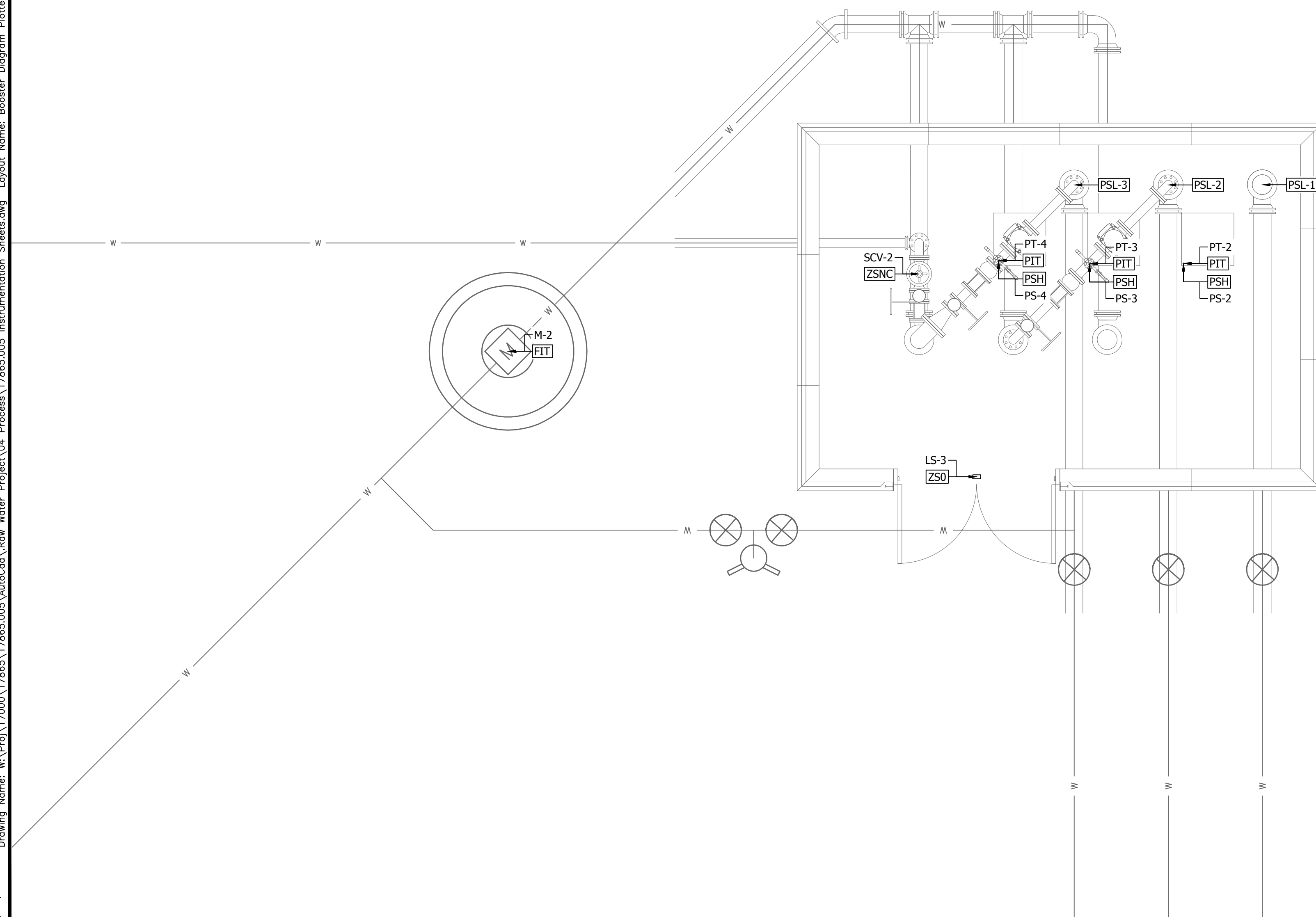
DESIGNED BY:	JAS
DRAWN BY:	MKA
APPROVED BY:	JAS
DESIGN PROJ:	17865.005
CONST PROJ:	----
SCALE:	AS NOTED
DATE:	OCT 2015
DRAWING NO:	I101
SHEET NO:	113 of 114



BOOSTER STATION PUMP SECTION

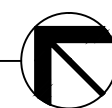
SCALE: NOT TO SCALE

1
I102



BOOSTER STATION

SCALE: 1"=3'



GENERAL NOTES

1. ALL SYMBOLS AND ABBREVIATIONS MAY NOT APPLY TO THIS PROJECT.
2. ALL CONTROL AND INTERLOCK REQUIREMENTS FOR EQUIPMENT SHOWN. REFER TO THE SPECIFICATIONS AND OTHER DRAWINGS FOR ADDITIONAL REQUIREMENTS.
3. RUN INDICATION SHALL BE PROVIDED FOR ALL EQUIPMENT MANUALLY CONTROLLED FROM LOCAL CONTROL PANELS.
4. ASTERISK (*) INDICATES INSTRUMENT FURNISHED BY EQUIPMENT MANUFACTURER AND/OR UNDER OTHER DIVISIONS OF THE SPECIFICATIONS.
5. IF DISCREPANCIES EXIST BETWEEN THE SPECIFICATIONS PROCESS AND THE INSTRUMENTATION DIAGRAMS AND LOOP DIAGRAMS, THE MORE EXPENSIVE SCENARIO SHALL BE USED FOR BIDDING PURPOSES AND THE ENGINEER SHALL DETERMINE WHICH SOLUTION SHALL BE USED.
6. ALL PROCESS ITEMS, SUCH AS RELAYS, INTERLOCKS, ISOLATION VALVES, ETC., THAT ARE NOT CRITICAL FOR A GENERAL UNDERSTANDING OF THE EQUIPMENT AND INSTRUMENTATION FUNCTIONS ARE NOT SHOWN. REFER TO THE INDIVIDUAL SPECIFICATIONS FOR SPECIFIC REQUIREMENTS.
7. THE PUMP CONTROL VALVES AND PRESSURE SWITCHES, VIBRATION RELAYS, MOTOR TEMP SWITCHES (3). SEAL SENSOR RELAYS (3) FOR EACH PUMP SHALL BE HARDWIRED TO THE ASSOCIATED VFD. THE CONTROL LOGIC, RELAYS, INTERLOCKS, ETC. SHALL BE PROVIDED INTERNAL TO THE VFD TO ALLOW THE PUMP CONTROL VALVE TO OPERATE WHEN THE PUMP IS MANUALLY OR AUTOMATICALLY OPERATED.

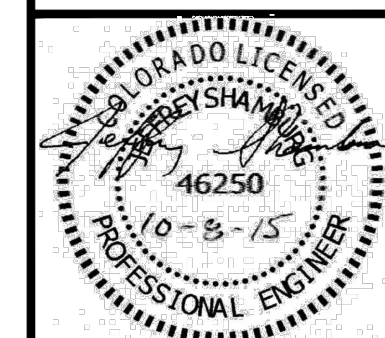
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BARTLETT & WEST

190 TALISMAN DR, UNIT D-1 PAGOSA SPRINGS, CO 81147
PHONE 970.306.0924
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PROCESS & INSTRUMENTATION BOOSTER STATION

**RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO**



DESIGNED BY: JAS

DRAWN BY: MKA

APPROVED BY: JAS

DESIGN PROJ:	17865.005
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CONST PROJ: _____

SCALE: AS NOTED

DATE:	OCT 2015
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DRAWING NO:

I102

1102

SHEET NO: 114 of 114

114 of 114