Contract Documents For
Construction Of
Thoreau Baca Well Connection

The Navajo Nation

VOLUME 2
Technical Specifications

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VOLUME 2

Technical Specifications and Index to Design Drawings

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1.2 CONTRACT DESCRIPTION

A. Work of the Project includes construction of an approximately 2,600 LF of PVC Pipeline, an access drive, a well pump house, and complete a well within the Thoreau Chapter of the Navajo Nation, McKinley County, New Mexico.

B. Perform Work of Contract under a stipulated price basis with Owner in accordance with Conditions of Contract.

1.3 SPECIAL CONSIDERATIONS

A. Contractor will contact Owner's Representative a minimum of 10 days prior to mobilization to the site and coordinate work schedules with the Owner's Representative throughout the completion of the work.

B. Contractor shall contact New Mexico One Call a minimum of 3 days prior to activity on site, for utility locations.

C. Contractor shall abide by all permit stipulations and requirements, including but not necessarily limited to BIA and Navajo Nation environmental and archaeological stipulations, utility pipeline encroachment agreements, and Navajo Nation Water Code Administration permits, regardless of whether such permits are obtained by the Owner, Engineer or Contractor.

1. Permits already obtained by the Owner or Engineer are found in Appendix C of these Bid Documents.

D. It is the Contractor's responsibility to apply for and obtain all permits required for the Work that have not already been obtained by the Owner or Engineer. No additional compensation will be provided for obtaining permits and all costs will be considered incidental to the Project. It is anticipated the Contractor will need to obtain, at a minimum, a 402 permit from U.S. EPA for discharge of construction water and water produced from the well. Contractor is wholly responsible to determine what additional permits may be required.

E. Contractor must comply with all requirements as defined by NNWCA Water Use Permit and Water Well Drilling Permit/Application.

1. Copies of NNWCA permits, including permit costs and water use fees to be paid are included in Appendix C to thee Bid Documents.

2. The NNWCA Water Use Permit requires pre-payment based on estimated water use. Should the Contractor use more water than the estimated amount, the Contractor shall pay additional water use fees based on actual usage.

3. The Owner has already paid NNWCA permit application fees and initial estimated water use fees for this project. The Contractor shall pay NNWCA for any water used beyond the estimated amount.

F. Construction water:

1. Construction water is available for purchase from the Navajo Tribal Utility Authority's (NTUA) existing water system, provided that NTUA has adequate water supply available at the time of Construction.

a. See Technical Specification section 33 21 13 for more details on use of NTUA water.

b. Usage fees are paid to both NTUA and NNWCA for all NTUA water used.

G. Contractor is responsible for coordinating with petroleum/gas line companies and obtaining encroachment agreements, if applicable. Contractor is responsible for all correspondence including notifying Owner, Engineer and utility companies at least 10 working days prior to any construction activities at crossings. Contractor shall adhere to all requirements of the gas line companies and any special notes provided on Drawings, including notification requirements. Contractor is advised that the exact location and of these utility lines is unknown and must be determined by the Contractor in the presence of the corresponding utility company representatives. Furthermore, any depth, location or diameter information provided in the Drawings regarding existing utility lines are only approximations and the Contractor shall be responsible to verify such information in the presence of the corresponding utility company representatives.

H. Contractor shall confine operations to the construction site.

I. Cultural Resources Requirements:

1. Contractor must be familiar with and abide by the Navajo Nation's cultural resource conditions of compliance included in Appendix C of the Contract Documents.

2. Contractor must allow archaeologist and/or Owner's representative to have access to the project site for examination of cultural resources. Contractor must allow archaeologist and/or Owner's representative to halt work, as necessary, to examine cultural resources in spoils and/or trenches. Contractor may move equipment to another location while archaeologist completes his/ her examination of cultural resources. Contractor shall not request additional compensation for any delays caused by archaeological examinations. However, such delays may be considered excused delays and not count toward Contractor's deadline for substantial completion, provided Contractor requests additional time within one (1) week of the delay.

3. Contractor is advised of the presence of designated "Culturally Sensitive Areas" in the project area, which are indicated on the Drawings. Contractor shall notify the Engineer at least 5 working days prior to any ground disturbing activity within 50 feet of any designated "culturally sensitive area" to allow time for a barricade to be erected and/or a permitted archaeological monitor to be scheduled on-site. Ground disturbing activities include equipment mobilization/ storage, access drive improvements, vehicular traffic and vegetation removal. The archaeological barricading and monitoring will be provided by the Owner at no cost to the Contractor. The Contractor shall not encroach beyond established easements.

a. Sites indicated on the Drawings as requiring flagging will require temporary flagging to be installed prior to any ground disturbing activities. The flagging will be installed by the Owner's archaeologist and/or surveyor and must remain in place during the life of the project. No vehicular traffic, personnel or construction activities shall be allowed past the flagging.

b. In addition to the flagging, sites indicated on the Drawings will also require archaeological monitoring when ground disturbing activities are occurring within the sensitive areas. Contractor shall not perform any ground disturbing activities within these areas without the Owner's archaeologist physically present at the site.

4. Archaeological Discovery in the Presence or Absence of Archaeological Monitoring: If, in its operations, the contractor discovers any previously unidentified historic or prehistoric cultural resources, then all work within 100 feet of the discovery will be suspended and the discovery promptly reported to the Engineer. The Navajo Nation Historic Preservation Department (for Navajo lands) will then specify what action is to be taken. If the discovery is evaluated as being significant, treatment of the discovery may be required prior to allowing the project to proceed. Further damage to significant cultural resources will not be allowed until any required treatment is completed.

J. Contractor must be familiar with and abide by the Navajo Nation's biological resource conditions of compliance included in Appendix C of the Contract Documents.

K. Should nesting of a species protected under the Migratory Bird Treaty Act be identified in the construction zone, construction will be limited to a time of year outside the general migratory bird nesting season of March through August, avoided until nesting is complete, or the nest will be relocated by a properly trained and authorized expert.

L. The Navajo Tribal Utility Authority (NTUA) will be the operator of the completed well upon transfer from the owner. NTUA will not be the owner's RPR for the project. The Engineer will provide RPR services. However, NTUA will be on the job site periodically to inspect work. NTUA must be present for the key inspections of the well site, including bacteriological tests, pre-final walkthrough, and final inspection. NTUA's final approval will be required for the contractor to receive substantial completion. The contractor is required to coordinate all these activities with the owner's RPR and NTUA.

M. Contractor shall provide access to the site to the Owner, Owner's Representative, and NTUA at all times. 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.

N. Contractor is advised that electrical power is not available at the time of bidding at the Well Site. Power will be provided during the course of the project. Contractor shall be responsible for installing meter pole, setting up account, coordinating with electrical utility, and other responsibilities as noted in the Specifications and Electrical Drawings.

O. Prior to beginning construction activities, the Contractor must furnish full-coverage photo or video documentation of the entire construction site, per SC-2.05.B of the EJCDC C-800 Supplementary Conditions. The video must include coverage of all areas and adjacent features that may potentially be impacted by the impending construction work. Contractor must submit two (2) copies of the video documentation on DVD format as part of the submittal process.

P. Contractor must maintain a full set of Drawings and Technical Specifications at the construction site at all times throughout the construction process. All subcontractors must

possess at least all Drawings and Technical Specifications pertaining to their portion of the work while on the construction site at all times.

Q. Site access:

1. A portion of the site access is along an existing unpaved residential road.
    a. Access to driveways and other roads along the project site access route must be maintained at all times.
        1) Contractor will be responsible for maintaining the existing unpaved road during the course of construction, and for returning the road to its original or better condition at the completion of the project.
        2) Cost of maintaining existing roadways is incidental to the work.
2. The Owner has acquired an access easement from the existing road to the well site. The Contractor is responsible for constructing the improvements necessary for their vehicles, equipment, crews, and materials to access the well site.
    a. The Contractor shall be responsible for maintenance of the access drive throughout construction, to provide safe access to the Contractor, Owner's Representative, and other authorized visitors to the site.
    b. Any access gates should be kept closed at all times unless otherwise directed by the Owner.
    c. Contractor shall restore fences to original condition or better and shall install 10-ft wide 'rancher-style' gates. Attach wire to the H-braces prior to cutting the fence to prevent slacking of wire. Contract shall repair all gates and fences in a timely manner to prevent livestock ingress / egress.
    d. The cost of this work is incidental to the project, with the following exception:
        1) Material and material placement for access improvements called for within the culturally sensitive area shown on the drawings shall be paid to the contractor at the unit price.

R. Upon completion of the Work, ground surfaces will be restored to their original condition by grading and seeding with native plant species as per technical specifications. Contractor shall coordinate seeding dates to coincide with the dates stipulated in the NNAD re-vegetation requirements and stipulations, provided in Appendix C.

1. Contractor shall indicate exact proposed re-seeding dates in project schedule and shall notify the Engineer as early as possible of any deviations from this proposed seeding schedule.

S. Prior to beginning construction activities, the Contractor will furnish full-coverage photo or video documentation of the entire construction site per requirements set forth in Article 3.2.A of Section 33 11 13 of the Technical Specifications.

T. Contractor is responsible for restoring the site to original or better condition at the Contractor's expense. Site restoration including temporary erosion control provisions is a prerequisite for periodic and final payment.

U. Storm Water Pollution Prevention Plan (SWPPP): Contractor shall be wholly responsible for the preparation and implementation of the SWPPP, and any erosion / sediment practices described therein. Such implementation shall include, but not necessarily be limited to, obtaining any required NPDES permit(s) and submitting the contractor's Notice of Intent (NOI) to competent agencies prior to construction, implementation and maintenance of all Best Management Practices (BMPs) specified in the SWPPP, inspection of entire project site as specified in the SWPPP, maintaining and providing all documentation required in the SWPPP (including keeping up-to-date project maps and as-builts before, during and after construction), filing of a Notice of Termination (NOT) upon completion of the project and removal of BMPs upon the required time interval after completion of the project.

V. Drawings in CAD (Civil3D-2013, ACAD 2010, and Land XML) format related to earthwork required at the tank sites are available from Souder, Miller & Associates at www.soudermiller.com. Any Bidder interested in obtaining access to the files must complete an 'Electronic Data File Transfer and Sharing Agreement' and submit to the office of the Engineer, Souder, Miller and Associates, attention Judy Holland, Project Manager Assistant, at judy.holland@soudermiller.com. Upon submittal of the attached form, the Bidder will receive instructions on how to access the files.

W. Upon request, CAD files for the plan and profile sheets will be made available to the winning Contractor after Notice of Award. However, neither the Owner nor Engineer shall assume any liability for their use, nor shall use of any electronic files relieve the Contractor of his/her responsibility to meet the conditions of the Contract Documents, including the published Drawings. Contractor must submit an Electronic Data File Transfer and Sharing Agreement to the Engineer prior to receiving CAD files.Horizontal bends: At most locations, the plan and profile sheets show horizontal bends without specifying whether the horizontal bend is to be accomplished by DI ells, fusible PVC sweeps, bending of fusible PVC pipe, or joint deflection of jointed PVC pipe. At such locations, the method of bending is at Contractor's option, provided all design requirements set forth in the Drawings and Specifications are met. At locations where fusible PVC sweeps are shown, they must be used.

X. Contractor shall provide two (2) copies of the safety plan to the Engineer prior to commencing construction (one shall be for Owner's files). Neither the Owner nor Engineer shall approve or comment on the Contractor's safety plan, nor shall the Owner or Engineer assume any responsibility for assuring compliance on the part of personnel on site, other than Owner's or Engineer's employees and representatives, as stipulated in Paragraph 7.12.D of the Standard General Conditions and Navajo Nation Supplemental Conditions (EJCDC C-700 NN).

Y.

1.4 WORK BY OWNER

A. Not Applicable.

1.5 CONTRACTOR'S USE OF PREMISES

A. The Contractor will be allowed to perform work onsite twenty-four (24) hours per day, seven (7) days a week.

B. The Contractor shall make every effort to minimize noise and light pollution caused by their operations, as there are residential areas near the well site. Equipment shall be equipped with silencers or mufflers designed to operate with the least possible noise. Work area lighting shall be set up and directed to adequately illuminate the work area while minimizing light pollution beyond the site.

C. The Contractor shall restrict his operations as nearly as possible to the immediate site. Unnecessary cutting of vegetation adjacent to the site is prohibited. Every effort shall be made to minimize erosion during and after construction and the site shall be returned to its original condition, except where improvements are indicated or required.

D. The Contractor shall take action to prevent the misuse of the natural environment, wasting of natural resources, or destruction of natural values.

E. The Contractor shall conform to all requirements set forth in the latest edition of the Navajo Nation Primary Drinking Water Regulations (NNPDWR), New Mexico Standard Specifications for Public Works Construction with latest revision, and Occupational Safety and Health Administration Regulations for trenching, shoring and excavation, and all other activities where such regulations apply. The Contractor and all subcontractors shall conduct all activities in conformance with federal, state, & tribal laws and regulations relating to occupational health and safety. Authorized inspectors from NMED's Occupational Health and Safety Bureau shall have unobstructed access to project sites and shall not be impeded in any way from performance of their duties.

1.6 SPECIFICATION CONVENTIONS

A. These specifications are written in imperative mood and streamlined form. This imperative language is directed to the Contractor, unless specifically noted otherwise. The words "shall be" are included by inference where a colon (:) is used within sentences or phrases.

B. The Contractor shall furnish all materials, labor, plant and equipment necessary to complete the contract work as called for by the Technical Specifications and as indicated on the Drawings. Material and work, either expressed or implied, necessary for the satisfactory completion of the contract work shall be considered an integral part thereof.

C. All standards incorporated herein by reference shall be the latest edition, unless otherwise specified. The abbreviations and applicable standards are described below:

AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AIA	American Institute of Architects
ANSI	American National Standards Institute, Inc.
ASTM	American Society for Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association
CID	Construction Industries Division of the NM Regulation and Licensing Dept.
EJCDC	Engineers Joint Contract Documents Committee
EPA	Environmental Protection Agency

IBC	International Building Code
ISO	International Organization for Standardization
MSJC	Masonry Standards Joint Committee
NACE	National Association of Corrosion Engineers
NNPDWR	Navajo Nation Primary Drinking Water Regulations
NNWCA	Navajo Nation Water Code Administration
NMDOT	New Mexico Department of Transportation
NMED	New Mexico Department of Environment
NMSSPWC	New Mexico Standard Specifications for Public Works Construction
NSF	National Sanitation Foundation
NTUA	Navajo Tribal Utility Authority
OSHA	Occupational Safety and Health Administration
SAE	Society of Automotive Engineers
SSPC	Steel Structure Painting Council
UL	Underwriters Laboratories, Inc.

1.7 MINIMUM WAGE RATE DETERMINATION

A. The Navajo Nation prevailing wage rates will apply to this project. The wage rate determination provided by the Navajo Office of Labor Relations (NOLR) is provided in Appendix B to the Contract Documents. It is wholly the responsibility of the Contractor to inform him/herself of and abide by all regulations and requirements set forth by the NOLR.

B. The Federal Davis-Bacon Act and the New Mexico Public Works Minimum Wage Act do not apply to the present project.

1.8 TESTING AND INSPECTION ALLOWANCES

A. Testing Allowance: The bid schedule includes predetermined sums to cover testing and inspections, including geophysics testing of the pilot well and water sample analyses.

B. If requested by Engineer, Contractor shall submit details regarding the proposed testing laboratory or inspection firm, including a statement of qualifications and a proposed schedule of unit price costs and estimated total cost for testing and inspection to be completed under the allowance. Any additional costs, such as travel time, shall also be detailed for this project on a unit price basis and as part of the estimated total cost of testing and inspection. Engineer may require the Contractor to solicit additional quotes if the proposed costs are not competitive.

C. Costs Included in Allowance: Cost of inspection, testing, or laboratory analysis and reporting of results.

D. Costs Not Included in Allowance:

1. Incidental labor and facilities required to assist testing or inspection firm.
2. Cost of disinfection of the well and equipment and bacteriological testing.
3. Costs of hydrostatic pressure testing or testing of material welds as called for in the Contract Documents.

E. Costs will be drawn from testing allowance and paid based on invoice(s) submitted to Contractor by testing or inspection firm(s), and reimbursed at cost, with no markup by Contractor. Contractor shall submit appropriate NTTC form to testing firm to assure tax is not included on invoices.

1.9 SCHEDULE OF VALUES

A. Submit schedule of values on the Construction Progress sheet within the Application for Payment forms provided in the Construction Contract Documents (EJCDC Form C-620 (2013 Edition), or on other form acceptable to the Engineer.

B. Base structure of Schedule of Values on Bid Schedule with identical item numbering, quantities, and values.

1.10 APPLICATIONS FOR PAYMENT

A. Application for Payment is synonymous with Partial Payment Estimate.

B. Submit copies of each application on the Partial Payment Estimate form provided in the Contract Documents, together with updated Schedule of Values identifying fully the list of items in the Application for Payment.

C. The Application for Payment form shall be submitted to the Engineer and RPR electronically 15 days prior to the monthly progress meeting electronically as an Excel spreadsheet. Submit up-to-date revisions of the following documents every month with Application for Payment. Application for Payment will not be processed without these updated documents.

1. Record Drawings
2. Construction Schedule, including overall project schedule and look-ahead schedule
3. All relevant documentation of testing performed during the pay period, such as geophysical logs, pump testing data, concrete testing, compaction testing, and any other testing specified in the Contract Documents
4. Any Stored Material Invoices

D. Payment Period: Monthly.

1.11 CHANGE PROCEDURES

A. All Change Orders shall be prepared on the form provided in these Contract Documents.

B. Unit Price Change Order: For pre-determined unit prices and quantities, Change Order will be executed on fixed unit price basis. For unit costs or quantities of units of work not pre-determined, refer to Article 12 - Change of Contract Price; Change of Contract Times, of the Standard General Conditions (EJCDC C-700 Standard General Conditions of the Construction Contract).

1.12 UNIT PRICES

A. Engineer will take measurements and compute quantities accordingly. The Contractor will assist in taking of measurements and determination of work completed prior to preparation of corresponding Application for Payment.

1.13 ALTERNATES

A. Not applicable.

1.14 COORDINATION

A. See subpart 1.3 “Special Considerations” of this section for additional coordination requirements.

B. Obtain any required business license(s) required by Owner or agency(ies) with jurisdiction prior to commencing construction activities.

C. Coordinate scheduling, submittals, and Work of various sections of specifications to ensure efficient and orderly sequence of installation of interdependent construction elements.

D. Verify utility requirement characteristics of operating equipment are compatible with building utilities.

E. The Contractor is also responsible for obtaining all applicable local, county and state building and development permits not previously obtained by Engineer or Owner.

1. If permits have been obtained by the Engineer, the Contractor shall comply with the permit conditions, and shall coordinate with permitting agency and Engineer to replace the insurance certificate with a certificate issued by the Contractor’s insurer prior to commencing work.

F. Contractor is responsible for timely scheduling of any pertinent inspections with local, county and state agencies with jurisdiction, and as required by the permits.

G. All notices, demands, requests, instructions, approvals, proposals and claims must be in writing.

1. Any notice to or demand upon the Contractor shall be sufficiently given if delivered at the office of the Contractor stated on the signature page of the Agreement.

2. All papers required to be delivered to the Owner shall, unless otherwise specified in writing to the Contractor, be delivered to the Owner at the address stated on the signature page of the Agreement.

3. Any such notice shall be deemed to have been given as of the time of actual delivery, in the case of mailing, when the same should have been received in due course of post, or in the case of telegrams, certified mail, or telephone facsimiles, at the time of actual receipt as the case may be.

1.15 SUSPENSION OF WORK

A. The Owner may order suspension of work due to seasonal or other conditions unsuitable for construction work.

B. Maintenance during suspension: Prior to suspension for any cause, the Contractor shall take necessary precautions to protect the work during the period of suspension from any factors which would contribute to its deterioration.

C. Time elapsed during suspension of the work shall not count as contract time. The Contractor shall make no claim for damages due to delay, additional mobilization charges, nor any additional costs that may be incurred solely due to suspension of work.

D. Requests for additional time to be added after the "contract completion date" due to delays or extra work shall be made to the Owner in writing by the Contractor within ten (10) days after the time of the occurrence of the delay or receipt of a Change Order for extra work. Such requests shall set forth the justification for the additional time.

E. Upon approval, the additional contract time shall then be in full force and effect, the same as though it were the original date for completion and will be shown as the completion date plus an amount of additional working days. Any time required to complete the work beyond the contract time or additional contract time will result in the assessment of liquidated damages, as specified in the Contract Documents. Failure to make such requests within the above limits will be considered as a waiver on the part of the Contractor as to the need for additional contract time.

1.16 FIELD ENGINEERING

A. Establish elevations, lines, and levels and certify and confirm elevations and locations of the Work, conforming with the Contract Documents, with the Engineer prior to performing any excavation.

B. Verify field measurements are as indicated on shop drawings or as instructed by manufacturer.

C. From the information provided by the Owner, the Contractor shall develop and make all detail surveys needed for construction such as slope stakes, batter boards, easement alignments, stakes for pipe locations and other working points, lines, elevations and cut sheets.

1.17 PRE-CONSTRUCTION CONFERENCE

A. Engineer will schedule Pre-Construction Conference after Notice of Award for affected parties.

B. The Contractor, or his duly authorized representative, and subcontractor representatives will attend the meeting.

1.18 PROGRESS MEETINGS

A. Schedule in coordination with the Engineer at maximum monthly intervals and attend all Progress Meetings throughout progress of the Work.

B. The purpose of the meetings will be to review the following:

1. Work progress since previous meetings.

2. Field observations, problems, conflicts.

3. Problems which impede construction schedule.

4. Corrective measures and procedures to regain projected schedule.
5. Revisions to construction schedule.
6. Plan progress and schedule during succeeding work period.
7. Coordination of schedules.
8. Off-site fabrication and delivery schedules.
9. Maintenance of quality standards.
10. Proposed changes, construction schedule and completion date.
11. Coordination of separate contracts.
12. Record or "as-built" drawings of completed work.
13. Other business as required.
14. Regulatory requirements including OSHA, Navajo Office of Labor Relations, and others as applicable.
15. Funding requirements including Navajo Nation, RUS, NMED, NMFA, DFA, USEPA and others as applicable.

C. During each meeting, the Contractor is required to present any issues which may impact his Work, with a plan to resolve these issues expeditiously.

D. Together with each payment application, Contractor must present the current as-built drawings reflecting all work performed to date.

1.19 CUTTING AND PATCHING

A. Employ skilled and experienced installer to perform cutting and patching new Work; restore Work with new Products.

B. Execute cutting, fitting, and patching, including excavation and fill, to complete Work, and to:

1. Uncover Work to install or correct ill-timed Work.
2. Remove and replace defective and non-conforming Work.
3. Remove samples of installed Work for testing.
4. Provide openings in elements of Work for penetration of mechanical and electrical Work.

C. Cut masonry and concrete materials using masonry saw or core drill. Restore Work with new Products in accordance with requirements of Contract Documents.

D. Fit Work tight to adjacent elements. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.

E. Refinish surfaces to match adjacent finishes.

1.20 SUBMITTAL PROCEDURES

A. Identify Project, Contractor, subcontractor and supplier; pertinent drawing and detail number, and specification section number, appropriate to submittal.

B. Apply Contractor's stamp, signed or initialed, certifying that review, verification of Products required, field dimensions and elevations, adjacent construction Work, and coordination of information is in accordance with requirements of the Work and Contract Documents.

C. Identify variations from Contract Documents and Product or system limitations which may be detrimental to successful performance of completed Work.

D. Revise and resubmit submittals as required by the Engineer; identify changes made since previous submittal.

E. Submit number of copies Contractor requires, plus two copies Engineer will retain, at a minimum, unless otherwise indicated at the Pre-Construction Conference.

F. Transmit each submittal with Engineer accepted form.

G. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with requirements.

H. Prior to commencing construction activities, Contractor shall provide two (2) copies of the corresponding Project safety plan to the Engineer, per SC-7.12.I of EJCDC C-800 Supplementary Conditions.

1.21 CONSTRUCTION PROGRESS SCHEDULES

A. Submit initial progress schedule in duplicate within fifteen [15] days after date of Owner-Contractor Agreement for Engineer review.

B. Submit revised schedules with each Application for Payment, identifying changes since previous version. Indicate estimated percentage of completion for each item of Work at each submission.

C. Distribute copies of reviewed schedules to Project site file, subcontractors, suppliers, and other concerned parties.

D. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate early and late start, early and late finish, float dates, and duration.

E. Indicate delivery dates for Owner furnished products and products identified under Allowances.

1.22 PROPOSED PRODUCTS LIST

A. Unless required as an attachment to Bid, within 15 days after date of Owner-Contractor Agreement, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.

B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.23 PRODUCT DATA

A. Product Data: Submit to Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.

B. Submit copies and distribute in accordance with Submittal Procedures article.

C. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

D. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

1.24 SHOP DRAWINGS

A. Shop Drawings:

1. Submitted to Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.

2. Include detail design calculations, shop drawings, fabrication, and installation drawings, erection drawings, list, graphs, catalog sheets, data sheets, and similar items.

3. Design calculations shall bear the signature and seal of an engineer registered in the appropriate branch and in the state wherein the project is to be built, unless otherwise directed.

4. After review, provide copies and distribute in accordance with Submittal Procedures article and for record documents purposes as specified.

5. Except as may otherwise be indicated herein, the Engineer will return copies of each submittal to the Contractor with comments noted thereon, within 30 calendar days following their receipt by the Engineer.

B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

C. Submit number of opaque reproductions Contractor requires, plus two copies Engineer will retain.

1.25 TEST REPORTS

A. Submit for Engineer's knowledge as contract administrator or for Owner.

B. Submit test reports for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.26 MANUFACTURER’S INSTRUCTIONS AND CERTIFICATES

A. When specified in individual specification sections, submit manufacturer printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, to Engineer for delivery to Owner in quantities specified for Product Data.

B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

C. When specified in individual specifications sections, submit certifications by manufacturer to Engineer, in quantities specified for Product Data.

D. Indicate material or Product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

E. Certificates may be recent or previous test results on material or Product, but must be acceptable to Engineer.

1.27 QUALITY CONTROL

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply with manufacturer's instructions.

C. Comply with specified standards as minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

1.28 TOLERANCES

A. Monitor fabrication and installation tolerance control of installed products over suppliers, manufacturers, products, site conditions, and workmanship, to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply fully with manufacturer's tolerances.

1.29 REFERENCES

A. Conform to reference standards by date of issue current as of date of Contract Documents.

B. When specified reference standard conflict with Contract Documents, request clarification from Engineer before proceeding.

1.30 MANUFACTURER'S FIELD SERVICES AND REPORTS

A. When specified in individual specification sections, require material or product suppliers or manufacturers to furnish qualified staff personnel to observe site conditions and to initiate instructions when necessary.

B. Report observations and site decisions or instructions that are supplemental or contrary to manufacturer's written instructions.

1.31 EXAMINATION

A. Verify existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.

B. Verify utility services are available, of correct characteristics, and in correct location.

C. Contractor is solely responsible for utility location, protection and verification. Contractor must notify New Mexico One Call System Inc., at 811, and all local utility providers, including NTUA 'Call Before You Dig' at (928) 729-5721, three (3) days before starting utility line construction.

D. It shall be the responsibility of the Contractor to become acquainted with the location of all underground structures which may be encountered, or which may affect the Work hereunder.

1.32 TEMPORARY SERVICES

A. Provide, maintain and pay for suitable quality water service as required.

B. Maintain uninterrupted water and electric service to all properties adjoining the Work, except where specifically approved by the authority having jurisdiction. Services damaged by the Contractor shall be immediately and permanently repaired or replaced at the expense of the Contractor. Give a minimum of 48-hour advance notice to occupants of adjacent properties before interrupting any service. Any interruption of service shall be kept to the minimum length of time possible.

C. Until final inspection and approval of the Work and issuance of the Certificate of Substantial Completion, the Contractor is responsible for all Work directly or indirectly affected by the Contractor's activities. Such responsibility continues for all Work detailed on the punch list that may accompany the Certificate of Substantial Completion, until satisfactorily completed by the Contractor and approved by the Owner and Engineer.

D. Furnish, install and maintain any temporary water storage structures, electrical connections, meters, wiring, outlets, switches, lamps, etc., as necessary for the work. The Contractor shall provide such temporary heat as may be necessary for the prevention of injury to the work or material through dampness or cold. All temporary connections, installations, facilities and supplies furnished or installed as specified in this paragraph, shall be removed prior to the completion of the Contract, and the premises left perfectly clean and satisfactory to the Owner.

E. Maintain ambient temperature above freezing in enclosed/occupied areas where construction is in progress, unless indicated otherwise in specifications.

F. Provide temporary electricity and power outlets for construction operations, connections, branch wiring, distribution boxes, and flexible power cords as required. Do not disrupt Owner's need for continuous service.

G. Provide and maintain required sanitary facilities and enclosures in clean and sanitary condition.

1.33 ACCESS ROADS

A. Construct and maintain temporary roads accessing public thoroughfares to serve construction area.

B. Existing on-site roads, designated by the Owner, may be used for construction traffic.

1.34 PROGRESS CLEANING AND WASTE REMOVAL

A. Collect and maintain areas free of waste materials, debris, and rubbish. Maintain site in clean and orderly condition.

B. Remove waste and surplus materials, rubbish, and construction facilities from site. Restore all job sites and adjoining areas, including roads and driveways, to a condition equal to or better than the original status. Special attention will be made to not disturb unimproved roads by placing any excavated material to the sides of these roads when water lines are located along the right-of-way.

C. Brush and trees shall be felled parallel to the right-of-way to minimize damage to trees and structures on adjacent property. All brush, tree tops, stumps and other debris shall be

removed from the right-of-way and disposed of by the Contractor, subject to and in conformity with the special provisions applying to the tract of land involved (if any). The Contractor shall not destroy nor remove any trees, shrubbery, nor any other improvements, without permission of the Owner.

D. The Contractor shall not dispose of debris, refuse or sanitary wastes in an open dump or in a natural watercourse, whether on public or private property, or in such places that undesirable wastes can eventually be exposed or carried to a natural watercourse.

1.35 PROJECT IDENTIFICATION

A. No project sign is required.

B. The Contractor shall not erect or permit the erection of advertising signs. Only minimal identification and direction signs shall be permitted on the site. Unnecessary or obnoxious posters, pictures, signs, symbols, drawings or writing on work, material or equipment, resulting from vandalism or other causes, shall be covered or removed by the Contractor.

1.36 BARRIERS AND FENCING

A. Provide barriers or fencing to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from damage.

1.37 PROTECTION OF INSTALLED WORK

A. Protect installed Work and provide special protection where specified in individual specification sections.

1.38 SECURITY

A. Provide security and facilities to protect Work and existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.

1.39 WATER CONTROL

A. Provide erosion control.

B. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.

C. In the event that one acre of earth or more is disturbed, the Contractor shall submit to the Owner’s Resident Project Representative a Storm Water Pollution Prevention Plan (SWPPP) that will address all construction phases and the proposed pollution prevention and sediment control measures. This shall be done in accordance with the National Pollution Discharge Elimination System (NPDES) general permit requirements for all construction activities and shall include all required reporting. If the Bid Form does not include an item for preparation and implementation of the SWPPP, the cost thereof will be considered incidental to related work.

D. The Contractor shall conduct his operations to minimize damage to natural watercourses, and shall not permit petroleum products, volatile fluid wastes, or any other wastes which are prohibited by local ordinances, or excessive amounts of silt, clay, or mud to enter any drainage system. The bed of natural watercourses or man-made irrigation ditches shall be restored to normal gradient and cross-section after being disturbed.

1.40 POLLUTION AND ENVIRONMENTAL CONTROL

A. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations.

B. Provide dust control, erosion and sediment control, noise control, pest control and rodent control to allow for proper execution of the Work. Short term effects of dust produced by equipment will be mitigated by sprinkling traffic areas with water. Motor equipment shall be kept in repair and equipped with anti-pollution devices, if possible, to cut down on exhaust emissions. Burning as a method of cleaning or disposal will not be permitted without approval of the proper authorities.

C. Comply with all applicable standards, orders, or regulations issued pursuant to the Clean Air Act of 1970 (42 U.S.C. 1251 et seq.) as amended. Violations shall be reported to the New Mexico Environment Department.

D. The Contractor shall be responsible for the reporting and the cleanup of spills associated with project construction and shall report and respond to spills of hazardous materials such as gasoline, diesel, motor oil, solvents, chemicals, toxic and corrosive substances, and other materials which may be a threat to the public health or the environment. The Contractor shall be responsible for reporting past spills encountered during construction and of current spills not associated with construction. Reports shall be made to the New Mexico Environment Department Emergency Response Team at (505) 476-6025 during business hours. If there is no emergency situation the Contractor can leave a message regarding the nature of the spill, location and contact information. For emergencies that require immediate attention and mitigation, and there is no response at the NMED Emergency Response Team number above, call (505) 827-9329. For emergencies that pose immediate danger to public health or property, call 911. For any and all spills, Contractor shall also immediately contact the Owner's Resident Project Representative.

E. The Contractor shall clean up any unreported spills associated with project construction identified after construction.

1.41 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, and materials, prior to Substantial Completion review.

B. Clean and repair damage caused by installation or use of temporary work.

C. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

1.42 PRODUCTS

A. Products: Means new material, machinery, components, equipment, fixtures, and systems forming the Work, but does not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work. Products may also include existing materials or components specifically identified for reuse.

B. Do not use materials and equipment removed from existing premises, except as specifically identified or allowed by the Contract Documents.

C. Provide interchangeable components of same manufacturer for components being replaced.

1.43 DELIVERY, HANDLING, STORAGE, AND PROTECTION

A. Deliver, handle, store, and protect Products in accordance with manufacturer's instructions.

1.44 SUBSTITUTIONS

A. Substitutions will only be considered when Product becomes unavailable through no fault of Contractor, or where an "approved equal" is specifically allowed elsewhere in the Technical Specifications or noted on the Drawings. In such cases, the brand name and/or model number of products that have been identified in these Specifications serve as the basis of the design. These products may be substituted with other products that meet the same manufacturing standards, quality, performance and desired characteristics of the Specifications when approved by the Engineer or Owner's representative.

B. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.

C. Submit three [3] copies of request for Substitution to the Engineer for consideration. Limit each request to one proposed Substitution.

1.45 CLOSEOUT PROCEDURES

A. Submit written certification Contract Documents have been reviewed, Work has been inspected, and Work is complete in accordance with Contract Documents and ready for Engineer's inspection.

B. Submit final Application for Payment identifying total adjusted Contract Price, previous payments, and amount remaining due.

C. Project closeout submittals shall include, but not necessarily be limited to:

1. NTUA Affidavit of Punch List Completion
2. Project Record Documents
3. Operations and Maintenance Data
4. Spare Parts and Maintenance Materials
5. Extended Warranties
6. Release of Liens
7. Consent of Surety
8. Certification of Labor Standards
9. Complete packages of all testing results, start-up reports and data logs, including all closeout submittals required in Technical Specification 33 21 13.

D. Affidavit of Punch List Completion must be signed by NTUA prior to Final Completion.

1. Final payment will not be processed until Affidavit of Punch List Completion is accepted by NTUA.

2. Warrantee period shall commence upon execution of Affidavit of Punch List Completion by NTUA.

1.46 FINAL CLEANING

A. Execute final cleaning prior to final inspection.

B. Upon completion of the work under this contract, thoroughly clean and make any needed repairs caused by damage during construction to any existing utilities or other structures on the site.

C. Notify the Engineer in writing once final cleaning is complete. The final estimate will not be prepared until the Contractor has complied with all requirements set forth and the Engineer has made his final inspection of the entire work and is satisfied that it is properly constructed and the site properly cleaned.

1.47 STARTING OF SYSTEMS

A. Provide seven [7] days notification prior to start-up of each item.

B. Ensure each piece of equipment or system is ready for operation.

C. Execute start-up under supervision of responsible persons in accordance with manufacturer's instructions.

D. Submit written report stating equipment or system has been properly installed and is functioning correctly.

1.48 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of Products to Owner's personnel two weeks prior to date of Substantial Completion.

B. For equipment or systems requiring seasonal operation, perform demonstration for other season within six [6] months.

C. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed-upon times, at designated location.

1.49 TESTING, ADJUSTING, AND BALANCING

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

B. Owner retains the right to appoint, employ, and pay for services of independent firm to perform testing, adjusting, and balancing. Reports will be submitted by independent firm to Engineer indicating observations and results of tests and indicating compliance or non-compliance with specified requirements and with requirements of Contract Documents.

C. Contractor will cooperate with independent firm; furnish assistance as requested.

D. Re-testing required because of non-conformance to specified requirements will be charged to Contractor.

1.50 PROTECTING INSTALLED CONSTRUCTION

A. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

B. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

C. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

D. Prohibit traffic from landscaped areas.

1.51 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of Contract Documents to be utilized for record documents.

B. Record actual revisions to the Work. Record information concurrent with construction progress.

C. Specifications: Legibly mark and record at each Product section description of actual Products installed.

D. Record Documents and Shop Drawings (As-Built Drawings): Legibly mark each item to record actual construction. Deliver two (2) sets of As-Built Drawings with redlines to the Owner upon completion of the Project. The As-Built Drawings will be submitted to the Engineer prior to processing of final payment to the Contractor.

E. Submit documents to Engineer together with claim for final Application for Payment.

1.52 OPERATION AND MAINTENANCE DATA

A. Submit one electronic set and 3 hardcopy sets prior to final inspection, bound in 8-1/2 x 11 inch text pages, three D side ring binders with durable plastic covers.

B. Prepare binder cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS" and title of project.

C. Internally subdivide binder contents with permanent page dividers, logically organized.

D. Contents:

1. Part 1: Directory

    a. List names, addresses, and telephone numbers of Engineer, Contractor, subcontractors, and major equipment suppliers.

2. Part 2: Operation and maintenance instructions, arranged by system:

    a. Equipment summary, operational procedures, preventive maintenance procedures and schedules, parts list, shop drawings, safety issues.

3. Part 3: Project documents and certificates.

    a. All equipment warranties, affidavits, and certifications required by the Technical Specifications shall be placed in this part.

1.53 SPARE PARTS AND MAINTENANCE MATERIALS

A. Provide products, spare parts, maintenance and extra materials in quantities specified in individual specification sections.

B. Deliver to project site and place in location as directed by Engineer; obtain receipt prior to final payment.

1.54 WARRANTIES AND PRODUCT REGISTRATION

A. Execute and assemble transferable warranty documents from subcontractors, suppliers, and manufacturers for all products with extended warranties beyond one (1) year.

B. All warranty periods shall commence upon the date of final acceptance of the work and execution of the Affidavit of Punch List Completion by NTUA.

C. Execute and assemble product registration documents from suppliers and manufacturers, on Owner's behalf, for all products requiring such registration, for recall or warranty purposes.

D. Submit prior to final Application for Payment.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 03 10 00

CONCRETE FORMS AND ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

A. The Contractor shall furnish all materials for concrete formwork, bracing, shoring and supports and shall design and construct all forms, bracing, shoring and falsework, all in accordance with the requirements of the Contract Documents.

B. Section Includes:
1. Formwork for cast-in place concrete.
2. Shoring, bracing, and anchorage.
3. Form accessories.
4. Form stripping.

C. Related Sections:
1. Section 03 20 00 - Concrete Reinforcement.
2. Section 03 29 00 - Joints in Concrete
3. Section 03 30 00 - Cast-in-Place Concrete.

1.2 REFERENCES

A. International Building Code (IBC), as referenced herein, shall be the most recent New Mexico Construction Industries Division (CID) adopted edition

B. American Concrete Institute:
1. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
2. ACI 301 - Specifications for Structural Concrete.
3. ACI 318 - Building Code Requirements for Structural Concrete.
4. ACI 347 - Guide to Formwork for Concrete.

C. Government Standards:
1. PS 1-74 U.S. Product Standard for Concrete Forms, Class I.

D. American Forest and Paper Association:
1. AF&PA - National Design Specifications for Wood Construction.

E. The Engineered Wood Association:
1. APA/EWA PS 1 - Voluntary Product Standard for Construction and Industrial Plywood.

F. American Society of Mechanical Engineers:
1. ASME A17.1 - Safety Code for Elevators and Escalators.

G. ASTM International:
1. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
2. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

1.3 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.

B. Product Data:
1. List of form materials and locations of use.
2. Form release agent with EPA Certification.

1.4 QUALITY ASSURANCE

A. Tolerances: The variation from established lines and grades shall not exceed 1/4-inch in ten (10) feet and there shall be no offsets or visible waviness in the finished surface. All other tolerances shall be within the "Suggested Tolerances" specified in Section 3.3 and 3.4 of ACI 347.

PART 2 PRODUCTS

2.1 FORM MATERIALS

A. Except as otherwise expressly accepted by the Engineer, all lumber brought on the job site for use as forms, shoring or bracing shall be new material. All forms shall be smooth surface forms and shall be of the following materials:
1. Walls: Steel or plywood panel
2. Columns: Steel, plywood or fiberglass
3. Roof and Floor Slabs: Plywood
4. All Other Work: Steel panels, plywood or tongue and groove lumber

2.2 FORM TIES

A. Form ties with Integral water stops shall be provided with a plastic cone or other suitable means for forming a conical hole to ensure that the form tie may be broken off back of the face of the concrete.
1. The maximum diameter of removable cones for rod ties, or of other removable form-tie fasteners having a circular cross-section, shall not exceed 1-inch and all such fasteners shall be such as to leave holes of regular shape for reaming.
2. Form ties for water-retaining structures shall have integral water stops. Removable taper ties may be used when approved by the Engineer. A preformed neoprene or polyurethane tapered plug sized to seat at the center of the wall shall be inserted in the hole left by the removal of the taper tie.

2.3 FORM AND FALSEWORK MATERIALS

A. Materials for concrete forms, formwork and falsework shall conform to the following requirements:
   1. Lumber shall be Douglas Fir or Southern Pine, construction grade or better, in conformance with U.S. Product Standard PS10.
   2. Plywood for concrete formwork shall be new, waterproof, synthetic resin bonded, exterior type Douglas Fir or Southern Pine plywood manufactured especially for concrete formwork and shall conform to the requirements for PS 1 for Concrete Forms, Class I, and shall be edge sealed.
   3. Form materials shall be metal, wood, plywood or other approved material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line and grade shown. Metal forms shall be an approved type that will accomplish such results. Wood forms for surfaces to be painted shall be Medium Density Overlaid plywood, MDO Ext. Grade.

B. Unless otherwise shown, exterior corners in concrete members shall be provided with 3/4-inch chamfers. Re-entrant corners in concrete members shall not have fillets unless otherwise shown.

C. Forms and falsework to support roof and floor slabs shall be designed for the total dead load, plus a live load of 40 psf (minimum).

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Coordination and project conditions.

B. Verify lines, levels, and centers before proceeding with formwork. Verify dimensions agree with Drawings.

C. When formwork is placed after reinforcement resulting in insufficient concrete cover over reinforcement before proceeding, request instructions from Engineer.

3.2 GENERAL

A. Forms to confine the concrete and shape it to the required lines shall be used wherever necessary. The Contractor shall assume full responsibility for the adequate design of all forms. Forms which are unsafe or inadequate in any respect shall promptly be removed from the Work and replaced at the Contractor's expense. A sufficient number of forms of each kind shall be provided to permit the required rate of progress to be maintained. The design and inspection of concrete forms, falsework and shoring shall comply with applicable Local, State and Federal regulations. Plumb and string lines shall be installed before concrete placement and shall be maintained during placement. Such lines shall be used by Contractor's personnel and by the Engineer and shall be in sufficient number and properly installed. During concrete placement the Contractor shall continually monitor plumb and string line form positions and immediately correct deficiencies.

B. Concrete forms shall conform to the shape, lines and dimensions of structural components as called for on the Drawings and shall be free from surface defects and sufficiently tight to prevent leakage.

3.3 FORM DESIGN

A. All forms shall be true in every respect to the required shape and size, shall conform to the established alignment and grade and shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating the concrete.

B. Suitable and effective means shall be provided on all forms for holding adjacent edges and end of panels and sections tightly together and in accurate alignment so as to prevent the formation of ridges, fins, offsets or similar surface defects in the finished concrete.

C. Plywood, 5/8-inch and greater in thickness, may be fastened directly to studding if the studs are spaced close enough to prevent visible deflection marks in the concrete. The form joints shall be tight so as to prevent the loss of water, cement and fines during the placing and vibrating of the concrete. The bottom of the wall forms that rest on concrete footings or slabs shall be provided with a gasket to prevent loss of fines and paste during placement and vibration of concrete. Adequate cleanout holes shall be provided at the bottom of each lift of forms.

3.4 INSTALLATION

A. Formwork - General:
1. Construct forms to correct shape and dimensions, mortar-tight, braced, and of sufficient strength to maintain shape and position under imposed loads from construction operations.
2. All vertical surfaces of concrete members shall be formed.
3. Carefully verify horizontal and vertical positions of forms. Correct misaligned or misplaced forms before placing concrete.
4. Complete wedging and bracing before placing concrete.

B. Forms for Smooth Finish Concrete:
1. Use steel, plywood or lined board forms.
2. Use clean and smooth plywood and form liners, uniform in size, and free from surface and edge damage capable of affecting resulting concrete finish.
3. Install form lining with close-fitting square joints between separate sheets without springing into place.
4. Use full size sheets of form lines and plywood wherever possible.
5. Tape joints to prevent protrusions in concrete.
6. Use care in forming and stripping wood forms to protect corners and edges.
7. Level and continue horizontal joints.
8. Keep wood forms wet until stripped.

C. Forms for Surfaces to Receive Membrane Waterproofing: Use plywood or steel forms. After erection of forms, tape form joints to prevent protrusions in concrete.

D. Framing, Studding and Bracing:
   1. Size framing, bracing, centering, and supporting members with sufficient strength to maintain shape and position under imposed loads from construction operations.
   2. Distribute bracing loads over base area on which bracing is erected.
   3. When placed on ground, protect against undermining, settlement or accidental impact.

E. Erect formwork, shoring, and bracing to achieve design requirements, in accordance with requirements of ACI 301.

F. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.

G. Obtain Engineer's approval before framing openings in structural members not indicated on Drawings.

H. Install fillet and chamfer strips on external corners of beams, joists, and/or columns, as called for on the Drawings.

I. Install void forms in accordance with manufacturer's recommendations.

3.5 APPLICATION - FORM RELEASE AGENT

A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

C. Do not apply form release agent where concrete surfaces are indicated to receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

D. Reuse and Coating of Forms: Thoroughly clean forms and reapply form coating before each reuse. For exposed work, do not reuse forms with damaged faces or edges. Apply form coating to forms in accordance with manufacturer's specifications. Do not coat forms for concrete indicated to receive "scored finish". Apply form coatings before placing reinforcing steel.

3.6 INSTALLATION - INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Install formed openings for items to be embedded in or passing through concrete work.

B. Locate and set in place items required to be cast directly into concrete.

C. Install accessories straight, level, and plumb. Ensure items are not disturbed during concrete placement.

D. Install water stops continuous without displacing reinforcement.

E. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.

F. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

G. Form Ties:
1. Use sufficient strength and sufficient quantity to prevent spreading of forms.
2. Leave inner rods in concrete when forms are stripped.
3. Space form ties equidistant, symmetrical and aligned vertically and horizontally unless otherwise shown on Drawings.
4. Holes left by the removal of form tie cones shall be reamed with suitable toothed reamers so as to leave the surface of the holes clean and rough before being filled with mortar as specified for "Finish of Concrete Surfaces" in Section 03 30 00 - Cast-In-Place Concrete.
5. Wire ties for holding forms will not be permitted. No form-tying device or part thereof, other than metal, shall be left embedded in the concrete. Ties shall not be removed in such manner as to leave a hole extending through the interior of the concrete members. The use of snap-ties which cause spalling of the concrete form stripping or tie removal will not be permitted.
6. If steel panel forms are used, rubber grommets shall be provided where the ties pass through the form in order to prevent loss of cement paste. Where metal rods extending through the concrete are used to support or to strengthen forms, the rods shall remain embedded and shall terminate not less than 1-inch back from the formed face or faces of the concrete.

H. Removable Ties:
1. Where taper ties are approved for use, the larger end of the taper tie shall be on the wet side of walls in water retaining structures. After the taper tie is removed, the hole shall be thoroughly cleaned and roughened for bond.
2. A precast neoprene or polyurethane taped plug shall be located at the wall centerline. The hole shall be completely filled with non-shrink grout for water bearing and below-grade walls. The hole shall be completely filled with non-shrink grout for above-grade walls that are dry on both sides.
3. Exposed faces of walls shall have the outer 2-inches of the exposed face filled with a cement grout which shall match the color and texture of the surrounding wall surface.

I. Arrangement: Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.

J. Construction Joints:
1. Concrete construction joints will not be permitted at locations other than those shown or specified, except as may be acceptable to the Engineer.
2. Install surfaced pouring strip where construction joints intersect exposed surfaces to provide straight line at joints.
3. Just prior to subsequent concrete placement, remove strip and tighten forms to conceal shrinkage.

4. Show no overlapping of construction joints. Construct joints to present same appearance as butted plywood joints.
5. Arrange joints in continuous line straight, true and sharp.

K. Embedded Items:
1. Make provisions for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, water stops, and other features.
2. Do not embed wood or uncoated aluminum in concrete.
3. Obtain installation and setting information for embedded items furnished under other Specification sections.
4. Securely anchor embedded items in correct location and alignment prior to placing concrete.
5. Verify conduits and pipes, including those made of coated aluminum, meet requirements of ACI 318 for size and location limitations.

L. Openings for Items Passing Through Concrete:
1. Frame openings in concrete where indicated on Drawings. Establish exact locations, sizes, and other conditions required for openings and attachment of work specified under other sections.
2. Coordinate work to avoid cutting and patching of concrete after placement.
3. Perform cutting and repairing of concrete required as result of failure to provide required openings.

M. Screeds:
1. Set screeds and establish levels for tops of concrete slabs and levels for finish on slabs.
2. Slope slabs to drain where required or as shown on Drawings.
3. Before depositing concrete, remove debris from space to be occupied by concrete and thoroughly wet forms. Remove freestanding water.

N. Screed Supports:
1. For concrete over waterproof membranes and vapor retarder membranes, use cradle, pad or base type screed supports which will not puncture membrane.
2. Staking through membrane is not permitted.

O. Cleanouts and Access Panels:
1. Provide removable cleanout sections or access panels at bottoms of forms to permit inspection and effective cleaning of loose dirt, debris and waste material.
2. Clean forms and surfaces against which concrete is to be placed. Remove chips, saw dust and other debris. Thoroughly blow out forms with compressed air just before concrete is placed.

3.7 MAINTENANCE OF FORMS

A. Forms shall be maintained at all times in good condition, particularly as to cleanliness, strength, rigidity, tightness and smoothness of surface. After forms have been removed from a concrete placement they shall be immediately and thoroughly cleaned and repaired and surface treated before reuse.

B. The form surfaces shall be treated with a non-staining mineral oil or other lubricant acceptable to the Engineer. Any excess lubricant shall be satisfactorily removed before placing the concrete. Oil shall be kept off the surfaces of steel reinforcement and other metal items to be embedded in concrete.

3.8 FORM REMOVAL

A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads and removal has been approved by Engineer.

B. For roof slabs and aboveground floor slabs, forms shall remain in place until test cylinders attain a minimum compressive strength of seventy-five percent (75%) of the 28-day strength specified in Section 03 30 00 - Cast-In-Place Concrete.

C. No forms shall be disturbed or removed under an individual panel or unit before the concrete in the adjacent panel or unit has attained seventy-five percent (75%) of the specified 28-day strength and has been in place for a minimum of seven (7) days. Forms for all vertical walls and columns shall remain in place at least forty-eight (48) hours after the concrete has been placed, except for periods of cold weather when forms shall remain in place at least seventy-two (72) hours after concrete has been placed.

D. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

E. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.

F. Leave forms in place for minimum number of days as specified in ACI 347.

3.9 REUSE OF FORMS

A. Forms may be reused only if in good condition and only if acceptable to the Engineer. Light sanding between uses will be required wherever necessary to obtain uniform surface texture on all exposed concrete surfaces. Exposed concrete surfaces are defined as surfaces that are permanently exposed to view.

3.10 FALSEWORK

A. The Contractor shall be responsible for the design, engineering, construction, maintenance and safety of all falsework, including staging, walkways, forms, ladders and similar appurtenances, which shall equal or exceed the applicable requirements of the provisions of the OSHA Safety and Health Standards for Construction, and the requirements specified herein.

B. All falsework shall be designed and constructed to provide the necessary rigidity and to support the required dead load plus a minimum of 40 psf live load. Falsework for the support of a superstructure shall be designed to support the loads that would be imposed if the entire superstructure were placed at one time. Falsework shall be placed upon a solid footing, safe against undermining and protected from softening. When falsework is

supported on any portion of the structure that is already constructed, the load imposed by the falsework shall be spread, distributed and braced in such a way as to avoid any possibility of damage to the structure. Falsework supported off finished floor slabs shall be set in such a way to protect the finish floor surface from being scarred, chipped or gouged.

3.11 FIELD QUALITY CONTROL

A. Section 01 00 00 - Execution Requirements: Field inspecting, testing, adjusting, and balancing.

B. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.

C. Notify Engineer after placement of reinforcing steel in forms, but prior to placing concrete.

D. Schedule concrete placement to permit formwork inspection before placing concrete.

END OF SECTION

SECTION 03 20 00

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.1 SUMMARY

A. The Contractor shall furnish, fabricate and place all concrete and masonry reinforcement steel, including all the tie wires, clips, supports, chairs, spacers and other accessories, all as shown and specified in the Contract Documents.

B. Related Sections:
1. Section 03 10 00 - Concrete Forms and Accessories.
2. Section 03 30 00 - Cast-in-Place Concrete.

1.2 REFERENCES

A. Codes:
1. The International Building Code, as referenced herein, shall be the most recent New Mexico Construction Industries Division (CID) adopted edition of International Building Code (IBC).

B. American Concrete Institute:
1. ACI 301 - Specifications for Structural Concrete.
2. ACI 315 - Details and Detailing of Concrete Reinforcement.
3. ACI 318 - Building Code Requirements for Structural Concrete.
4. ACI SP-66 - ACI Detailing Manual.

C. ASTM International:
1. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
2. ASTM A184/A184M - Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.
3. ASTM A185 - Specification for Welded Steel Wire Fabric (Latest Edition) for Concrete Reinforcement.
4. ASTM A496 - Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
5. ASTM A497 - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
6. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
7. ASTM A934/A934M - Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars.
8. ASTM A996/A996M - Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement.
9. ASTM D3963/D3963M - Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Reinforcing Steel Bars.

D. American Welding Society:
   1. AWS D1.4 - Structural Welding Code - Reinforcing Steel.

E. Concrete Reinforcing Steel Institute:
   1. CRSI - Manual of Standard Practice (Latest Edition).
   2. CRSI - Placing Reinforcing Bars (Latest Edition).

F. Wire Reinforcement Institute:
   1. Manual of Standard Practice for Welded Wire Fabric.

1.3 SUBMITTALS

A. The Contractor shall furnish to the Engineer reinforcing steel placing drawings. These drawings shall show the number, grade, size, length, mark, location and bending diagrams for all reinforcing steel and related products, together with lists of bent and straight bars in accordance with the ACI Detailing Manual (latest edition) of the American Concrete Institute and the requirements specified herein and shown on the Contract Drawings. The Engineer may or may not review the placement drawings. Any review of the placement drawings by the Engineer will be limited to general compliance with the Contract Documents and will not be returned to the Contractor. Reinforcing steel placement will be checked in the field using the design drawings. Any discrepancies, errors or omissions from the requirements of the Contract Documents shall be corrected prior to placement of concrete and at the sole expense of the Contractor.

1.4 QUALITY ASSURANCE

A. When required by any applicable permits, such as CID permits, Contractor shall have reinforcement inspected by the agency with jurisdiction prior to placement of concrete.

B. If requested by the Engineer, the Contractor shall provide a certified copy of the mill test report showing physical and chemical analysis for each heat of reinforcement steel delivered.

PART 2 PRODUCTS

2.1 REINFORCEMENT STEEL

A. Reinforcement steel for all cast-in-place reinforced concrete construction shall conform to the following requirements:
   1. Bar reinforcement shall conform to the requirements of ASTM A615 for Grade 60 Billet Steel Reinforcement with supplementary requirement S-1, or as otherwise shown.
   2. Welded wire fabric reinforcement shall conform to the requirements of ASTM A185 and the details shown. Welded wire fabric with longitudinal wire equal to or less than 4.0 size wire shall be either furnished in flat sheets or in rolls with a core diameter or not less than 10-inches. Welded wire fabric with longitudinal wires larger than 4.0 size shall be furnished in flat sheets only.

3. Spiral reinforcement shall be cold-drawn steel wire conforming to the requirements of ASTM A82.

B. Accessories:
1. The Contractor shall furnish and install all accessories including necessary chairs or bolsters, tie wires, supports, spacers and other devices to position reinforcement during concrete placement, all of which must be approved by the Engineer prior to installation.
2. Wire sizes and geometric dimensions shall be made in accordance with Table II of the latest edition of CRSI Manual of Standard Practice.
3. Concrete blocks (dobies), used to support and position reinforcement steel, are not allowed.
4. The wire tie shall be 16-gauge or heavier, black annealed.

2.2 MECHANICAL COUPLERS

A. Mechanical couplers shall be provided where shown and where approved by the Engineer. The couplers shall develop a tensile strength that exceeds one hundred fifty percent (150%) of the yield strength of the reinforcement bars being spliced at each splice.

PART 3 EXECUTION

3.1 GENERAL

A. All reinforcement steel, welded wire fabric, couplers and other appurtenances shall be fabricated and placed in accordance with the requirements of the Contract Documents, including referenced specifications, codes and standards.

3.2 FABRICATION

A. Reinforcement steel shall be accurately fabricated to the dimensions and shape shown in the Contract Documents. Fabricating details shall be prepared in accordance with ACI 315 and ACI 318, except as modified by the Drawings. Bends shall conform to bend dimensions defined as standard in accordance with details in the ACI Detailing Manual and/or CRSI Manual of Standard Practice, unless otherwise shown. Bars shall be bent cold and shall not be bent or straightened in a manner that will injure the material. All hooks shall conform to bend dimensions defined as ACI Standard Hooks.

B. The Contractor shall fabricate reinforcement bars within the tolerances shown in the ACI Detailing Manual and/or CRSI Manual of Standard Practice.

C. Reinforcing bars delivered to the field shall be tagged with durable material and marked in a legible manner with waterproof markings. Tags shall show the grade, number of pieces, size and mark or length of bars.

3.3 PLACING

A. Reinforcing steel shall be accurately positioned as shown on the Contract Documents and shall be adequately supported and wired together to prevent displacement. All reinforcement steel shall be supported or spaced off the forms by metal supports which are rigid enough to prevent any displacement or the reinforcement steel. Concrete blocks (or dobies) shall not be used.

B. Tie wires shall be bent away from the forms in order to provide the specified concrete coverage.

C. Bars additional to those shown which may be found necessary or desirable by the Contractor for the purpose of securing reinforcement in position shall be provided by the Contractor at its own expense.

D. Placing Tolerances: Unless otherwise specified, reinforcement placing tolerances shall be within the limits specified in Section 7.5 or ACI 318, except where in conflict with the requirements of Building Code.

E. Bars may need to be moved to avoid interference with other reinforcement steel, conduits or embedded items. If bars are moved more than one bar diameter, or enough to exceed the above tolerances, the resulting arrangement of bars shall be as acceptable to the Engineer. Additional bars may be necessary to prevent cracking or provide additional reinforcement in this case and shall be provided by the Contractor at its own expense.

F. Welded wire fabric placed over the ground shall be supported on steel chairs spaced not more than three (3) feet on centers in any direction. The construction practice of placing welded wire fabric on the ground and hooking into place in the freshly placed concrete shall not be used.

3.4 SPACING OF BARS

A. The clear distance between parallel bars (except in columns and between multiple layers of bars in beams) shall be not less than the nominal diameter of the bars nor less than 1-1/3 times the maximum size of the coarse aggregate, nor less than 1-inch.

B. Where reinforcement in beams or girders is placed in two (2) or more layers, the clear distance between layers shall be not less than 1-inch.

C. In columns, the clear distance between longitudinal bars shall not be less than 1-1/2 times the bar diameter, more less than 1-1/2 times the maximum size of the coarse aggregate, more less than 1-1/2 inches.

3.5 SPLICING

A. General: Reinforcement bar splices shall only be used at locations shown, unless otherwise acceptable to the Engineer.

B. Splices of Reinforcement: The length of lap for reinforcement bars, unless otherwise shown shall be in accordance with ACI 318, Section 12.15.1 for a class C splice.

C. Laps of welded wire fabric shall be in accordance with ACI 318. Adjoining sheets shall be securely tied together with No. 14 tie wire, one tie for each two (2) running feet. Wires shall be staggered and tied in such a manner that they cannot slip.

D. Bending or Straightening: Reinforcement shall not be straightened or rebent in a manner which will injure the material. Bars with kinks or bends not shown shall not be used. All bars shall be bent cold, unless otherwise permitted by the Engineer. No bars partially embedded in concrete shall be field-bent, except as specifically permitted by the Engineer.

3.6 CLEANING AND PROTECTION

A. Reinforcing steel delivered to the jobsite shall be suitably stored off the ground and protected from oils, mud, concrete splatter and all conditions conducive to corrosion until embedded in concrete.

B. The surfaces of all reinforcement steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar and other foreign substances immediately before the concrete is placed. Where there is delay in depositing concrete, reinforcement shall be reinspected and, if necessary, recleaned.

END OF SECTION

SECTION 03 29 00

JOINTS IN CONCRETE

PART 1 GENERAL

1.1 SUMMARY

A. The Contractor shall construct all construction joints, expansion joints and control joints in concrete at the locations shown and formed in accordance with the details shown in the drawings.

B. Waterstops shall be provided in all construction and expansion joints of hydraulic or below grade structures unless specifically noted otherwise on the drawings.

C. Related Sections:
1. Section 03 10 00 - Concrete Forms and Accessories.
2. Section 03 20 00 - Concrete Reinforcement.
3. Section 03 30 00 - Cast-in-Place Concrete.

1.2 REFERENCES

A. Federal Specifications:

1.	TSS-S-00227E(3)	Sealing Compound, elastomeric type, multi-component (for Caulking, Sealing, Glazing Buildings and Other Structures)

B. Commercial Standards:

1.	ASTM C 920-86	Specification for Elastomeric Joint Sealants
2.	ASTM D 624-81	Test Method for Rubber Property - Tear Resistance
3.	ASTM D 1752-84	Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

1.3 CONTRACTOR SUBMITTALS

A. Concrete Pipe Sleeve: Prior to installation of concrete pipe sleeve required under this Contract, the Contractor shall submit for review submittal for approval.

1.4 QUALITY ASSURANCE

A. Pipe Sleeve Inspection: Pipe sleeve shall be inspected by the Engineer. No concrete shall be placed prior to the Engineer's inspection. Not less than twenty-four (24) hours notice shall be provided to the Engineer for scheduling such inspection.

B. Sealant Material: The sealant material shall show no signs of adhesive or cohesive failure when tested in accordance with the following procedure:

1. Sealant specimen shall be prepared between two concrete blocks (1-inch by 2-inch by 3-inch). Spacing between the blocks shall be 1/2-inch. Coated spacers (2-inch by 1-1/2 inch by 1/2-inch) shall be used to ensure sealant cross-sections of 1/2-inch by 2-inches with a width of 1/2-inch.
2. Sealant shall be cast and cured according to manufacturer's recommendations except that curing period shall not exceed twenty-four (24) hours.
3. Following curing period, the gap between blocks shall be widened to 1-inch. Spacers shall be used to maintain this gap for twenty-four (24) hours prior to inspection for failure.

PART 2 PRODUCTS

2.1 CONCRETE PIPE SLEEVE

A. Arlington CPS30 Plastic Concrete Pipe Sleeve 2 Inch or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION OF CONCRETE PIPE SLEEVE

A. As per manufacture’s requirements.

3.2 JOINT CONSTRUCTION

A. Joint Location: Construction joints, expansion joints and control joints shall be provided where shown. The location of all joints shall be submitted for acceptance by the Engineer.

B. Construction joints shall be cut using 1/8-inch wide masonry blade to a minimum depth of 2 inches. Construction joints shall be filled with gray polyurethane or elastomeric joint sealant.

C. Special care shall be used in preparing concrete surfaces at joints where bonding between two (2) sections of concrete is required. Unless otherwise shown, such bonding will be required at all horizontal joints in walls and wall to slab joints. Surfaces shall be prepared by sandblasting and washing for removal of latence or any objectionable material. Joints shall be kept clean until the concrete is placed. Vertical joints shall be clean and free of concrete fins, rock pockets or any objectionable material.

D. Sealant grooves shall be formed as shown on the drawings and shall be protected from damage until final application of the sealant. Care shall be taken to prevent chipping of the sealant grove during removal of forms.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

A. The Contractor shall furnish all materials for concrete in accordance with the provisions of this Section and shall form, mix, place, cure, repair, finish, and do all other work as required to produce finished concrete, in accordance with the requirements of the Contract Documents.

B. The following types of concrete shall be covered in this Section:
1. Sitework Concrete: Concrete to be used for curbs, gutters, catch basins, sidewalks, pavements, thrust blocks, fence and guard post embedment, and other concrete ties unless otherwise shown.
2. Structural Concrete: Concrete to be used where noted in the Contract Documents.
3. Lean Concrete: Concrete to be used for pipe trench cut-off walls and cradles, where the preceding items are detailed on the Drawings as un-reinforced.
4. Duct Bank Concrete: Red colored concrete to be used for electrical duct banks.

C. The term "hydraulic structure" used in these specifications shall refer to environmental engineering concrete structures for the containment, treatment, or transmission of water, wastewater, or other fluids.

D. Related Sections:
1. Section 03 10 00 - Concrete Forms and Accessories.
2. Section 03 20 00 - Concrete Reinforcement.
3. Section 03 29 00 - Joints in Concrete.
4. Section 31 23 23 - Backfill.
5. Section 32 12 16 - Asphalt Paving.
6. Section 33 11 00 - Water Utility Distribution Piping.

1.2 REFERENCES

A. American Concrete Institute (ACI):
1. ACI 117 - Specification for Tolerances for Concrete Construction and Materials.
2. ACI 214R - Guide to Evaluation of Strength Test Results of Concrete.
3. ACI 301 - Specifications for Structural Concrete.
4. ACI 305.1 - Specification for Hot Weather Concreting.
5. ACI 306.1 - Standard Specification for Cold Weather Concreting.
6. ACI 308.1 - Standard Specification for Curing Concrete.
7. ACI 309R - Guide for Consolidation of Concrete.
8. ACI 318 - Building Code Requirements for Structural Concrete.

B. ASTM International (ASTM):

1. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
2. ASTM C33/C33M - Standard Specification for Concrete Aggregates.
3. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
4. ASTM C40M - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
5. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
6. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
7. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic Cement Concrete.
8. ASTM C150/C150M - Standard Specification for Portland Cement.
9. ASTM C156 - Standard Test Method for Water Loss [from a Mortar Specimen] Through Liquid Membrane Forming Curing Compounds for Concrete.
10. ASTM C157/C157M - Standard Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete.
11. ASTM C172/C172M - Standard Practice for Sampling Freshly Mixed Concrete.
12. ASTM C192/C192M - Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory.
13. ASTM C227 - Standard Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar Bar Method).
14. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete.
15. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
16. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete.
17. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
18. ASTM C1077 - Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation.
19. ASTM C1116/C1116M - Standard Specification for Fiber-Reinforced Concrete.
20. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures.
21. ASTM C1550 - Standard Test Method for Flexural Toughness of Fiber Reinforced Concrete (Using Centrally Loaded Round Panel).
22. ASTM C1567 - Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method).
23. ASTM C1579 - Standard Test Method for Evaluating Plastic Shrinkage Cracking of Restrained Fiber Reinforced Concrete (Using a Steel Form Insert).
24. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.
25. ASTM C1609/C1609M - Standard Test Method for Flexural Performance of Fiber-Reinforced Concrete (Using Beam with Third-Point Loading).

26. ASTM C1778 - Standard Guide for Reducing the Risk of Deleterious Alkali-Aggregate Reaction in Concrete.
27. ASTM D2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.

C. DIN (Deutsches Institut Fur Normung, Germany):
1. DIN 1048 Part 5 "Testing Concrete - Testing of Hardened Concrete (Specimens Prepared in Mould)".

D. International Organization for Standardization (ISO):
1. ISO 22196 – Measurement of Antibacterial Activity on Plastics and Other Non-porous Surfaces (Modified).

E. NSF International (NSF):
1. NSF/ANSI Standard 61 - Drinking Water System Components.

F. U.S. Army Corps of Engineers (COE):
1. CRD-C 48 - Standard Test Method for Water Permeability of Concrete.

1.3 SUBMITTALS

A. General**:** Submittals shall be submitted to the Engineer for review in accordance with Section 01 00 00, Contractor Submittals. Submittals shall include, but not be limited to the following:
1. Mix Designs**:** Prior to beginning the Work and within 14 days of the Notice to Proceed, the Contractor shall submit to the Engineer, for review, the proposed ready-mix supplier and their Laboratory-Certified concrete mix design for each class and type of concrete specified for the Work. Submitted mix designs shall have been performance-tested and certified by an independent laboratory approved by the Owner. All costs related to providing mix design shall be borne by the Contractor. Mix designs shall show the following in accordance with ACI 301:
   a. Proportions for all materials proposed.
   b. Mill tests for cement.
   c. Admixture certification, chloride ion content must be included.
   d. Aggregate gradation and certification.
2. Delivery Tickets: Where ready-mix concrete is used, the Contractor shall furnish delivery tickets at the time of delivery of each load of concrete. Each ticket shall show the state certified equipment used for measuring and the total quantities, by weight of cement, sand, each class of aggregate, admixtures, and the amounts of water in the aggregate added at the batching plant, and the amount allowed to be added at the site for the specific design mix. In addition, each ticket shall state the approved mix design number, total yield in cubic yards, and the time of day, to the nearest minute, corresponding to the times when the batch was dispatched, when it left the plant, when it arrived at the site, when unloading began, and when unloading was finished.
3. Materials and methods for curing:
   a. List of curing methods to be used on each type and class of concrete.
   b. Curing compound.
   c. Curing blankets and mats.

d. Evaporation retardant.

1.4 QUALITY ASSURANCE

A. When required by any applicable permits, such as Construction Industries Division (CID) permits, Contractor shall have reinforcement inspected by the agency with jurisdiction prior to placement of concrete.

B. General:
1. Tests on concrete will be field performed in accordance with all requirements of applicable ASTM standards for such tests, including but not limited to obtaining samples, temperature, slump, air entrainment, making and curing specimens, breaking concrete cylinders, and other as may be applicable.
2. The cost of all laboratory tests on cement, aggregates, and concrete, for the development of the mix design, will be borne by the Contractor. The laboratory must meet or exceed the requirements of ASTM C1077.
3. Concrete for testing shall be supplied by the Contractor as part of the project cost, and the Contractor shall provide assistance in obtaining samples, and disposal and cleanup of excess material.
4. Test cylinders will be prepared at the frequency determined by the Owner and Engineer.

C. Compression Tests:
1. Compression test specimens will be taken during construction from the first placement of each class of concrete specified herein and at intervals thereafter as indicated above to ensure continued compliance with these specifications. Each set of test specimens will be a minimum of 5 cylinders.
2. Compression test specimens for concrete shall be made in accordance with ASTM C31. Specimens shall be 6-inch diameter by 12-inch high cylinders.
3. Compression tests shall be performed in accordance with ASTM C39. One test cylinder will be tested at 7 days and 2 at 28 days. The remaining cylinders will be held to verify test results, if needed.
4. Compression testing will be paid for by the Owner.

D. Evaluation and Acceptance of Concrete:
1. Evaluation and acceptance of the compressive strength of concrete shall be according to the requirements of ACI 318, and as specified herein.
2. All concrete that fails to meet the ACI requirements and these specifications, is subject to removal and replacement at the cost of the Contractor.
3. Concrete delivered to the site that does not meet the requirements as herein specified may be rejected.

1.5 CONSTRUCTION TOLERANCES

A. The Contractor shall set and maintain concrete forms and perform finishing operations so as to ensure that the completed work is within the tolerances specified herein. Surface defects and irregularities are defined as finishes and are to be distinguished from tolerances. Tolerance is the specified permissible variation from lines, grades, or dimensions shown.

Where tolerances are not stated in the specifications, permissible deviations will be in accordance with ACI 117.

B. The following construction tolerances are hereby established and apply to finished walls and slabs unless otherwise shown:

Item	Tolerance
Variation of the constructed linear outline from the established position in plan.	In 10 feet: 1/4-inch In 20 feet or more: 1/2-inch
Variation from the level or from the grades shown.	In 10 feet: 1/4-inch In 20 feet or more: 1/2-inch
Variation from the plumb.	In 10 feet: 1/4-inch In 20 feet or more: 1/2-inch
Variation in the thickness of slabs and walls.	Minus 1/4-inch; Plus 1/2-inch
Variation in the locations and sizes of slabs and wall openings.	Plus or minus 1/4-inch

PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

A. Cement: Except as otherwise specified, all cement shall be standard brand portland Cement conforming to ASTM C150 for Type II, low alkali. Portland cement shall contain not more than 0.60 percent total alkalies. The term "alkalies" is defined as the sum sodium oxide (Na_2O), potassium oxide (K2O), calculated as sodium oxide (.658 K2O). Only one (1) brand of cement shall be used for exposed concrete in any individual structure. The cement shall be suitably protected from exposure to moisture until used. Certified mill test reports for each shipment of cement to be used shall be submitted to the Engineer. Mill test reports shall include the alkali content.

B. Supplementary Cementitious Materials (SCM) include:

1. Fly ash/pozzolan shall conform to ASTM C618, including the requirements of Table 1A, therein, and the following supplementary requirements:

a.	Class C Fly Ash	
	Loss on ignition, maximum	1%
	SO3 content, maximum	4%
	Moisture content, maximum	1%
	R = (CaO - 5%)/(Fe_2O_3), maximum	4.5
b.	Class F Fly Ash	
	Loss on ignition, maximum	1%
	SO3 content, maximum	3%
	Moisture content, maximum	1%
	R = (CaO - 5%)/(Fe_2O_3), maximum	1.5

c. Fly ash shall be proportioned by weight of cement to provide a fly ash to portland cement ratio not less than 1:4 and not less than 25 percent of the total cementitious material. Portland cement concrete submitted under this specification shall be proportioned with Class F fly ash, unless a variance is authorized by the Engineer per conditions specified in paragraph 2.3.D below. Alternatively, lithium-based admixture can be used in lieu of Class F fly ash to mitigate ASR. The Contractor shall provide the Engineer with chemical and physical analysis of the fly ash.

2. Slag Cement shall conform to ASTM C989, Grade 100 or 120. Slag cement may be added to the mix and shall be proportioned by weight of cement to provide a slag cement to portland cement ratio of no greater than 80 percent.
3. Silica Fume shall conform to ASTM C1240. Silica fume may be added to the mix and shall be proportioned by weight of cement to provide a silica fume to portland cement ratio not less than 1:25 and no greater than 1:7.
4. Metakaolin shall conform to ASTM C618, Class N.

C. Water shall conform to ASTM C1602/C1602M, and be potable, clean and free from objectionable quantities of silty organic matter, alkali, salts and other impurities. The water shall be considered potable, for the purpose of this Section only, if it meets the requirements of the local governmental agencies. Agricultural water with high total dissolved solids (over 1000 mg/l TDS) shall not be used.

D. All concrete aggregates shall be obtained from pits acceptable to the Engineer, shall be non-reactive, sound, uniformly graded and free of deleterious material in excess of allowable limits specified. Combined aggregates shall be well graded from coarse to fine sizes, and be uniformly graded between screen sizes to produce a concrete that has optimum workability and consolidation characteristics. Lightweight sand for fine aggregate will not be permitted. Aggregates shall conform to ASTM C33.

1. Coarse Aggregate: Coarse aggregate shall consist of gravel, crushed gravel or crushed stone made up of clean, hard, durable particles free from calcareous coatings, organic matter or other foreign substances. Thin or elongated pieces having a length greater than four (4) times the average thickness shall not exceed fifteen percent (15%) by weight. Deleterious substances shall not be present in excess of the following percentages by weight, and in no case shall the total of all deleterious substances exceed one and one-half percent (1.5%):

Soft Fragments	1.5%
Shale	1.5%
Coal and Lignite	0.25%
Clay Lumps	0.25%
Materials Finer than No. 200 Sieve	0.50%*

*Except that when material finer than No. 200 sieve consists of crusher dust, the maximum amount maybe 1%.

Except as otherwise specified or approved in writing by the Engineer, coarse aggregate shall be graded as specified in ASTM C33, size No. 57.

2. Fine Aggregate: Fine aggregate for concrete or mortar shall consist of clean, natural sand or a combination of natural and manufactured sands that are hard and durable. Deleterious substances shall not be present in excess of the following percentages by weight of contaminating substances. In no case shall the total exceed three percent (3%):

Removed by Decantation (Dirt, Silt, Etc.)	3%
Shale	1%
Clay Lumps	1%

Fine aggregate shall not contain strong alkali nor organic matter which gives a color darker than a standard color when tested in accordance with ASTM C40. Fine aggregate shall have a fineness modulus not less than 2.50 nor greater than 3.00. Except as otherwise specified, fine aggregate shall be graded from coarse to fine in accordance with the requirements of ASTM C33.

E. If non-reactive aggregates are unavailable, and either the coarse or fine aggregates are found to be alkali-silica reactive, the Contractor shall submit a proposed design mix that effectively mitigates the alkali-silica reactivity, per ASTM C1778. Supplementary cementitious materials or lithium-based admixture or a combination of both will be considered effective if the mean mortar bar expansion at 14 days is less than or equal to 0.10%, when determined in accordance with the performance-based approach provided in ASTM C1778.

F. Admixtures of any type, except as otherwise specified, shall not be used unless written authorization has been obtained from the Engineer. The use of calcium chloride or admixtures containing intentionally-added chlorides will not be permitted. Admixtures will be compatible as documented by mix design history.

1. Air-Entraining Agent: ASTM C260, or U.S. Army Corps of Engineers Specifications CRD-C13.
2. Water-Reducing Admixture: ASTM C494/C494M Type A.
3. Mid-Range Water-Reducing Admixture: ASTM C494/C494M Type A.
4. High-Range Water-Reducing Admixture: ASTM C494/C494M Type F.
5. High-Range Water-Reducing and Retarding Admixture: ASTM C494, Type G.
6. Accelerating Admixture: ASTM C494/C494M Type C or E.
7. Retarding Admixture: ASTM C494/C494M Type B or D.
8. Hydration Control Admixture: ASTM C494/C494M Type B or D.
9. Workability-Retaining Admixture: ASTM C494/C494M Type S.
   a. Shall retain concrete workability without affecting time of setting or early-age strength development.
10. Permeability-Reducing Admixture:
    a. Shall be a portland cement-based crystalline capillary waterproofing admixture that reacts in concrete to form non-soluble crystalline hydration products in the capillary pores of the concrete.
    b. Shall show a reduction in permeability of concrete compared to an identical concrete mixture without the admixture, when tested in

accordance with CRD-C 48 at a pressure of 200 psi (equivalent to 460 ft. of head).

c. Shall reduce or have no penetration of water compared to an identical concrete mixture without the admixture, when tested in accordance with DIN 1048 for a duration of 96 hours.

d. Shall be certified to NSF/ANSI 61.

11. Corrosion-Inhibiting Admixture:
    a. Shall be a nominal 30 percent solution of calcium nitrite or an amine/ester-based organic corrosion-inhibiting admixture.
12. Shrinkage-Reducing Admixture: ASTM C494/C494M Type S.
13. Alkali-Silica Reaction Inhibiting Admixture: ASTM C494/C494M Type S.
    a. Shall contain a nominal lithium nitrate content of 30 percent.
14. Antimicrobial Admixture: ASTM C494, Type S.
    a. Shall be EPA-registered.
    b. Concrete treated with antimicrobial admixture shall show significant reduction in antibacterial activity compared to associated untreated (control) samples based on a modified version of the ISO 22196 test method.

2.2 CONCRETE CURING MATERIALS

A. Evaporation Retardant: Shall be a monomolecular film-forming liquid for application to fresh concrete to prevent rapid drying of the surface.

B. Materials for curing concrete shall conform to the following requirements:
1. Concrete curing compound shall be Protex LR-151 as manufactured by Protex Industries, Denver, CO; Hunt Process Clear ARB as manufactured by Hunt Process Co., Santa Fe Springs, CA; Select Cure CRB as manufactured by Select Products Co., Upland, CA; or equal. The curing compound shall contain a fugitive dye so that areas of application will be readily distinguishable.
2. Polyethylene sheet for use as concrete curing blanket shall be white and shall have a normal thickness of 10 mils.
3. Burlap, cotton mats or other covering material for use as concrete curing blanket must be overlapped adequately to ensure 100% coverage at all times, and must not be allowed to become dry at any point during the curing period
4. The loss of moisture, when determined in accordance with the requirements of ASTM C156, shall not exceed 0.055 grams per square centimeter of surface.

C. Evaporation Retarder: Waterborne, monomolecular fil forming, manufactured for application to fresh concrete

2.3 CONCRETE DESIGN REQUIREMENTS

A. General: The concrete mixes shall be designed to produce a concrete of such consistency and composition so as to obtain maximum density and minimum shrinkage. Mix designs with more than forty-one percent (41%) of sand of the total weight of fine and coarse aggregate shall not be used.

B. All concrete shall contain five percent (5%), plus or minus one percent (1%) entrained air of evenly dispersed air bubbles at the time of placement. The air-entraining agent shall be added to the batch in a portion of the mixing water. The solution shall be batched by means of a mechanical batcher capable of accurate measurement. The Engineer or Owner and his duly authorized representatives reserve the right, at any time, to sample and test the air-entraining agent or the air content of concrete received on the job by the Contractor. Air entrainment in the concrete shall be tested by ASTM C138, ASTM C231 or ASTM C173. If any sample tested does not have the specified air content, a second test shall be performed. If the second test does not meet the specified air content, the concrete represented by the test shall be removed from the job.

C. Water-Cementitious Materials Ratio and Compressive Strength: The minimum compressive strength and cement content of concrete shall not be less than that specified in the following Table:

Type of Work	Min. 28-Day Compressive Strength (psi)	Max. Size Aggregate (in.)	Min. Cement W/C per CY (94# sacks)	Maximum w/cm (by wt.)
Slabs on grade, footings, floor slabs, and all other concrete items not specified elsewhere.	4,000	1	6.0	0.50
Site work concrete such as fence posts, thrust blocks, valve collars, etc.	3,000	1	5.0	0.50

D. Adjustments to Mix Design: The mixes used shall be changed whenever such change is necessary or desirable to secure the required strength, density, workability and surface finish and the Contractor shall be entitled to no additional compensation because of such changes.

E. At the Contractors option, fly ash or other supplementary cementitious materials may be used as a partial cement replacement in concrete as follows:

1. Fly ash shall replace not more than twenty-five percent (25%) by mass of the portland cement in the design mix. The design mix shall contain a minimum of six (6) sacks of cement per cubic yard before the replacement is made.
2. Fly ash for hydraulic/liquid containing structures shall be Class F fly ash. Fly ash concrete for all other structures shall be Class C or F fly ash.
3. If the coarse or fine aggregates are proven to be potentially alkali-silica reactive per ASTM C227, the SCM Class F fly ash shall be proportioned by mass of cement to provide a fly ash to portland cement ratio not less than 1:4 and not less than 25 percent of the total cementitious material. The Contractor shall provide the Engineer with chemical and physical analysis of the fly ash, and detailed design mix to meet the requirements in accordance with the performance-based approach provided in ASTM C1778.
4. Replacement levels of supplementary cementitious materials and the dosage of lithium nitrate based admixtures shall be determined in accordance with the performance-based approach provided in ASTM C1778.

F. A "superplasticizer" (high-range water-reducing) admixture may be used at the Contractor's option, subject to approval by the Engineer, for concrete in hydraulic structures. The amount of cement in the mix shall not be reduced. The slump may be increased to a maximum of 9-inches. Quantities of admixtures and procedures shall be in accordance with the manufacturers published recommendations.

2.4 CONSISTENCY

A. The consistency of the concrete in successive batches shall be determined by slump tests in accordance with ASTM C 143. The slumps shall be as follows:

Part of Work	Slump (inches)
Footings and Slabs	3-inches + 1/2-inches, - 1 inch.
Other Work	3-inches ± 1-inch.
With High Range Water Reducer Added	9-inches maximum.

2.5 TRIAL BATCH AND LABORATORY TESTS

A. Before placing any concrete, the Contractor shall submit the certified trial batch results of each class of concrete having a 28-day strength of 3,500 psi or higher, based on the preliminary concrete mixes submitted by the Contractor. All concrete shall conform to the requirements of this Section, whether the aggregate proportions are from the Contractors preliminary mix design, or whether the proportions have been adjusted during the trial batch process. The trial batch shall be prepared using the aggregates, cement and admixture proposed for the project. The trial batch materials shall be of a quantity such that the testing laboratory can obtain three (3) drying shrinkage, and six (6) compression test specimens from each batch. The costs for the trial batch tests shall be borne by the Contractor.

B. The determination of compressive strength will be made by testing cylinders as defined in Article 1.4 herein; made, cured and tested in accordance with ASTM C192 and ASTM C39. Three (3) compression test cylinders will be tested at 7-days and three (3) at 28-days. The average compressive strength for the three (3) cylinders tested at 28-days for any given trial batch shall not be less than one hundred twenty-five percent (125%) of the specified compressive strength.

C. A standard sieve analysis of the combined aggregate for each trial batch shall be performed according to the requirements for ASTM C136. Values shall be given for percent passing each sieve.

2.6 SHRINKAGE LIMITATION

A. Drying shrinkage specimens shall be 4-inch by 4-inch by 11-inch prisms with an effective gage length of 10-inches, fabricated, cured, dried and measured in accordance with ASTM C157 modified as follows: Specimens shall be removed from molds at an age of 23+ hours after trial batching, shall be placed immediately in water at 70 degrees F. +3 degrees F. for at least thirty (30) minutes, and shall be measured within thirty (30) minutes thereafter to determine original length and then submerged in saturated lime water at 73 degrees F. +3 degrees F. Measurement to determine expansion expressed as a percentage of original

length shall be made at age 7-days. This length at age 7-days shall be the base length for drying shrinkage calculations ("0" days drying age). Specimens then shall be stored immediately in a humidity control room maintained at 73 degrees F. +3 degrees F. and fifty percent (50%) +4 percent relative humidity for the remainder of the test. Measurements to determine shrinkage expressed as percentage of base length shall be made and reported separately for 7, 14, 21 and 28-days of drying after 7-days of moist curing.

B. The drying shrinkage deformation of each specimen shall be computed as the difference between the base length (at "0" days drying age) and the length after drying at each test age. The average drying shrinkage deformation of the specimens shall be computed to the nearest 0.0001-inch at each test age. If the drying shrinkage of any specimen departs from the average of that test age by more than 0.0004-inch, the results obtained from that specimen shall be disregarded. Results of the shrinkage test shall be reported to the nearest 0.001 percent of shrinkage. Compression test specimens shall be taken in each case from the same concrete used for preparing during shrinkage specimens. These tests shall be considered a part of the normal compression tests for the project. Allowable shrinkage limitations shall be specified herein.

C. The maximum concrete shrinkage for specimens cast in the laboratory from the trial batch, as measured at 21-day drying age or at 28-day drying age, shall be 0.036 percent or 0.042 percent, respectively. The Contractor shall only use a mix design for construction that has first met the trial batch shrinkage requirements.

D. The maximum concrete shrinkage for specimens cast in the field shall not exceed the trial batch maximum shrinkage requirement by more than twenty-five percent (25%).

E. If the required shrinkage limitation is not met during construction, the Contractor shall take all necessary action, at no additional cost to the Owner, for securing the specified shrinkage requirements. These actions may include changing the source of aggregates, cement and/or admixtures; reducing water content ratio; washing or aggregate to reduce fines; increasing the number of construction joints; modifying the curing requirements; or other actions designed to minimize shrinkage or the effects of shrinkage.

2.7 CEMENT GROUT

A. Cement grout materials shall be as specified in Section 03 60 00 - Grout.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Coordination and project conditions.

B. Verify requirements for concrete cover over reinforcement.

C. Verify anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with placing concrete.

3.2 MIXING CONCRETE

A. Mixing equipment shall be subject to the Engineers approval. Mixers shall be of the stationary plant or truck mixer type. Adequate equipment and facilities shall be provided for accurate measurement and control of all materials and for readily changing the proportions of the material. The mixing equipment shall be maintained in good working order and shall be capable of combining the aggregates, cement and water within the specified time into a thoroughly mixed and uniform mass and of discharging the mixture without segregation. Cement and aggregate shall be proportioned by weight.

B. The batch plant shall be capable of controlling and delivering of all material to within one percent (1%) by weight of the individual material. If bulk cement is used, it shall be weighed on a separate visible scale that will accurately register the scale load at any stage of the weighing operation from zero to full capacity.

1. Cement shall not come in contact with aggregate or with water until the materials are in the mixer ready for complete mixing with all mixing water. The procedure of mixing cement with sand or with sand and coarse aggregate for delivery to the jobsite for final mixing and an addition of mixing water will not be permitted. Retempering of concrete (addition of water to previously prepared concrete mix) will not be permitted. The entire batch shall be discharged before recharging. The volume of the mixed material per batch shall not exceed the manufacturers rated capacity of the mixer.
2. Each mixer shall be equipped with a device for accurately measuring and indicating the quantity of water entering the concrete, and the operating mechanism shall be such that leakage will not occur when the valves are closed. Each mixer shall be equipped with a device for automatically measuring, indicating and controlling the time required for mixing. This device shall be interlocked to prevent the discharge of concrete from the mixer before the expiration of the mixing period.
3. Transit-mixed concrete shall be mixed and delivered in accordance with ASTM C94. After the drum is once started, it shall be revolved continuously until it has completely discharged its batch. Water shall not be admitted to the mix until the drum has started revolving. The right is reserved to increase the required minimum number of revolutions allowed, if necessary, to obtain satisfactory mixing, and the Contractor will not be entitled to additional compensation because of such an increase or decrease.

C. Mixed concrete shall be delivered to the site of the work and discharge shall be completed within one (1) hour after the addition of the cement to the aggregates. In hot weather or under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 85 degrees F. or above, the time between the introduction of the cement to the aggregates and discharge shall not exceed forty-five (45) minutes. The use of non-agitating equipment for transporting concrete will not be permitted.

D. Truck mixers shall be equipped with counters so that the number of revolutions of the drum may be readily verified. The counter must be capable of being reset and shall be actuated at the time of starting mixers at mixing speeds. Concrete shall be mixed in a truck mixer for not less than seventy (70) revolutions of the drum or blades at the rate of rotation

designated by the manufacturer of equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. All materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolution of mixing.

3.3 PREPARATION OF SURFACES FOR CONCRETING

A. Earth surfaces shall be thoroughly and uniformly wetted by sprinkling prior to the placing of any concrete. These surfaces shall be kept moist by frequent sprinkling up to the time concrete is placed thereon. The surface shall be free from standing water, mud and debris at the time of placing concrete.

B. The surfaces of all horizontal construction joints shall be cleaned of all laitance, loose or defective concrete and foreign material. Such cleaning shall be accomplished by sandblasting followed by thorough washing. All pools of water shall be removed from the surface of construction joints before the new concrete is placed.

C. No concrete shall be placed until all formwork, installation of parts to be embedded, reinforcement steel and preparation off surfaces involved in the placing have been completed and accepted by the Engineer at least four (4) hours before placement of concrete. All reinforcement, anchor bolts, sleeves, inserts and similar items shall be set and secured in the forms where shown or by shop drawings and shall be acceptable to the Engineer before any concrete is placed. Accuracy of placement is the responsibility of the Contractor. All surfaces of embedded items that have become encrusted with dried grout from concrete previously placed shall be cleaned of all such grout before the surrounding or adjacent concrete is placed.

D. All form surfaces in contact with the concrete shall be thoroughly cleaned of all previous concrete, dirt and other surface contaminants prior to use. Damaged form surfaces shall not be used.
   1. Wood form surfaces in contact with the concrete shall be coated with an approved release agent prior to form installation. The release agent shall be non-staining and non-toxic after thirty (30) days. Mill scale and other ferrous deposits shall be sandblasted or otherwise removed from the contact surface of steel forms.
   2. All steel forms shall have the contact surfaces coated with an approved release agent. The release agent shall be effective in preventing discoloration of the concrete from rust and shall be non-toxic after thirty (30) days.

E. Where concrete is to be cast against old existing concrete, the old concrete shall be thoroughly roughened to exposed, hard aggregate by sandblasting or chipping. Any additional surface preparation shall be as called for in the drawings.

F. No concrete shall be placed in any structure until all water entering the space to be filled with concrete has been properly cut off or diverted out of the forms and clear of the work. No concrete shall be deposited under water or allowed to rise on any concrete until the concrete has attained its initial set. Pumping or other necessary dewatering operations for removing ground water, if required, shall be the responsibility of the Contractor and will be subject to review by the Engineer.

G. Pipe, conduit, dowels, sleeves and other ferrous items required to be embedded in concrete construction shall be adequately positioned and supported prior to placement of concrete. There shall be a minimum of 2-inches clearance between embedded items and any of the concrete reinforcement. Securing embedments in position by wiring or welding them to the reinforcement will not be permitted.

3.4 PLACING CONCRETE

A. No concrete shall be placed without prior inspection of the forms, reinforcing and embedded items and approval from an authorized representative of the Engineer. The Contractor shall notify the Engineer at least twenty-four (24) hours in advance of any scheduled concrete placement and shall call for final inspections no later than four (4) hours in advance of the scheduled placement. The Contractor shall notify the Engineer at least two (2) hours in advance of setting the opposite side of wall forms so that the construction joint preparation, water stop installation and reinforcing steel inspections can be conducted. It is the Contractors responsibility to see that the forms are properly cleaned and oiled before being set, the construction joints properly prepared, reinforcing steel is securely and properly supported in the correct position and that all embedment items including electrical conduit is correctly installed before calling for inspections. The Engineer may at his option require the use of placement cords if deemed necessary.

B. Placement of concrete shall conform to the requirements and recommendations of ACI 301, 304R, 305.1, 306.1, and 318, except as modified herein.

C. Concrete, which upon or before placing is found not to conform to the requirements specified herein, shall be rejected and immediately removed from the Work. Concrete which is not placed in accordance with these specifications, or which is of inferior quality, shall be removed and replaced at the expense of the Contractor.

D. No concrete shall be placed during rain or snow storms, unless completely covered to prevent storm water from coming in contact with it. Sufficient protective covering material shall be kept on hand at all times should rain or snow storms arise during concrete placement operations.

E. Concrete shall be deposited at or near its final position to avoid segregation caused by rehandling or flowing. Concrete shall not be deposited in large quantities in one place and worked along the forms with vibrator or other means. Concrete shall be uniformly distributed during the placing process and in no case after depositing shall any portion be displaced in the forms more than 2-feet in horizontal direction. Concrete shall be deposited in forms in horizontal layers not to exceed 24-inches in depth and shall be brought up evenly in all parts of the form. The rate of placement of concrete in forms shall not exceed 5-feet of vertical rise per hour. As the concrete is placed it shall be consolidated thoroughly and uniformly by mechanical vibration to secure a dense mass, close bond with reinforcement and other embedded items and smooth surface. The mechanical vibrator shall penetrate not only the freshly placed concrete, but also the previously placed lift to ensure the lifts become monolith. New concrete shall be placed against previously placed concrete, not away from it. When concrete is placed on a slope, placement shall begin at the lower end of the slope and progress to the upper end for the full width of the placement. Consolidation by mechanical vibration shall follow directly behind placement and the rate

of placement shall never get ahead of the consolidation crew. Concrete placement shall continue without avoidable interruption, in a continuous operation until the end of the placement is reached.

F. The drop of concrete into slab or wall forms shall be vertical. Concrete shall not be dropped through reinforced steel, but deposited in forms using a hopper with a drop chute to avoid segregation and to keep mortar from coating the reinforcement steel and forms above the in-place concrete. In no case shall the free fall of concrete exceed 4-feet below the end of the hopper or chute.

G. If it takes more than 20-minutes to get back to place concrete over concrete previously placed, the depth of the layers being placed at one time shall be reduced, and/or placing equipment increased, until it is possible to return with the placing operation to previously placed concrete within 20-minutes. If concrete is to be placed over previously poured concrete and more than 20-minutes have elapsed, then a layer of grout not less than 1/2-inch thick shall be spread over the surface before placing the additional concrete.

H. The placement of concrete for slabs, beams or walkways cast monolithically with walls or columns shall not commence until the concrete in the walls or columns has been allowed to set and shrink. The time allowed for shrinkage shall be not less than one (1) hour.

I. Concrete shall be placed with the aid of approved mechanical vibrators. Vibration shall be supplemented by manual forking or spading adjacent to the forms on exposed faced in order to secure smooth dense surfaces. The concrete shall be thoroughly consolidated around reinforcement, pipes or other shapes built into the work. The vibration shall be sufficiently intense to cause the concrete to flow and settle readily into place and to visibly affect the concrete over a radius of at least 18-inches.

1. Sufficient vibrators shall be on hand at all times to vibrate the concrete as placed. In addition to the vibrators in actual use while concrete is being placed, the Contractor shall have on hand one (1) spare vibrator in serviceable condition. No concrete shall be placed until it has been ascertained that all vibrating equipment, including spares, is in serviceable condition.

J. Special care shall be taken to place the concrete solidly against the forms so as to leave no voids. Every precaution shall be taken to make all concrete solid, compact and smooth, and if for any reason the surfaces or interiors have voids or are in any way defective, such concrete shall be repaired as directed by the Engineer. No defective work shall be patched or repaired without the prior inspection and approval of the Engineer.

K. The temperature of concrete when it is being placed shall be not more than 90 degrees F. nor less than 40 degrees F. in moderate weather, and not less than 50 degrees F. in weather during which the mean daily temperature drops below 40 degrees 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 degrees 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 degrees F. In general, the Contractor shall adhere to the requirements in ACI 305.1 for hot weather concreting, except as

required herein. The Contractor shall be entitled to no additional compensation on account of the foregoing requirements.

L. Concrete shall not be placed on a frozen subgrade or subgrade that contains frozen materials. All ice and snow shall be removed from inside forms and from reinforcing steel and embedded items. The temperature of all surfaces that the concrete will contact shall be raised above the freezing point for at least 12-hours prior to placing new concrete.

1. The minimum temperature of fresh concrete as mixed shall be 60 degrees F. for ambient temperature above 30 degrees F.; 65 degrees F. for ambient temperature 0 degrees F. to 30 degrees F.; and 70 degrees F. for ambient temperature below 0 degrees F. The minimum temperature of fresh concrete after placing shall be 55 degrees F. for the first 72-hours.
2. The use of calcium chloride shall not be permitted.
3. In general, the Contractor shall adhere to the requirements in ACI 306.1 for cold weather concreting, except as required herein.

3.5 PUMPING OF CONCRETE

A. Pumping of concrete will be permitted only with the Engineer's approval. The pumping equipment must have two (2) cylinders and be designed to operate with one (1) cylinder only in case the other one is not functioning. In lieu of this requirement, the Contractor shall have a standby pump or crane and concrete bucket on site during pumping to provide assurance the concrete will be placed without cold joints in the event of pumping equipment breakdown. The minimum diameter of the hose (conduits) shall be 4-inches. Pumping equipment and hoses (conduits) that are not functioning properly, shall be replaced. Aluminum conduits for conveying the concrete will not be permitted.

B. Concrete samples for slump and test cylinders will be taken at the discharge end of the pumping conduit.

3.6 ORDER OF PLACING CONCRETE

A. 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, the concrete shall be placed in units as bounded by construction joints shown. 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 two (2) adjacent wall panels have cured at least 14-days.

B. The surface of the concrete shall be level whenever a run of concrete is stopped. To ensure a level, straight joint on the exposed surface of walls, a wood strip at least 3/4-inch thick shall be tacked to the forms on these surfaces. The concrete shall be carried about 1/2-inch above the underside of the strip. About one (1) 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.

3.7 TAMPING AND VIBRATING

A. 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 be 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.

B. 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 flat-strip type waterstops are horizontal, 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.

C. Concrete in walls shall be internally vibrated and at the same time rammed, 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. 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 with fifteen (15) minutes after concrete of the prescribed consistency is placed in the forms. The vibrating head shall be kept from contact with the surfaces of the forms. Care shall be taken not to vibrate concrete excessively or to work it in any manner that causes segregation of its constituents.

3.8 FINISHING CONCRETE SURFACES

A. General: Surfaces shall be free from fins, bulges, ridges, offsets, honeycombing or roughness of any kind, and shall present a finished, smooth, continuous hard surface. Allowable deviations from plumb or level and from the alignment, profiles and dimensions shown are defined as tolerances and are specified in Paragraph 1.5, herein. These tolerances are to be distinguished from irregularities in finish as described herein. Aluminum finishing tools shall not be used.

B. Unformed Surfaces: After placing and consolidating concrete, all unformed top surfaces of slabs, walls, curbs, gutter and steps, shall be brought to a uniform finished surface. The classes of finish specified for unformed concrete surfaces are defined as follows:
   1. Finish U1: Sufficient leveling and screeding to produce an even, uniform surface with surface irregularities not to exceed 3/8-inch. No further special finish is required.
   2. Finish U2: After sufficient stiffening of the screeded concrete, surfaces shall be float finished with wood or metal floats or with a finishing machine using float blades. Excessive floating of surfaces while the concrete is plastic and dusting of dry cement and sand on the concrete surface to absorb excess moisture will not be permitted. Floating shall be the minimum necessary to produce a surface that is free from screed marks and is uniform texture. Surface irregularities shall not

exceed 1/4-inch. Joints and edges shall be tooled where shown or as determined by the Engineer.

3. Finish U3: After the floated surface (as specified for Finish U2) has hardened sufficiently to prevent excess of fine material from being drawn to the surface, steel troweling shall be performed with firm pressure such as will flatten the sandy texture of the floated surface and produce a dense, uniform surface free from blemishes, ripples and trowel marks. The finish shall be smooth and free of all irregularities.
4. Finish U4: Steel trowel finish (as specified for Finish U3) without local depressions or high points. In addition, the surface shall be given a light hairbroom finish with brooming perpendicular to drainage unless otherwise shown. The resulting surface shall be rough enough to provide a non-skid finish.

C. The schedule for finished unformed surfaces shall be as follows:

Area	Finish
Grade slabs and foundations to be covered with concrete or fill material.	U1
Floor slabs to be covered with grouted tile or topping grout and slabs to be covered with built-up roofing.	U2
All building and machine room floors, basin floors not receiving a grout topping, channel floors, top of interior walls, top of interior curbs, steps and walkways. Grout Surfaces in Bottom of Clarifier and DAF.	U3
Exterior walkways, curb, gutter, sidewalk and steps, top of valve or meter vaults, electrical pull boxes and catch basins. Grout surface in Clarifier and DAF Launders.	U4

D. Floor Sealer Hardener (Surface Applied):

1. Floor hardener shall be applied where shown or noted on the drawings.
2. Floors to receive hardener shall be cured, cleaned and dry with all work above them completed. Apply zinc and/or magnesium fluosilicate evenly, using three (3) coats, allowing 24-hours between coats.
3. The first coat shall be 1/3 strength, second coat 1/2 strength and third coat shall be 2/3 strength. Each coat shall be applied so as to remain set on the concrete surface for fifteen (15) minutes. If sodium silicate is used, it shall be applied evenly, using three (3) coats, allowing twenty-four (24) hours between coats, and the material shall be applied full strength at the rate of one (1) gallon per 300 square feet. Approved proprietary hardeners shall be applied in conformance with the manufacturer's instructions. After the final coat is completed and dry, surplus hardener shall be removed from the surface by scrubbing and mopping with water.

E. Formed Surfaces: Immediately following the removal of forms, the concrete shall be inspected for defects such as rock pockets, grout loss, damage from stripping forms, surface defects such as fins, offsets, bulges, excessive bug-holes and stains. All defective concrete work shall be removed and replaced or repaired to the satisfaction of the Engineer. Any work which has not been constructed in accordance with the plans and specifications will be considered defective.

Correction of defective work shall be as directed by the Engineer and specified herein. No defective work shall be patched, repaired or covered without prior inspection and approval of the Engineer.

Holes left by tie-rod cones or taper ties shall be reamed with suitable toothed reamers so as to leave the surfaces of the holes clean and rough. These holes then shall be repaired in an approved manner with non-metallic grout.

The classes of formed concrete surfaces are defined as follows:

1. Finish F1: No special treatment is required after form removal except for curing, repair of defective concrete treatment of surface defects, removal of fins and projections, filling of tie holes and filling of depressions and bug-holes 3/8-inch or larger in width or depth with mortar.
2. Finish F2: All defective concrete shall be repaired, all fins, offsets, bulges and projections ground smooth, filling of tie holes and filling of depressions and bug-holes 1/4-inch or larger in width or depth with mortar.
3. Finish F3: All defective concrete shall be repaired, all fins, offsets, bulges and projections ground smooth and tie holes filled with grout. The entire surface shall then receive a light stoning or grinding using a No. 50 or No. 60 grit carborundum stone or grinding wheel to remove any laitance and curing film and to open up bug-holes hidden beneath the thin surface grout film. The surface shall then be given a stoned-sand type architectural finish as follows:
    a. The concrete surface shall be pre-wet for several hours or overnight before treatment.
    b. While the surface is still damp, spread a sand mix, consisting of one (1) part of Type II Cement and one to one and a half (1 to 1-1/2) parts of fine sand passing the No. 70 screen mixed with enough water and an emulsified bonding agent to have the consistency of thick cream. The sand mix should be spread thinly over the damp surface with a rubber float and rubbed in over the entire area leaving only a minimum amount of material on the surface necessary to produce a sand texture, approximately 1/32-inch in thickness.
    c. The surface shall be kept continually damp for seventy-two (72) hours following this finish treatment.

F. The schedule for formed surface finish shall be as follows:

Area	Finish
Formed concrete surfaces to be covered by backfill or coated with below grade waterproofing systems.	F1
Formed concrete surfaces in water channels, below water surface of basins, inside meter and valve vaults, inside cells of hydraulic splitter boxes and weirs.	F2
Formed concrete surfaces inside buildings and machine rooms and all exposed exterior surfaces of foundations, basins, vaults, hydraulic structures and curbs.	F3

3.9 CURING AND DAMPPROOFING

A. General: All concrete shall be cured for not less than ten (10) days in warm to hot weather (per ACI 305.1) and fourteen (14) days in cold weather (per ACI 306.1) after placing, unless otherwise indicated by the Engineer, in accordance with the methods specified herein for the different parts of the Work, and described in detail as follows:

1. Water Curing: Keep the concrete structures thoroughly and continuously wet and covered for at least 7 days. Place and anchor covers, mats, and sheeting to ensure continuous contact with the concrete surfaces. Use one of the water curing methods as detailed in ACI 308.1.
2. Curing Compound: The surface shall be sprayed with a liquid membrane-forming curing compound applied in accordance with the manufacturers printed instructions.
    a. Care shall be exercised to avoid damage to the seal during the curing period. Should the seal be damaged or broken before the expiration of the curing period, the break shall be repaired immediately by the application of additional curing compound over the damaged portion.
    b. Curing compound specified shall be applied as soon as the concrete has hardened enough to prevent marring on unformed surfaces, and within one (1) hour after removal of forms from contact with formed surfaces. Repairs to formed surfaces shall be made within the said one (1) hour period. If repairs cannot be made with the one (1) hour period they shall be delayed until after the curing compound has been applied. When repairs are to be made to an area on which curing compound has been applied, the area involved shall first be sandblasted to remove the curing compound, following which repairs shall be made as specified herein.
3. Cold weather is defined as when the temperature reaches or goes below 35 degrees F for one (1) hour during any 24-hour period during the curing period.

B. Method 2 shall be used for wall sections with forms removed, encasement concrete and all concrete surfaces where Method 1 is not feasible.

3.10 PROTECTION

A. The Contractor shall protect all concrete against injury or damage from excessive heat, lack of moisture, overstress or any other cause until final acceptance by the Owner. Particular care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damage to finish surfaces.

B. Finished floor slabs in buildings and machine rooms shall be suitably protected from wear or damage from construction operations. The Contractor shall not use newly finished floors or buildings for machine assembly, fabrication, pipefitting, curing or welding operations without covering the working area with plastic sheets and/or plywood. Any concrete found to be damaged or which may have been originally defective or which becomes defective at any time prior to the final acceptance of the completed work, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be satisfactorily repaired or removed and replaced with acceptable concrete at the Contractor's expense.

C. Immediately following the first frost in the fall, the Contractor shall be prepared to protect all concrete against freezing.

3.11 CURING IN COLD WEATHER

A. After the first frost, and until the mean daily temperature in the vicinity of the worksite falls below 40 degrees F for more than one (1) day, the concrete shall be protected against freezing temperatures for not less than forty-eight (48) hours after it is placed. After the mean daily temperature in the vicinity of the worksite falls below 40 degrees F. for more than one (1) day, the concrete shall be maintained at a temperature not lower than 50 degrees F. for at least seventy-two (72) hours after it is placed.

B. Discontinuance of protection against freezing temperatures shall be such that the drop in temperature of any portion of the concrete will be gradual and will not exceed 40 degrees F. over a (3) three day duration.

C. Where artificial heat is employed, special care shall be taken to prevent the concrete from drying. Use of unvented heaters will be permitted only when unformed surfaces of concrete adjacent to the heaters are protected from drying and excessive carbon dioxide atmosphere by application of curing Method 2 or Method 3, as specified under Article 3.9, Paragraph A herein.

3.12 REPAIR OF DEFECTIVE CONCRETE

A. No concrete repairs shall be made until after inspection and approval of the method of repair by the Engineer. In no case will extensive patching of honeycombed concrete be permitted. Concrete containing extensive voids, holes, honeycombing or similar depression defects shall be completely removed and replaced. Concrete containing minor voids, holes, honeycombing or similar depression defects shall be repaired as specified

herein. All concrete repairs and replacements shall be promptly executed by the Contractor at its own expense.

B. Prior to filling any structure with water, all cracks that may have developed shall be "vee'd" as shown on the Drawings and filled with construction joint sealant conforming to the requirements under Section 03 29 00 - Joints In Concrete. This repair method shall be done on the water bearing face of members. Prior to backfilling, faces of members in contact with fill, which are not covered with a waterproofing membrane shall also have cracks repaired as specified herein.

C. The repair of holes left by rock pockets, penetrations, tie rods or other reasons will require the use of non-shrink, non-metallic grout material.

END OF SECTION

SECTION 03 60 00

GROUT

PART 1 GENERAL

1.1 SUMMARY

A. The Contractor shall furnish, place, finish and cure the following types of grouting mortars as called for herein and as shown in the Contract Documents.

1. Non-Shrink Grout: This type of grout shall be used wherever grout is shown or called for in the Contract Documents, unless another type is specifically referenced.

2. Topping Grout: This type of grout shall be used for grouting in submerged applications, such as clarifier bottoms.

3. Epoxy Grout: This type of grout shall be used for anchor bolt or reinforcing steel embedment, repairs and resurfacing.

B. Related Sections:

1. Section 03 30 00 - Cast-in-Place Concrete.

1.2 REFERENCES

A. American Concrete Institute:

1. ACI 301 - Specifications for Structural Concrete.

2. ACI 318 - Building Code Requirements for Structural Concrete.

B. American Society of Testing and Materials:

1. ASTM C33 - Standard Specification for Concrete Aggregates.

2. ASTM C109 - Standard Test Method for Compressive (Latest Edition) Strength of Hydraulic Cement Mortars (Using 2-inch or 50-mm Cube Specimens).

3. ASTM C150 - Standard Specification for Portland Cement.

4. ASTM C827 - Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures.

C. U. S. Army Corps of Engineers Concrete Research Division (CRD):

1. CRD C621 - Non-Shrink Grout.

1.3 SUBMITTALS

A. Non-Shrink Grout: Submit manufacturers' technical data including compressive strength and expansion data at plastic, flowable and fluid consistencies. Also submit manufacturer's applications manual containing instructions and recommendations for mixing, handling, placement and appropriate uses for each type of non-shrink grout used in the work.

B. Topping Grout: Provide certified mix design including proportions and gradations of all materials and compressive strength test results from at least one (1) trial batch. Tests

shall be performed by a certified testing laboratory. All costs for such mix design and trial batch tests shall be borne by the Contractor.

C. Epoxy Grout: Submit manufacturers' technical data including strengths and application manual of instructions for mixing, handling and placing.

1.4 QUALITY ASSURANCE

A. Mix design tests for topping grout shall be performed per the standards referenced herein.

B. During the progress of construction, the Engineer may have tests made of each type of grout used in the work to ensure compliance with the Contract Documents. These tests will be made in accordance with the standards referenced herein. The test expense during construction, except for the mix design and trial batch tests, will be borne by the Owner. The costs of additional tests including non-destructive tests and core drilling needed to verify or investigate the quality of questionable work or material shall be borne by the Contractor.

C. Grout for testing shall be supplied by the Contractor at no cost to the Owner.

D. If any grout fails to meet the requirements of these specifications, immediate corrective action shall be taken for all subsequent batches. Grout already in place that fails to meet these requirements is subject to removal and replacement with all costs borne by the Contractor.

E. Construction tolerances shall be as specified in Section 03 30 00 - Cast-In-Place Concrete, except as modified herein and elsewhere in the Contract Documents.

PART 2 PRODUCTS

2.1 NON-SHRINK GROUT

A. Non-shrink grout shall be a prepackaged, inorganic, non-gas-liberating, non-metallic, cement-based grout requiring only the addition of water. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged.

B. Non-shrink grouts for use as herein specified shall conform to the Corps of Engineers specifications for Non-Shrink Grout, CRD-C621-85 and to these specifications. The grout shall have a 28-day compressive strength of 6,000 psi or greater.

C. Non-shrink grouts shall be as manufactured by: Tremcrete Systems Inc., Woodland, California; Gifford-Hill & Company, Inc., Dallas, Texas; or approved equal.

2.2 TOPPING GROUT

A. Grout for topping of slabs and concrete fill for built-up surfaces of tank, channel, and basin bottoms shall be composed of cement, fine aggregate, coarse aggregate, water, and admixtures proportioned and mixed as indicated herein. All materials and procedures specified for concrete in Section 03 30 00 shall apply except as indicated otherwise herein.

B. Topping grout and concrete fill shall contain a minimum of 564 pound of cement per cubic yard with a maximum water cement ratio of 0.45. Where concrete fill is thicker than 3 inches, structural concrete as indicated in Section 03 30 00 may be used when accepted by the Engineer.

C. Coarse aggregate shall be graded as follows:

U.S. STANDARD SIEVE SIZE	PERCENT BY WEIGHT PASSING
1/2"	100
3/8"	90-100
No. 4	20-55
No. 8	5-30
No. 16	0-10
No. 30	0

D. Final mix design shall be as determined by trial mix design under supervision of the approved testing laboratory.

E. Strength: Minimum compressive strength at 28-days shall be 4,000 psi.

2.3 EPOXY GROUT

A. Epoxy grout shall be a pourable, non-shrink, one-hundred percent (100%) solids system. The epoxy grout system shall have three components; resin, hardener, and specially blended aggregate, all premeasured and prepackaged. The resin component shall not contain any non-reactive diluents. Resins containing butyl glycidyl ether (BGE) or other highly volatile and hazardous reactive diluents are not acceptable. Variation of component ratios is not permitted unless specifically recommended by the manufacturer. The chemical formulation of the epoxy grout shall be that recommended by the manufacturer for the particular application. Manufacturer's instructions shall be printed on each container in which the materials are packaged.

B. The mixed epoxy grout system shall have a minimum working life of 45 minutes at 75 degrees F. The epoxy grout shall develop a minimum compressive strength of 5,000 psi in 24-hours and 10,000 psi in 7-days.

2.4 CEMENT GROUT

A. Portland Cement: ASTM C150, Type I and II.

B. Water:

1. Potable; containing no impurities, suspended particles, algae or dissolved natural salts in quantities capable of causing:

   a. Corrosion of steel.

   b. Volume change increasing shrinkage cracking.

   c. Efflorescence.

   d. Excess air entraining.

C. Fine Aggregate:

1. Washed natural sand.

2. Gradation in accordance with ASTM C33 and represented by smooth granulometric curve within required limits.

3. Free from injurious amounts of organic impurities as determined by ASTM C40.

D. Mix:

1. Portland cement, sand and water. Do not use ferrous aggregate or staining ingredients in grout mixes.

2. Water content shall be such that the grout can be readily spread, yet not wet enough to cause trouble with surface water or laitance, or failure to stay in place after screeding. All grout mixes and mixing procedures shall be submitted in accordance with Section 01 00 00 - Contractor Submittals, and shall be subject to review and approval by the Engineer prior to commencing the grouting operations.

E. The minimum compressive strength at 28 days shall be 4000 psi.

F. Procedures for Grout placement shall be approved by the equipment supplier, to insure that no equipment is overstressed, as well as proper placement tolerances. Equipment Supplier shall have final say on grouting procedures and final tolerances.

2.5 CONSISTENCY

A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is such that the grout is plastic and moldable but will not flow. Where "dry pack" is called for in the Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as required for the particular application.

B. The slump for topping grout and concrete fill shall be adjusted to match placement and finishing conditions but shall not exceed 4 inches.

2.6 CURING MATERIALS

A. Curing materials shall be as specified in Section 03 30 00 - Cast-In-Place Concrete, for cement topping grout and as recommended by the manufacturer of non-shrink grouts.

PART 3 EXECUTION

3.1 PREPARATION

A. All surface preparation, curing, and protection of cement grout shall be as specified in Section 03 30 00. The finish of the grout surface shall match that of the adjacent concrete

B. Remove defective concrete, laitance, dirt, oil, grease and other foreign material from concrete surfaces by brushing, hammering, chipping or other similar means until sound, clean concrete surface is achieved.

C. Rough concrete lightly, but not enough to interfere with placement of grout.

D. Remove foreign materials from metal surfaces in contact with grout.

E. Align, level and maintain final positioning of components to be grouted.

F. Saturate concrete surfaces with clean water; remove excess water, leave none standing.

3.2 PLACING NON-SHRINK AND EPOXY GROUT

A. All forming, mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.

B. Place grout material quickly and continuously.

C. Do not use pneumatic-pressure or dry-packing methods.

D. Apply grout from one side only to avoid entrapping air.

E. Do not vibrate placed grout mixture, or permit placement when area is being vibrated by nearby equipment.

F. Thoroughly compact final installation and eliminate air pockets.

G. Do not remove leveling shims for at least 48 hours after grout has been placed.

3.3 PLACING TOPPING GROUT

A. All mechanical, electrical, and finish work shall be completed prior to placement of topping or concrete fill. The base slab shall be given a roughened textured surface by sandblasting or hydroblasting exposing the aggregates to ensure bonding to the base slab.

B. The minimum thickness of grout topping and concrete fill shall be one inch, unless otherwise indicated on the Design Drawings. Where the finished surface of concrete fill is to form an intersecting angle of less than 45 degrees with the concrete surface it is to be placed against, a key shall be formed in the concrete surface at the intersection point. The key shall be a minimum of 3-1/2-inches wide by 1-1/2-inches deep.

C. The base slab shall be thoroughly cleaned and wetted prior to placing topping and fill. No topping concrete shall be placed until the slab is completely free from standing pools or ponds of water. A thin coat of neat Type II cement grout shall be broomed into the surface of the slab just before topping or fill placement. The topping and fill shall be compacted by rolling or tamping, brought to established grade, and floated. Grouted fill for tank and basin bottoms where scraping mechanisms are to be installed shall be screeded by blades attached to the revolving mechanism of the equipment in accordance with the procedures outlined by the equipment manufacturer after the grout is brought to the established grade.

D. Topping grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement.

E. The surface shall be tested with a straight edge to detect high and low spots which shall be immediately eliminated. When the topping and fill has hardened sufficiently, it shall be steel troweled to a smooth surface free from pinholes and other imperfections. An approved type of mechanical trowel may be used as an assist in this operation, but the last pass over the surface shall be by hand-troweling. During finishing, no water, dry cement or mixture of dry cement and sand shall be applied to the surface.

3.4 CONSOLIDATION

A. Grout shall be placed in such a manner, for the consistency necessary for each application, so as to assure that the space to be grouted is completely filled.

3.5 CURING

A. Immediately after placement, protect grout from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. After grout has attained its initial set, keep damp for minimum of 7 days, or as otherwise indicated by the manufacturer.

END OF SECTION

SECTION 08 11 14

BULLET-RESISTANT STEEL DOORS AND FRAMES

PART 1 GENERAL

1.1 SUMMARY

A. Works included:

1. All labor, material, equipment, and services necessary to furnish and install bullet-resistant primed-finish steel doors and doorframes to be located as shown on the construction drawings or as noted in the door and window schedules.

1.2 REFERENCES

A. Underwriters Laboratory

1. UL 752, Current Edition, Standard for Bullet-Resisting Equipment.

1.3 QUALITY ASSURANCE

A. Ballistic Performance: Certification shall be furnished indicating that all materials have been tested in accordance with the appropriate test procedures.

B. Obtain bullet-resistant components through one source from a single manufacturer.

1.4 SUBMITTALS

A. Shop Drawings shall be submitted for approval prior to the fabrication of materials. The drawings shall include plan views, elevations, sections, and details of the proposed installation including attachment methods.

B. Shop Drawings shall indicate dimensions, component profiles, and material finishes.

C. Manufacturer’s warranty and product data, glazing product information, and installation instructions shall be included with the submittal package.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Pack bullet-resistant doors/frames in wood crates for shipment. Glazing should be crated separately, unless doors are factory glazed.

B. All items shall be delivered, stored, and handled in a manner that will not damage or deform.

C. Abraded, scarred, or rusty areas shall be cleaned, repaired, or replaced immediately upon detection. Damaged items that cannot be restored to like-new condition shall be replaced.

D. Store crated components in a dry location on platforms or pallets that are adequately ventilated, free of dust, water, and other contaminants, and stored in a manner that permits easy access for inspection and handling.

1.6 JOB CONDITIONS

A. Field Measurements: Contractor shall verify frame openings by field measurement prior to fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: If field measurements cannot be made without causing a delay, establish opening dimensions and proceed with fabrication of bullet-resistant frames without field measurements. Coordinate construction to ensure that the actual opening dimensions correspond to the established dimensions.

PART 2 PRODUCTS

2.1 STEEL DOORS AND FRAMES

A. Manufacturers:

1. North American Bullet Proof, Shotgard Series.
2. U.S. Bullet Proofing.
3. Substitutions: Permitted with prior written approval by Engineer.

2.2 MATERIALS

A. Bullet-Resistant Primed-Finish Steel Doors and Doorframes:

1. Bullet-Resistant SDR Primed-Finish Steel Door and Primed-Finish Steel Doorframe
2. Frames, doors, and glazing shall be supplied to provide a complete assembly.
3. Ballistic Resistance Performance Level: U.L. 752, Level 4.
4. SDR integral door/frame system to provide ballistic overlap protection.
5. SDR Primed-Finish Steel Door to be constructed of 10-gauge steel skins over tube-steel skeleton with mitered, continuously welded corners.
6. SDR Primed-Finish Steel Doorframe to be constructed of 12-gauge steel with mitered, continuously welded corners.
7. Frame Profile: 2” x 5½” bolt-in frame, lined with steel as required for ballistic protection level.
8. View Window (when shown on drawings): 10” x 10” visual opening; performance level of the glazing to match the performance level of the door.
9. Door to be pre-hung with 1100-lb. rated continuous-gear hinge with security pins.
10. Door and frame to be prepped for mortise lock and standard strike.
11. Testing: Independently tested to U.L. 752 to level specified.

2.3 SDR COMPONENTS

A. Hinge: The SDR steel door shall be supplied pre-hung, with an 1100-lb. rated continuous-geared hinge with tamper-resistant dogging pins.

B. Silencers: Silencers shall be provided at the strike-jamb stop.

C. View Window Glazing: Glazing material shall be factory-fabricated units designed to be bullet-resistant to the specified test standard. Glazing material shall be glass-clad

polycarbonate with a low-spall protected interior face. Low-spall interior face shall meet or exceed requirements for spall resistance defined in U.L. 752.

D. Setting Blocks: provide 1/4" x 1" x 4" rubber setting blocks for installation at the sill.

E. Anchor-hole Plugs: Provide decorative plugs to cover anchor-access holes.

F. Anchors and Sealants to be provided by installer.

G. Floor door closers (where shown on drawings):

1. Manufacturers:
    a. ASSA ABLOY Rixson Model L27
    b. Substitutions: Approved Equal
2. Heavy duty, floor-mounted door closer
3. Rated to wind speed of 90 mph
4. Rated to weight of bullet-resistant door
5. Built-in positive dead stop to prevent door from opening beyond maximum opening degree of 105°.
6. Shall feature separate and independent valves for closing speed, latch speed and backcheck.

H. Top Jamb door closers (where shown on drawings):

1. Manufacturers:
    a. Norton Model 7500 Industrial Series
    b. Substitutions: Approved Equal
2. Rigid, Heavy duty, top jamb-mounted door closer
3. Non-adjustable arm
4. Opening degree of 180°.

I. Heavy duty cane bolt and gate stop assembly to hold open doors:

1. 5/8" diameter, 36" long, black steel cane bolt.
    a. Bolt must be able to be kept in the 'up/unengaged' position, such that operator need not hold the bolt up as door is opened or closed.
2. Minimum 6" throw, or more to allow full engagement with the gate stop set into concrete porch or driveway.
3. Gate stop shall be a field type gate center stop (set in concrete porch or driveway), part number HS 015 913-34 (custom) as by Hardware Specialties of Albuquerque, OAE
    a. 3"x5" rectangular cold-plate steel formed with 7/8" wide, 3" long, 1" deep at center concave channel.
    b. 5/8" diameter, 5" long cold rolled steel bar affixed to bottom center of plate.

2.4 FABRICATION

A. General: Fabricate bullet-resistant components to comply with indicated standards. Include a complete system for assembly and installation of bullet-resistant components.
   1. Provide doors that are capable of being reglazed from the secure side without dismantling the threat side of the frame.
   2. Prepare doors for glazing in the field, unless preglazing at the factory is indicated.
   3. Steel shall be free of scale, pitting, coil breaks, and finish work shall be neat and free of defects.

B. Framing: Miter corners the full depth of the frame. Continuously weld and dress smooth. No body fillers to be used.
   1. Install armor inside the frame in the thickness necessary for the ballistic resistance level indicated.
   2. Prep frame for standard 4⅞" ANSI strike at 40 inches above finished floor.
   3. Provide spreader at bottom of doorframe for protection during shipping, and for easier, cleaner installation.

C. View Window Stops: Provide a one-piece removable glazing stop, two-inch depth, made from 12-gauge steel, on the secure side of the frame attached with machine screws.
   1. Corners are to be mitered, welded, and dressed smooth.
   2. Stops shall be installed in a location appropriate for the glazing thickness.
   3. Finish glazing stops to match door finish.
   4. The threat-side glazing stop shall be welded-in-place 3/8" ballistic steel.

D. SDR: Fabricate steel doors with 10 gauge steel door skins.
   1. Proprietary adhesive to be used to bond door skins to door structure.
   2. Prep door for lockset to line-up with strike.
   3. Hinge reinforcement: Provide 3/16" steel continuous hinge reinforcement, welded to door edge.

E. Hardware: Templates are to be provided to the door manufacturer by the hardware contractor. The installing contractor shall perform drilling and tapping for surface mounted hardware at the jobsite.

F. Metal Protection: Separate dissimilar metals to protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.

G. Any openings in glazing for are to be factory-cut.

H. No field alterations to the construction of the units fabricated under the specified standards shall be allowed unless approved by the manufacturer.

2.5 FINISHES

A. Provide shop-applied primer after fabrication:

1. Prior to shop painting, surfaces shall be cleaned with solvents to remove any grease or oil, and with power wire-brushing or sandblasting to remove loose rust, loose mill scale and other foreign substances.
2. Primer: Rust inhibitive paint suitable as a base for finish coating.

B. Door manufacturer shall provide finish powder coating of the surfaces of the door prior to shipment, per coating manufacturer's instructions, color to be selected by Owner.

C. Steel Sheet: Shop finished galvanized to ASTM A653/A653M A40.

D. Finishes: ANSI A156.18; furnish following finishes unless otherwise noted.

1. Hinges:
   a. BHMA 630 and 626, satin finish.
2. Typical Exterior Exposed and High Use Interior Door Hardware:
   a. BHMA 630, satin finished stainless steel.
3. Typical Interior Door Hardware:
   a. BHMA 626, satin chromium plated brass or bronze.
4. Thresholds: Finish appearance to match door hardware on exterior face of door.
   a. BHMA 628, satin aluminum, clear anodized.
5. Other Items: Furnish manufacturer's standard finishes to match similar hardware types on same door, and maintain acceptable finish considering anticipated use and BHMA category of finish.

2.6 LABELING

A. Bullet-resistant components shall be plainly and permanently labeled. The label shall be compatible with finishes. The label shall be visible only on the secure side, after installation, and shall include:

1. Manufacturer's name or identifying symbol.
2. Model Number.
3. Date of manufacture by month and year. This may be done through use of lot number or other traceable code.
4. Correct mounting position including threat side and secure side.
5. Code indicating bullet-resistant rating and test standard used.

PART 3 EXECUTION

3.1 EXAMINATION

A. Prior to commencing installation, examine all areas to receive the bullet-resistant doors and frames to ensure that they are ready for installation. Components shall be checked and corrected for racking, twisting, and other malformation prior to installation. All surfaces and connections shall be examined for damage prior to installation.

B. Verify that the doors and frames comply with indicated requirements for type, size, and location.

C. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. The Contractor shall field verify dimensions of the finished openings. SDR bolt-in frames must be installed in a plumb, level, and square finished opening. The finished opening must be 1/4" larger in width and in height than the doorframe.

3.3 INSTALLATION

A. Install: Place the frame in the opening, centered on wall. Mark the anchor holes. Remove the frame and drill the anchor holes. Install the frame and shim for plumb/level. Secure with anchors. Note: all anchors provided by installer.

B. Test: Test the door for proper fit and operation. If required, remove the unit, adjust the shims, and reinstall. Install the anchor-hole plugs.

C. Finish: Seal all joints in and around the frame. Sand and finish the frame. Wait until all sealants and paint are cured before operating.

D. Glazing: Identify the secure and threat sides of the glass. Remove any protective cover from the glazing. Apply butyl tape to the view widow stops. Place the rubber setting blocks in the opening. Install glazing, making sure it fits properly. Install the removable stop using the screws provided with the window. Apply sealant over butyl tape.

E. Cane bolt and gate stop assembly to hold open doors:

1. Cane bolts must be factory welded to doors for pre-fabricated buildings.

2. If cane bolt assembly welded to door in field, touch-up paint and door finish as needed after welding.

3. Weld cane bolt assembly to steel door so as to allow 6" of throw, or more if needed to ensure bolt fully engages the field type gate center stop when bolt is in 'down' position. Bottom of bolt shall be held flush or slightly above bottom of door when disengaged.

4. After building is in place with doors and cane bolts installed, set gate stop in wet concrete so that plate is flush with finished surface and channel is perpendicular to door's swinging path when fully open. Before the concrete sets verify that angle and position of gate stop will allow bolt to fully engage the gate stop at the center of the gate stop.

3.4 ADJUST AND CLEAN

A. Use care and follow instructions for cleaning the glazing.

END OF SECTION

SECTION 08 71 00

DOOR HARDWARE

PART 1 GENERAL

1.1 SUMMARY

A. Section includes hardware for steel doors.

1. Provide door gaskets, including weather-stripping and seals, and locksets.

B. Related Sections:

1. Section 08 11 13 Steel Doors and Frames

1.2 REFERENCES

A. American National Standards Institute:

1. ANSI A156.2 - Bored and Preassembled Locks and Latches.
2. ANSI A156.3 - Exit Devices.
3. ANSI A156.4 - Door Controls - Closures.
4. ANSI A156.5 - Auxiliary Locks and Associated Products.
5. ANSI A156.6 - Architectural Door Trim.
6. ANSI A156.7 - Template Hinge Dimensions.
7. ANSI A156.8 - Door Controls - Overhead Holders.
8. ANSI A156.12 - Interconnected Locks and Latches.
9. ANSI A156.13 - Mortise Locks and Latches.
10. ANSI A156.14 - Sliding and Folding Door Hardware.
11. ANSI A156.15 - Closer Holder Release Devices.
12. ANSI A156.16 - Auxiliary Hardware.
13. ANSI A156.18 - Materials and Finishes
14. ANSI A156.19 - Power Assist and Low Energy Power Operated Doors.
15. ANSI A156.23 - Electromagnetic Locks.
16. ANSI A156.24 - Delayed Egress Locks.
17. ANSI A156 - Complete Set of 24 BHMA Standards (A156 Series) with Binder.

B. Builders Hardware Manufacturers Association:

1. BHMA Directory of Certified Products.

C. National Fire Protection Association:

1. NFPA 80 - Standard for Fire Doors, Fire Windows.
2. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.

D. Underwriters Laboratories Inc.:

1. UL 10B - Fire Tests of Door Assemblies.
2. UL 305 - Panic Hardware.
3. UL - Building Materials Directory.

E. Intertek Testing Services (Warnock Hersey Listed):

1. WH - Certification Listings.

1.3 PERFORMANCE REQUIREMENTS

A. Fire Rated Openings: Provide door hardware listed by UL or Intertek Testing Services (Warnock Hersey Listed), or other testing laboratory approved by applicable authorities.

1. Hardware: Tested in accordance with NFPA 252.

1.4 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings:

1. Indicate locations and mounting heights of each type of hardware, schedules, catalog cuts.
2. Submit manufacturer's parts lists.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 00 00 - Execution Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of installed cylinders and their master key code.

C. Operation and Maintenance Data: Submit data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

D. Keys: Deliver with identifying tags to Owner by security shipment direct from hardware supplier.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 01 00 00 - Product Requirements: Product storage and handling requirements.

B. Package hardware items individually with necessary fasteners, instructions, and installation templates, when necessary; label and identify each package with door opening code to match hardware schedule.

1.7 COORDINATION

A. Coordinate Work with other directly affected sections involving manufacture or fabrication of internal reinforcement for door hardware and recessed items.

1. Provide templates or actual hardware as required to ensure proper preparation of doors and frames.

B. Sequence installation to accommodate required utility connections.

C. Coordinate Owner's keying requirements during course of Work.

1.8 WARRANTY

A. Furnish five year manufacturer warranty for locksets and door closers.

PART 2 PRODUCTS

2.1 DOOR HARDWARE

A. Manufacturers:

1. Bommer Industries, Inc.
2. Hager Companies.
3. Substitutions: Permitted.

B. Lockset Manufacturers:

1. Yale.
2. Substitutions: Permitted.

C. Closers Manufacturers:

1. Yale.
2. Norton.
3. Substitutions: Permitted.

2.2 COMPONENTS

A. General Hardware Requirements: Where not specifically indicated, comply with applicable ANSI A156 standard for type of hardware required. Furnish each type of hardware with accessories as required for applications indicated and for complete, finished, operational doors.

1. Templates: Furnish templates or physical hardware items to door and frame manufacturers sufficiently in advance to avoid delay in Work.
2. Reinforcing Units: Furnished by door and frame manufacturers; coordinated by hardware supplier or hardware manufacturer.
3. Fasteners: Furnish as recommended by hardware manufacturer and as required to secure hardware.
    a. Finish: Match hardware item being fastened.
4. Fire Ratings: Provide hardware with UL or Intertek Testing Services (Warnock Hersey Listed) listings for type of application involved.
5. Electrical Devices: Make provisions and coordinate requirements for electrical devices and connections for hardware.

B. Locksets: Furnish locksets compatible with specified cylinders. Typical 2-3/4 inch backset. Furnish standard strikes with extended lips to protect trim from being marred by latch bolt.

1. Mortise Locksets: ANSI A156.13, Series 1000, Grade 1 unless otherwise indicated.

2. Bored (Cylindrical) Locksets: ANSI A156.2, Series 4000, Grade 1 unless otherwise indicated.

3. Preassembled (Unit) Locksets: ANSI A156.12, Series 2000, Grade 1 unless otherwise indicated.

4. Interconnected Locksets: ANSI A156.12, Series 5000, Grade 1 unless otherwise indicated.

C. Latch Sets: Typical 2-3/4 inch backset. Furnish standard strikes with extended lips to protect trim from being marred by latch bolt.

1. Mortise Latch Sets: ANSI A156.13, Series 1000, Grade 1 unless otherwise indicated.

2. Bored (Cylindrical) Latch Sets: ANSI A156.2, Series 4000, Grade 1 unless otherwise indicated.

D. Exit Devices: ANSI A156.3, Grade 1 concealed vertical rod type, with cross bar, unless otherwise indicated. Furnish standard strikes with extended lips to protect trim from being marred by latch bolt, with dust-proof floor strikes.

1. Types: Suitable for doors requiring exit devices.

2. Coordinators: Furnish overhead concealed in frame type at pairs of doors.

E. Cylinders: ANSI A156.5, Grade 1, pin type removable cylinders.

1. Keying: Key to existing keying system.

2. Provide eight (8) original keys to Owner.

2.3 ACCESSORIES

A. Through Bolts: Do not permit through bolts and grommet nuts on door faces in occupied areas unless no alternative is possible.

1. Do not use through bolts on solid wood core doors.

2.4 FINISHING

A. Finishes: ANSI A156.18; furnish following finishes except where otherwise indicated in Schedule at end of section.

1. Typical Exterior Exposed and High Use Interior Door Hardware:

a. BHMA 630, satin finished stainless steel.

2. Typical Interior Door Hardware:

a. BHMA 626, satin chromium plated brass or bronze.

3. Other Items: Furnish manufacturer's standard finishes to match similar hardware types on same door, and maintain acceptable finish considering anticipated use and BHMA category of finish.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Coordination and project conditions.

B. Verify doors and frames are ready to receive door hardware and dimensions are as instructed by manufacturer.

3.2 INSTALLATION

A. Coordinate mounting heights with door and frame manufacturers. Use templates provided by hardware item manufacturer.

B. Mounting Heights from Finished Floor to Center Line of Hardware Item: Comply with manufacturer recommendations and applicable codes where not otherwise indicated.

1. Locksets: 38 inch.
2. Push/Pulls: 42 inch.
3. Dead Locks: 48 inch.
4. Push Pad Type Exit Devices: 42 inch.
5. Cross Bar Type Exit Devices: 38 inch.

3.3 ADJUSTING

A. Adjust hardware for smooth operation.

3.4 PROTECTION OF INSTALLED CONSTRUCTION

A. Do not permit adjacent work to damage hardware or hardware finish.

3.5 SCHEDULES

A. Hardware Set 1: Fire rated.

1.	Lock:	Mortise lock, Classroom Function.
2.	Closer:	Surface mounted as specified.
3.	Kickplate:	16 inch high, push side only.
4.	Gaskets:	Fire and smoke rated gaskets as specified.
5.	Floor Stop:	Dome type as specified.

END OF SECTION

SECTION 22 11 05

CHLORINATION FACILITY PLUMBING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pump house water piping.
2. Unions and flanges.
3. Ball valves.
4. Check valves.
5. Pipe hangers and supports.
6. Sleeves.
7. Water pressure gauges.
8. Air release valves.
9. Pressure relief valves.
10. Hose bibs and sample cocks.
11. Booster pumps.
12. Tapping Saddles

B. Related Sections:

1. Section 03 30 00 - Cast-In-Place Concrete: Execution requirements for placement of concrete specified by this section.
2. Section 31 23 17 - Trenching: Execution requirements for trenching required by this section.
3. Section 31 23 23 - Backfill: Requirements for backfill to be placed by this section.
4. Section 33 11 13 - Public Water Distribution Systems: Product and execution requirements for underground water piping.
5. Section 33 13 00 - Disinfection of Water Distribution: Product and execution requirements for disinfection of water piping.
6. Section 44 44 16 - Chlorination Equipment.

1.2 REFERENCES

A. American Society of Mechanical Engineers (ASME):

1. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
2. ASME B31.9 - Building Services Piping.

B. American Society of Sanitary Engineering (ASSE):

1. ASSE 1010 - Performance Requirements for Water Hammer Arresters.
2. ASSE 1011 - Performance Requirements for Hose Connection Vacuum Breakers.
3. ASSE 1012 - Performance Requirements for Backflow Preventer with Intermediate Atmospheric Vent.
4. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers.
5. ASSE 1019 - Performance Requirements for Wall Hydrants, Freezeless, Automatic Draining, AntiBackflow Types.

C. American Society for Testing and Materials International (ASTM):

1. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
2. ASTM A536 - Standard Specification for Ductile Iron Castings.
3. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
4. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
5. ASTM D2464 - Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
6. ASTM D2467 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
7. ASTM D2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
8. ASTM D2609 - Standard Specification for Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe.
9. ASTM D2665 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
10. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
11. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
12. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.

D. American Water Works Association (AWWA):

1. AWWA C104 - American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.

2. AWWA C105 - American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
3. AWWA C110 - American National Standard for Ductile-Iron and Grey-Iron Fittings, 3 in. through 48 in. (75 mm through 1200 mm), for Water and Other Liquids.
4. AWWA C111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
5. AWWA C151 - American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
6. AWWA C651 - Disinfecting Water Mains.

E. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
2. MSS SP 67 - Butterfly Valves.
3. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
4. MSS SP 70 - Cast Iron Gate Valves, Flanged and Threaded Ends.
5. MSS SP 71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends.
6. MSS SP 78 - Cast Iron Plug Valves, Flanged and Threaded Ends.
7. MSS SP 80 - Bronze Gate, Globe, Angle and Check Valves.
8. MSS SP 85 - Cast Iron Globe & Angle Valves, Flanged and Threaded.
9. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
10. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

F. NSF International Standard / American National Standard (ANSI)

1. NSF/ANSI 61 – Drinking Water System Components – Health Effects.

1.3 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Submittal procedures.

B. Product Data:

1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturer's catalog information.
2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
3. Hangers and Supports: Submit manufacturers catalog information including load capacity.
4. Domestic Water Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.

5. Pumps: Submit pump type(s), capacity, certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions: Submit installation instructions for pumps, valves and accessories.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 00 00 - Execution Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of valves and equipment.

C. Operation and Maintenance Data: Submit spare parts list, exploded assembly views and recommended maintenance intervals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Section 01 00 00 - Product Requirements: Product storage and handling requirements.

B. Accept valves and equipment on site in shipping containers with labeling in place. Inspect for damage.

C. Provide temporary protective coating on metallic and steel valves.

D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

PART 2 PRODUCTS

2.1 General

A. All materials in contact with water shall be NSF61-certified.

B. All bolts, nuts, and washers in chemical room shall be stainless steel 316, and shall be provided by the valve or fitting manufacturer specifically for use with their respective components.

2.2 CHLORINATION BUILDING WATER PIPING

A. Steel Pipe: Refer to Section 33 11 00 – Water Utility Distribution Piping.

B. Ductile Iron Pipe: Refer to Section 33 11 00 – Water Utility Distribution Piping.

C. Polyvinyl Chloride (PVC): Schedule 80, ASTM D1785, at locations indicated on Drawings.

1. Fittings: PVC Schedule 80 per ASTM D2467.

2.3 UNIONS AND FLANGES

A. Unions for Pipe 2 inches and Smaller:

1. Steel Piping: Class 150, malleable iron, threaded.
2. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
3. PVC Piping: PVC.

B. Flanges for Pipe 2-1/2 inches and Larger:

1. Steel Piping: Class 150, forged steel, slip-on flanges.
2. Copper Piping: Class 150, slip-on bronze flanges.
3. PVC Piping: PVC flanges.
4. CPVC Piping: CPVC flanges.
5. Gaskets: 1/16 inch thick preformed neoprene gaskets.

C. PVC Pipe Materials: For connections to equipment and valves with threaded connections, furnish solvent-weld socket to screwed joint adapters and unions, or ASTM D2464, Schedule 80, threaded, PVC pipe.

2.4 GATE AND BALL VALVES

A. Resilient Wedge Gate Valves: AWWA C515, NSF 61, American-made; ductile iron.

1. Resilient seats.
2. Stem: Non-rising bronze stem.
3. Handwheel
4. Gearing
   a. Bevel geared for horizontal installation.
   b. Spur geared for vertical installation.
5. Valve Ends:
   a. Flanged, as indicated on Drawings.
   b. Flanged ends shall be drilled in accordance with ANSI Class 125/150 bolt pattern, unless otherwise noted on Drawings.
   c. Pressure rating not less than that of valve body.
6. Working pressure rating: 350 psi.
7. Pressure testing: Seat test – 525 psi for 15 seconds, test seat from each side of valve separately per UL262. Shell test pressure: 700 psi.
8. Inside and outside of valve fully coated with Fusion Bonded Epoxy, 10 mils nominal, conforming to AWWA C550 and NSF 61 requirements.

B. Brass Gate Valve

1. Manufacturers:
    a. NIBCO, Inc.
    b. Substitutions: Approved equal
2. Size as shown on drawings.
3. Threaded ends
4. Working pressure: 200 psi

C. PVC Ball Valves

1. Shall be used where called for on the Drawings, or for any additional ball valves required to be added to PVC piping within the chemical room.
2. Manufacturers:
    a. NIBCO, Inc.
    b. Spears Manufacturing Co.
    c. Substitutions: Approved equal
3. True union valve ends
4. PVC Schedule 80
5. Working pressure: 150 psi

2.5 PIPE HANGERS AND SUPPORTS

A. Manufacturers:

1. Carpenter & Paterson Inc.
2. Creative Systems Inc.
3. Flex-Weld, Inc.
4. Glope Pipe Hanger Products Inc.
5. Michigan Hanger Co.
6. Superior Valve Co.
7. Substitutions: Approved equal.

B. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron Carbon steel, adjustable swivel, split ring.

C. Hangers for Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.

D. Multiple or Trapeze Hangers: Steel channels with welded supports or spacers and hanger rods.

E. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hooks.

F. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamps.

G. Vertical Support: Steel riser clamp.

H. Floor Support for Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

I. Copper Pipe Support: Carbon steel ring, adjustable, copper plate.

2.6 CHECK VALVES

A. Silent Wafer Style

B. Silent Operation - fast closure to prevent check valve slam water hammer

C. Precision metal-to-metal seating

D. Expanded Body - provides full flow area

E. Double guided disc - prevents vibrations and wear

F. Resilient Seat - available for zero leakage

2.7 SLEEVES

A. Sleeves for Pipes through Non-fire Rated Floors: 18 gage thick galvanized steel.

B. Sleeves for Pipes through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gauge thick galvanized steel.

C. Sleeves for Round Ductwork: Galvanized steel.

D. Sleeves for Rectangular Ductwork: Galvanized steel or wood.

2.8 WATER PRESSURE GAUGES

A. Manufacturers:

1. WIKA
2. Substitutions: Approved equal.

B. Must conform to ANSI B40.1 and have the following characteristics:

1. Liquid filled, altitude/psi process gauge.
2. Stainless steel isolation ball valve.
3. Accuracy: 0.5% of full scale.
4. Wetted materials: 316 SS.
5. Case material: Polypropylene; safety glass window.
6. Connection: 1/4" NPT(M), bottom.
7. Dial Size: 4-1/2".
8. Mounting: Stem or surface.
9. Range: As indicated on Drawings.

2.9 COMBINATION AIR VALVE:

A. Manufacturer:
   1. Val-Matic Valve and Manufacturing Corporation, Model # 201C.2SV, Single Body Type.
   2. Substitutions: Not permitted

B. Working pressure: 300 psi

C. Test Pressure: 450 psi

D. Intlet: 1" NPT

E. Cast iron body, cover and baffle; stainless steel trim, float, and fasteners.

F. Seat: Resilient Buna N.

G. Valve to perform functions of air release, pipe fill air exhaust and vacuum relief.

2.10 PRESSURE RELIEF VALVES

A. Manufacturers:

   1. Watts, Model BP30.

   2. Substitutions: Approved equal.

B. Bronze body with NPT threaded male inlet and NPT threaded female (drain) outlet connections, stainless steel spring and test lever.

C. Pressure relief setting as indicated on Drawings or as directed by Engineer.

2.11 HOSE BIBS AND SAMPLE COCKS

A. Interior: Bronze or brass with integral mounting flange, replaceable hexagonal disc, hose thread spout, chrome plated where exposed with hand wheel lock shield and removable key, integral vacuum breaker in conformance with ASSE 1011.

B. Interior Mixing: Bronze or brass, wall mounted, double service faucet with hose thread spout, integral stops, chrome plated where exposed with hand wheels, and vacuum breaker in conformance with ASSE 1011.

2.12 TAPPING SADDLES

A. Tapping Saddles:

   1. Manufacturers:

      a. Romac Industries, Inc

      b. JCM Industries, Inc

      c. Substitutions: Approved equal.

   2. Saddles shall only be used on taps 2-inches or smaller.

   3. Chlorinator Room Taps: Stainless steel tapping saddles, JSM 502, OAE, heavyweight treaded outlet, full band type, with full circumferential SS band, 8" width stainless steel band.

4. All saddles shall be specifically designed for use on the type of pipe that is being tapped.
5. All bands, straps, bolts, nuts and washers shall be SS 304. All bolts shall be provided by manufacturer especially for use with their respective components.
6. Minimum Working pressure rating: 200 psi.
7. Tapped Outlet: FNPT or as indicated on Drawings
8. All pipe taps shall be made with an engineer approved “tapping machine”.
9. Threadolets, where called for on Drawings, shall be welded to the pipe, ground, and blasted (if possible) prior to applying fusion-bonded epoxy coating to the pipe.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Coordination and project conditions.

B. Verify excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end steel pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

3.3 INSTALLATION - HANGERS AND SUPPORTS

A. Inserts:

1. Provide inserts for placement in concrete forms.
2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above flush with top of recessed into and grouted flush with slab.

B. Pipe Hangers and Supports:

1. Install in accordance with ASME B31.9, ASTM F708 and MSS SP 89.
2. Support horizontal piping as schedule.
3. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.
4. Place hangers within 12 inches of each horizontal elbow.

5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
7. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
8. Provide copper plated hangers and supports for copper piping sheet lead packing between hanger or support and piping.
9. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
10. Provide hangers adjacent to motor driven equipment with vibration isolation.

3.4 INSTALLATION - SLEEVES

A. Exterior watertight entries: Seal with mechanical sleeve seals.

B. Set sleeves in position in forms. Provide reinforcing around sleeves.

C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

D. Extend sleeves through floors 1-inch above finished floor level. Caulk sleeves.

3.5 INSTALLATION - ABOVE GROUND PIPING

A. Install non-conducting dielectric connections wherever joining dissimilar metals.

B. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

C. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.

D. Group piping whenever practical at common elevations.

E. Slope piping and arrange systems to drain at low points.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

H. Provide access where valves and fittings are not accessible.

I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

J. Provide support for utility meters in accordance with requirements of utility companies.

K. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.

L. Paint all steel pipe and uncoated ferrous appurtenances blue:

1. Minimum surface preparation: SSPC-SP1
2. Primer: 1 coat Sherwin Williams Galvite HS, OAE
   a. 3.0-4.5 mils dry film thickness
3. Finish: Two coats Sherwin Williams Industrial Enamel (B54 Series), OAE
   a. 2.0-4.0 mils dry film thickness
4. Follow all other paint manufacturer recommendations for preparation and application.

M. Install domestic water piping in accordance with ASME B31.9.

N. Sleeve pipes passing through partitions, walls and floors.

O. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping.

P. Install unions downstream of valves and at equipment or apparatus connections.

Q. Install valves with stems upright or horizontal, not inverted.

R. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

S. Install gate ball or ball valves for shut-off and to isolate equipment, part of systems, or vertical risers, if applicable.

T. Install globe ball or butterfly valves for throttling, bypass, or manual flow control services, if applicable.

U. Provide lug end butterfly valves adjacent to equipment when functioning to isolate equipment.

V. Provide spring loaded check valves on discharge of water pumps, if applicable.

W. Provide flow controls in water circulating systems as indicated on Drawings, if applicable.

X. Install potable water protection devices on plumbing lines where contamination of domestic water may occur.

Y. Pipe relief from valves, back-flow preventers and drains to nearest floor drain.

3.6 CLEANING

A. Prior to starting work, verify system is complete, flushed and clean.

B. Inject disinfectant, free chlorine in liquid, powder and tablet or gas form, throughout system to obtain residual from 50 to 80 mg/L.

C. Bleed water from outlets to obtain distribution and test for disinfectant residual at minimum 15 percent of outlets.

D. Maintain disinfectant in system for 24 hours.

E. When final disinfectant residual tests less than 25 mg/L, repeat treatment.

F. Flush disinfectant from system until residual concentration is equal to incoming water or 1.0 mg/L.

G. Take samples no sooner than 24 hours after flushing and analyze in accordance with AWWA C651.

END OF SECTION

SECTION 31 10 00

SITE CLEARING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Removing surface debris.
2. Removing designated paving, curbs, and other obstructions.
3. Removing designated trees, shrubs, and other plant life.
4. Removing abandoned utilities.
5. Excavating topsoil.

B. Related Sections:
1. Section 31 22 13 - Rough Grading.

1.2 QUALITY ASSURANCE

A. Perform Work in accordance with the most recent edition of the New Mexico Standard Specifications for Public Works Construction, with latest revisions.

B. Perform Work in accordance with the most recent edition of the NMDOT Standard Specifications for Road and Bridge Construction, with latest revisions.

C. Conform to applicable State of New Mexico code for environmental requirements, disposal of debris, burning debris on site, use of herbicides.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Quality Requirements: Examination of existing conditions before starting work.

B. Verify existing plant life designated to remain is tagged or identified.

C. Identify waste area and/or salvage area for placing removed materials.

3.2 PREPARATION

A. Call New Mexico "One Call" at 811, NTUA Call Before You Dig Program at 1-800-528-5011, and local utility companies at least three (3) days before performing Work.
   1. Request that underground utilities be located and marked within and surrounding construction areas.

B. Notify Engineer at least five (5) working days prior to commencing work within 100 feet of any designated culturally sensitive area, as shown on Plans. Do not commence work unless barricades are in place and/or archaeological monitor is present, as required. Refer to Section 01 00 00 for site-specific requirements.

3.3 PROTECTION

A. Locate, identify, and protect utilities indicated to remain, from damage.

B. Protect trees, plant growth, and features designated to remain, as final landscaping.

C. Protect benchmarks, survey control points, and existing structures from damage or displacement.

3.4 CLEARING

A. Clear areas required for access to site and execution of Work.

B. Remove trees and shrubs within indicated areas. Remove stumps and surface rock.

C. Clear undergrowth and deadwood, without disturbing subsoil.

D. Apply herbicide to remaining stumps to inhibit growth.

3.5 REMOVAL

A. Remove debris, rock, and extracted plant life from site.

B. Partially remove paving, curbs, and other obstructions as indicated on Drawings. Neatly saw cut edges at right angle to surface.

C. Remove abandoned utilities as directed by Owner and/or Engineer. Indicate removal termination point for underground utilities on Record Documents.

D. Continuously clean up and remove waste materials from site. Do not allow materials to accumulate on site.

E. The Engineer will indicate to the Contractor which obstructions are to be removed, disposed of, or salvaged, and will require special documentation.

F. All existing fences crossed by the Work, or are within the construction area, are to be removed and rebuilt to original condition or better. Fence materials resulting from such

removal are to be stored or disposed of as directed by the Engineer. Fence materials suitable for reuse or salvage that are damaged, lost or destroyed due to the Contractor's negligence or carelessness are to be replaced at the Contractor's expense.

G. Do not burn or bury materials on site. Leave site in clean condition.

3.6 TOPSOIL EXCAVATION

A. Excavate topsoil from areas to be further excavated, relandscaped, or regraded, without mixing with foreign materials for use in finish grading.

B. Do not excavate wet topsoil.

C. Stockpile in area designated on site to depth not exceeding 8 feet and protect from erosion. Stockpile material on impervious material and cover over with same material, until disposal.

D. Remove excess topsoil not intended for reuse, from site.

E. All equipment shall be properly maintained and with proper safety devices.

F. Contractor must maintain control of dust and minimize blowing debris.

END OF SECTION

SECTION 31 22 13

ROUGH GRADING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Excavating subsoil.
2. Cutting, grading, filling, rough contouring, and compacting site for site structures and building pads.

B. Related Sections:
1. Section 31 10 00 - Site Clearing: Excavating topsoil.
2. Section 31 23 17 - Trenching: Trenching and backfilling for utilities.
3. Section 31 23 23 - Backfill: General building area backfilling.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. The following payment concepts only apply when a corresponding item is included in the Bid Schedule. If no specific item is provided, then this work shall be considered incidental to those items which require grading.

B. Topsoil Fill:
1. Basis of Payment: Includes excavating existing soil, supplying soil materials, stockpiling, scarifying substrate surface, placing where required, and compacting.

C. Subsoil Fill:
1. Basis of Payment: Includes excavating existing subsoil, supplying subsoil materials, stockpiling, scarifying substrate surface, placing where required, and compacting.

D. Structural Fill:
1. Basis of Payment: Includes excavating existing subsoil, supplying structural fill materials, stockpiling, scarifying substrate surface, placing where required, and compacting.

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO):
1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 10-lb Rammer and an 18-in. Drop.

B. American Society for Testing and Materials International (ASTM):
1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
2. ASTM D422 - Particle -Size Analysis of Soils.

3. ASTM D653 - Terminology Relating to Soil, Rock, and Contained Fluids.
4. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort 12,400 ft-lbf/ft3.
5. ASTM D1140 - Amount of Material in Soils Finer than the No. 200 Sieve.
6. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
7. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort 56,000 ft-lbf/ft3.
8. ASTM D1633 - Test Method for Compressive Strength of Molded Soil - Cement Cylinders.
9. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
10. ASTM D2216 - Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
11. ASTM D2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
12. ASTM D2434 - Standard Test Method for Permeability of Granular Soils Constant Head.
13. ASTM D2487 - Classifications of Soils for Engineering Purposes (Unified Soil Classification System).
14. ASTM D2488 - Description and Identification of Soils (Visual-Manual Procedure).
15. ASTM D2774 - Standard Practice for Underground Installation of Thermoplastic Pressure Piping.
16. ASTM D2901 - Test Method for Cement Content of Freshly Mixed Soil Cement.
17. ASTM D4253 - Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
18. ASTM D4254 - Minimum Index Density and Unit Weight of Sols and Calculation of Relative Density.
19. ASTM D4318 - Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
20. ASTM D4564 - Density of Soil in Place by the Sleeve Method.
21. ASTM D4643 - Determination of Water (Moisture) Content of Soil by the Microwave Oven Heating.
22. ASTM D4718 - Correction of Unit Weight and Water Content for Soils Containing Oversize Particles.
23. ASTM D4832 - Compressive Strength of Controlled Low Strength Material.
24. ASTM D4914 - Density of Soil and Rock in Place by the Sand Replacement Method in a Test Pit.
25. ASTM D4959 - Determination of Water (Moisture) Content of Soil by Direct Heating.
26. ASTM D5030 - Density of Soil and Rock in Place by the Water Replacement Method in a Test Pit.
27. ASTM D5080 - Rapid Determination of Percent Compaction.
28. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.4 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures.

B. Samples: Submit, in airtight containers, 10 lb sample of each type of fill to testing laboratory.

C. Materials Source: Submit name of imported materials suppliers.

D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with ASTM C136, ASTM D2419, and ASTM D2434.

B. Perform Work in accordance with applicable New Mexico State Standards.

PART 2 PRODUCTS

2.1 MATERIALS

Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Quality Requirements: Examination of existing conditions before starting work.

B. Verify survey benchmark and intended elevations for the Work are as indicated on Drawings.

3.2 PREPARATION

A. Call New Mexico “One Call” at 811, NTUA Call Before You Dig Program at 1-800-528-5011, and local utility companies at least three (3) days before performing Work.
   1. Request underground utilities to be located and marked within and surrounding construction areas.

B. Notify Engineer at least five (5) working days prior to commencing work within 100 feet of any designated culturally sensitive area, as shown on Plans. Do not commence work unless barricades are in place and/or archaeological monitor is present, as required. Refer to Section 01 00 00 for site-specific requirements.

C. Identify required lines, levels, contours, and datum.

D. Notify utility company to remove and relocate utilities.

E. Protect remaining utilities from damage.

F. Protect plant life, lawns, and other features remaining as portion of final landscaping.

G. Protect benchmarks, survey control point, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

3.3 SUBSOIL EXCAVATION

A. Excavate subsoil from areas to be further excavated, landscaped, or graded.

B. Do not excavate wet subsoil or excavate and process wet material 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. Benching Slopes: Horizontally bench existing slopes greater than 1: 4 to key placed fill material to slope to provide firm bearing.

F. Stability: Replace damaged or displaced subsoil as specified for fill.

G. Notify Owner of any utility damage at once so emergency measures can be taken. The Contractor will pay for any required repairs.

H. Intercept and divert surface drainage and precipitation away from excavation through use of dikes, curb walls, ditches, pipes, or other means.

I. Remove and exclude water, including storm water, groundwater, irrigation water, and/or other waters, from all excavations. Dewatering wells, well-points, sump pumps, or other means shall be used to remove water and continuously maintain groundwater at a level below the bottom of excavations. Water shall be removed and excluded until backfilling is complete and all field soils testing have been completed.

J. Comply with New Mexico state standards and requirements for dewatering to any watercourse, prevention of stream degradation, and erosion and sediment control.

K. Excavation below Fills and Embankments: The subgrade areas beneath embankments shall be excavated to remove not less than the top 1 foot of native material and, where such sub-grade is sloped, the native material shall be benched. After the required excavation or over-excavation has been completed, the top 12 inches of material shall be scarified and moisture added or material dried to optimum moisture and the exposed surface shall be proof rolled.

L. Excavation under areas to be paved shall extend to the bottom of the sub-base. After the required excavation has been completed, the area shall be scarified a minimum of 12 inches below the subgrade surface and recompacted prior to the placement of the sub-base aggregate and/or base course aggregate. The finished sub-grade shall be even, self-draining, and in conformance with the slope of the finished pavement. Areas that could accumulate standing water shall be regraded to provide a self-draining subgrade.

M. Material beyond prescribed lines which is loosened by the Contractor's operations shall be removed, replaced and/or compacted, as directed by the Engineer, at no additional cost to the Owner.

3.4 FILLING

A. See Section 31 23 23 - Backfill.

3.5 DISPOSAL OF EXCAVATED MATERIALS

A. Excess excavated material or excavated material not suitable for backfill may be disposed of on-site, provided that:
   1. The finished grade substantially conforms with the Drawings, or any deviation therefrom is approved by the Engineer.
      a. Blend with natural terrain.
      b. Minimum slope: 2%.
      c. Maximum slope: 4:1.
   2. All excess excavated material spread on the right-of-way is compacted to the same specifications as final backfill, as set for in Section 31 23 23 - Backfill and the Drawings
   3. All on-site disposal of material is approved by the Engineer.

B. Do not dispose of waste material by dumping from tops of slopes.

C. Do not dispose of excess material within 15 feet of any wash, drainage or waterway.

D. Re-seed waste material areas in accordance with Section 32 92 19 - Seeding.

3.6 TOLERANCES

A. Section 01 00 00 - Quality Requirements: Tolerances.

B. Top Surface of Subgrade: Plus or minus 1/10 foot from required elevation.

3.7 FIELD QUALITY CONTROL

A. Section 01 00 00 - Execution Requirements: Testing, adjusting, and balancing.

B. Perform laboratory material tests in accordance with ASTM D1557, ASTM D698, AASHTO T180.

C. Perform in place compaction tests in accordance with the following:
   1. Density Tests: ASTM D6938.
   2. Moisture Tests: ASTM D6938.

D. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

E. Compaction testing shall be done to the extent such that the Owner and Engineer can be reasonably assured that the backfill has been placed in accordance with the requirements of the Contract Documents or in accordance with the NMDOT Standard Specifications for Road and Bridge Construction, whichever is the more stringent. When a testing allowance is established on the Bid Form, the Owner and Engineer will determine the testing frequency to be used throughout the project. The frequency of testing shall be at least once every 50 linear feet of trenching, or at least once every 50 square feet below slabs.

END OF SECTION

SECTION 31 23 17

TRENCHING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Excavating trenches for utilities.
2. Compacted fill from top of utility bedding to finished grade.
3. Backfilling and compaction.

B. Related Sections:
1. Section 03 05 00 - Basic Concrete Materials and Methods: Concrete materials.
2. Section 03 30 00 - Cast-in-Place Concrete: Concrete materials.
3. Section 31 22 13 - Rough Grading: Topsoil and subsoil removal from site surface.
4. Section 31 23 23 - Backfill: General backfilling.
5. Section 33 11 00 - Water Utility Distribution Piping.

1.2 REFERENCES

A. New Mexico Standard Specifications for Public Works Construction (NMSSPWC):
1. NMSSPWC Sections 701, 801 & 802 “Trenching, Excavation and Backfill”.

B. American Association of State Highway and Transportation Officials (AASHTO):
1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 10-lb Rammer and an 18-in. Drop.

C. American Society for Testing and Materials International (ASTM):
1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
2. ASTM D422 - Particle -Size Analysis of Soils.
3. ASTM D653 - Terminology Relating to Soil, Rock, and Contained Fluids.
4. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3).
5. ASTM D1140 - Amount of Material in Soils Finer than the No. 200 Sieve.
6. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
7. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3).
8. ASTM D1633 - Test Method for Compressive Strength of Molded Soil - Cement Cylinders.
9. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
10. ASTM D2216 - Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.

11. ASTM D2487 - Classifications of Soils for Engineering Purposes (Unified Soil Classification System).
12. ASTM D2488 - Description and Identification of Soils (Visual-Manual Procedure).
13. ASTM D2774 - Standard Practice for Underground Installation of Thermoplastic Pressure Piping.
14. ASTM D2901 - Test Method for Cement Content of Freshly Mixed Soil Cement.
15. ASTM D4253 - Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
16. ASTM D4254 - Minimum Index Density and Unit Weight of Sols and Calculation of Relative Density.
17. ASTM D4318 - Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
18. ASTM D4564 - Density of Soil in Place by the Sleeve Method.
19. ASTM D4643 - Determination of Water (Moisture) Content of Soil by the Microwave Oven Heating.
20. ASTM D4718 - Correction of Unit Weight and Water Content for Soils Containing Oversize Particles.
21. ASTM D4832 - Compressive Strength of Controlled Low Strength Material.
22. ASTM D4914 - Density of Soil and Rock in Place by the Sand Replacement Method in a Test Pit.
23. ASTM D4959 - Determination of Water (Moisture) Content of Soil by Direct Heating.
24. ASTM D5030 - Density of Soil and Rock in Place by the Water Replacement Method in a Test Pit.
25. ASTM D5080 - Rapid Determination of Percent Compaction.
26. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.3 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.

B. Materials Source: Submit name of imported fill materials suppliers.

C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with applicable New Mexico state standards and specifications of the utility provider.

B. Perform Work in accordance with applicable OSHA trench safety standards.

1.5 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.6 COORDINATION

A. Section 01 00 00 - Administrative Requirements: Coordination and project conditions.

B. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

PART 2 PRODUCTS

2.1 FILL MATERIALS

A. Pipe Bedding and Embedment: As specified in Section 31 23 23.

B. Pipe Backfill: As specified in Section 31 23 23.

C. Structural Fill: As specified in Section 31 23 23.

D. Granular Fill: As specified in Section 31 23 23.

E. Concrete: As specified in Section 03 30 00.

PART 3 EXECUTION

3.1 LINES AND GRADES

A. Lay pipes to lines and grades indicated on Drawings.
1. Engineer reserves right to make changes in lines, grades, and depths of utilities when changes are required for Project conditions.

3.2 PREPARATION

A. Call New Mexico "One Call" at 811, NTUA Call Before You Dig Program at 1-800-528-5011, and local utilities not less than three working days before performing Work.
1. Request underground utilities to be located and marked within and surrounding construction areas.

B. Notify Engineer at least five (5) working days prior to commencing work within 100 feet of any designated culturally sensitive area, as shown on Plans. Do not commence work unless barricades are in place and/or archaeological monitor is present, as required. Refer to Section 01 00 00 for site-specific requirements.

C. Identify required lines, levels, contours, and datum locations.

D. Protect plant life, lawns and other features remaining as portion of final landscaping.

E. Protect benchmarks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

F. Maintain and protect above and below grade utilities indicated to remain.

G. Establish temporary traffic control and detours when trenching is performed in public right-of-way. Relocate controls and reroute traffic as required during progress of Work.

3.3 LINES, GRADES AND DIMENSIONS

A. Excavate trench to lines and grades indicated on Drawings.
   1. Engineer reserves right to make changes in lines, grades, and depths of utilities when changes are required based on field conditions.
   2. Deviations from horizontal and vertical pipe line and grade by Contractor per Section 33 11 00 - Water Utility Distribution Piping.
   3. When bottom of trench is rocky, over-excavate and fill as specified in Section 31 23 23.

B. Excavate trench to minimum width as indicated on Drawings.
   1. Cut trenches to width indicated on Drawings, providing at least 6 inches of clear space between the trench face and the outside diameter of the pipe. The maximum permissible width of the trench shall be the outside diameter of the pipe (or distance between pipes plus pipe diameters in the event that two pipes are buried in the same trench) plus 24 inches, unless otherwise indicated on the Drawings, permission in writing to use a greater width is obtained from the Engineer.
   2. Increase trench width as required to meet required clearances between pipe and trench wall, to avoid voids in the haunch areas of the pipe and to meet embedment compaction requirements. Increased trench width, if needed to meet these requirements, shall be provided at no additional cost to the Owner.

3.4 TRENCHING

A. Excavate subsoil required for utilities.

B. Remove lumped subsoil, boulders, and rock up to the size that would require special equipment beyond conventional machinery used for trenching, in which case the Engineer should be notified immediately.

C. Allowable Open Trench: Trenches may be opened in advance of pipe placement and backfill operations under the following conditions:
   1. No more than 100 feet of trench shall be opened in advance of pipe laying operations. This distance may be reduced due to traffic control considerations. Backfilling shall begin as soon as pipe is laid and inspected and shall keep pace with the pipe laying. Whenever local, county, state or federal regulations impose stricter limitations, such regulations will take precedence.
   2. All trenches shall be fully backfilled at the end of each day or, in lieu thereof, shall be covered by traffic weight steel plates adequately braced and capable of supporting vehicular traffic in those locations where it is impractical to backfill at the end of each day.
   3. Do not block vehicular traffic or impede access to homes or businesses.
   4. Protect open trench to protect the public, livestock, wildlife and the environment.

      a. The Owner or land-controlling agencies, at their sole discretion, may require temporary fencing to protect livestock, wildlife and local residents and land users from open trenches. Such fences shall be required in all trenches left open in active livestock grazing areas. Contractor shall provide such fencing, if required, at no additional cost to the Owner.

5. Contractor is solely responsible for safety of all open trenches and bears sole liability for any incidents or accidents arising from open trenches.
6. The Owner may further restrict the amount of open trench as needed due to safety, land use or environmental considerations.

D. Intercept and divert surface drainage and precipitation away from excavation through use of dikes, curb walls, ditches, pipes, or other means.

E. Dewater and maintain substantially dry subgrade during pipe installation.
1. Remove groundwater by pumping to keep excavations dry.
2. Comply with New Mexico state standards and requirements for dewatering to any watercourse, prevention of stream degradation, and erosion and sediment control.
3. If a separate bid item is not included on the Bid Form for dewatering, the cost thereof will be considered incidental to the cost of trenching and utility installation.

F. Excavate trenches to depth indicated on Drawings. Provide uniform and continuous bearing and support for bedding material and pipe.

G. Do not interfere with 45 degree bearing splay of foundations. Any excavation in this area shall be backfilled and compacted using the same materials and methods as structural fill for new buildings. Refer to Section 31 23 23.

H. Slope or shore trench as needed to meet safety requirements. When sidewalls cannot be sloped, provide sheeting and shoring to protect excavation as specified in this section.

I. When subsurface materials at bottom of trench are loose or soft, excavate to greater depth as directed by Engineer until suitable material is encountered. Backfill and compact to reach specified or directed line and grade. Refer to specifications for overexcavation backfill, as set forth in Section 31 23 23.

J. Cut out soft areas of subgrade not capable of compaction in place. Backfill and compact to specified or directed line and grade. Refer to specifications for overexcavation backfill, as set forth in Section 31 23 23.

K. Trim excavation. Hand trim for bell and spigot pipe joints. Remove loose matter.

L. Correct over excavated areas with compacted backfill as specified for authorized excavation or replace with fill concrete as directed by Engineer.

M. Remove excess subsoil not intended for reuse, from site.

N. Protect open trench at all times to prevent danger to the public and to wildlife. Any safety requirements imposed by agencies or entities with jurisdiction must be met.

3.5 SHEETING AND SHORING

A. Sheet, shore, and brace excavations to prevent danger to persons, structures and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.

B. Support trenches more than 5 feet deep excavated through unstable, loose, or soft material. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.

C. Design sheeting and shoring to be removed at completion of excavation work. If the Engineer orders the sheeting to be left in place for the protection of the work, a payment will be allowed only for the actual cost of the timber left in place.

D. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.

E. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

3.6 BACKFILLING OF TRENCHES

A. See Section 31 23 23 - Backfill, Articles 3.3 and 3.4 for general backfill requirements, as well as trench backfill and bedding requirements around pipelines.

3.7 DISPOSAL OF EXCAVATED MATERIALS

A. Excess excavated material or excavated material not suitable for backfill may be disposed of on-site, provided that:
   1. The finished grade substantially conforms with the Drawings, or any deviation therefrom is approved by the Engineer
      a. Blend with natural terrain.
      b. Minimum slope: 2%.
      c. Maximum slope: 4:1.
   2. All excess excavated material spread on the right-of-way is compacted to the same specifications as final backfill, as set forth in Section 31 23 23 - Backfill and the Drawings, and
   3. All on-site disposal of material is approved by the Engineer.

B. Do not dispose of waste material by dumping from tops of slopes.

C. Do not dispose of excess material within 15 feet of any wash, drainage or waterway.

D. Re-seed waste material areas in accordance with Section 32 92 19 - Seeding.

3.8 TOLERANCES

A. Section 01 00 00 - Quality Requirements: Tolerances.

B. Top Surface of Backfilling Under Paved Areas: Plus or minus 1 inch from required elevations.

3.9 FIELD QUALITY CONTROL

A. Section 01 00 00 - Execution Requirements: Testing, adjusting, and balancing.

B. Determine compaction characteristics of materials in accordance with ASTM D698.

C. Classify soils in accordance with ASTM D2487.

D. Perform laboratory material tests in accordance with ASTM D1557.

E. Refer to compaction testing requirements in Section 31 22 13 - Rough Grading and/or Section 31 23 23 - Backfill, Field Quality Control, as applicable.

3.10 PROTECTION OF FINISHED WORK

A. Section 01 00 00 - Execution Requirements: Protecting installed construction.

B. Reshape and re-compact fills subjected to vehicular traffic during construction.

END OF SECTION

SECTION 31 23 18

ROCK REMOVAL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Removing identified and discovered rock during excavation.

B. Related Sections:

1. Section 31 23 17 - Trenching: Trenching and backfilling for utilities.
2. Section 31 23 23 - Backfill: Backfill materials.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Trench Rock Removal:

1. Basis of Measurement:
2. Rock Removal is incidental to the cost of the project.

1.3 SUBMITTALS

A. Submit type of equipment to be used for rock removal and/or processing.

B. If processed native rock is to be used for embedment and backfill, submit sieve analyses and other geotechnical data on the processed material, as required in field by Engineer.

1. Laboratory costs associated with such testing shall be reimbursable under project testing allowance. Other costs, such as sample collection and transport, are not covered under the allowance.

1.4 SCHEDULING

A. Section 01 00 00 - Administrative Requirements: Coordination.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Coordination.

B. Verify site conditions and note subsurface irregularities affecting Work of this section.

3.2 PREPARATION

A. Identify required lines, levels, contours, and datum.

3.3 ROCK REMOVAL BY MECHANICAL METHOD

A. Excavate and remove rock by mechanical methods.

B. Cut away rock at bottom of excavation to form level bearing.

C. Remove shaled layers to provide sound and unshattered base for footings.

D. For utility trenches, excavate to below invert elevation of pipe as shown on Drawings to ensure adequate bedding below pipe, and provide trench width as shown on Drawings to allow for proper embedment compaction or soil cement placement on sides of pipe. Exceptions to minimum trench width will be considered by Engineer if Contractor can demonstrate proper bedding and compaction are provided.

E. Disposal of excavated materials: Removed materials may be disposed of on-site, provided all criteria under Section 31 23 17 – Trenching, Article 3.8, are met.

3.4 ROCK REMOVAL BY EXPLOSIVE METHODS

A. Not allowed.

3.5 FIELD QUALITY CONTROL

A. Section 01 00 00 - Execution Requirements: Testing, adjusting, and balancing.

B. Request visual inspection of foundation bearing surfaces by Engineer before installing subsequent work.

END OF SECTION

BACKFILL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Backfilling building perimeter to subgrade elevations.
2. Backfilling site structures to subgrade elevations.
3. Fill under slabs-on-grade.
4. Fill under paving.
5. Fill for over-excavation.
6. Pipe bedding material.

B. Related Sections:
1. Section 03 30 00 - Cast-in-Place Concrete: Concrete materials.
2. Section 31 22 13 - Rough Grading: Site filling.
3. Section 31 23 17 - Trenching: Backfilling of utility trenches.
4. Section 33 11 00 - Water Utility Distribution Piping.
5. Section 33 42 14 - HDPE Corrugated Drain Pipe.

1.2 REFERENCES

A. New Mexico Standard Specifications for Public Works Construction (NMSSPWC):
1. NMSSPWC Sections 701, 801 & 802 “Trenching, Excavation and Backfill”.

B. American Association of State Highway and Transportation Officials (AASHTO):
1. AASHTO T99 - Standard Method of Test for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 3050mm (12-in.) Drop.
2. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

C. American Society for Testing and Materials International (ASTM):
1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
2. ASTM D422 - Particle -Size Analysis of Soils.
3. ASTM D653 - Terminology Relating to Soil, Rock, and Contained Fluids.
4. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
5. ASTM D1140 - Amount of Material in Soils Finer than the No. 200 Sieve.
6. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
7. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3, 2,700 kN-m/m3).
8. ASTM D1633 - Test Method for Compressive Strength of Molded Soil - Cement Cylinders.

9. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
10. ASTM D2216 - Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
11. ASTM D2487 - Classifications of Soils for Engineering Purposes (Unified Soil Classification System).
12. ASTM D2488 - Description and Identification of Soils (Visual-Manual Procedure).
13. ASTM D2774 - Standard Practice for Underground Installation of Thermoplastic Pressure Piping.
14. ASTM D2901 - Test Method for Cement Content of Freshly Mixed Soil Cement.
15. ASTM D4253 - Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
16. ASTM D4254 - Minimum Index Density and Unit Weight of Sols and Calculation of Relative Density.
17. ASTM D4318 - Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
18. ASTM D4564 - Density of Soil in Place by the Sleeve Method.
19. ASTM D4643 - Determination of Water (Moisture) Content of Soil by the Microwave Oven Heating.
20. ASTM D4718 - Correction of Unit Weight and Water Content for Soils Containing Oversize Particles.
21. ASTM D4832 - Compressive Strength of Controlled Low Strength Material.
22. ASTM D4914 - Density of Soil and Rock in Place by the Sand Replacement Method in a Test Pit.
23. ASTM D4959 - Determination of Water (Moisture) Content of Soil by Direct Heating.
24. ASTM D5030 - Density of Soil and Rock in Place by the Water Replacement Method in a Test Pit.
25. ASTM D5080 - Rapid Determination of Percent Compaction.
26. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.3 DEFINITIONS

A. Percentage Compaction: Ratio, expressed as percentage, of actual density of material compared with maximum dry density based on Modified Proctor (ASTM D1557).

B. Optimum Moisture Content: Based on Modified Proctor (ASTM D1557).

C. Unified Soil Classification System: Based on ASTM D2487.

1.4 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures.

B. Submit samples and certified test documentation of all materials to be used.

C. Materials Source: Submit name of imported fill materials suppliers.

D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

E. Submit field soil test on material in place as backfill and pipe bedding material.

F. Submit construction drawings with compaction test locations marked and labeled with station, date, test number, depth of test below ground surface, and test result.

PART 2 PRODUCTS

2.1 FILL MATERIALS

A. Suitable materials may be processed on-site, or may be imported. If imported materials are required to meet the quantity requirements of the project, it will be provided at no additional expense to the Owner, unless a unit price item is included for imported materials on the Bid Form. The following types of materials are defined as suitable where scheduled:

1. Type A (three-quarter inch minus aggregate backfill): Crushed rock or gravel, and sand with the gradation requirements below.

Sieve Size	Percentage Passing
3/4-inch	100
No. 4	30 – 50
No.200	0 – 12

2. Type B (Class I crushed stone): Manufactured angular, crushed stone, crushed rock, or crushed slag with the following gradation requirements. The material shall have a minimum sand equivalent value of 75.

Sieve Size	Percentage Passing
3/4-inch	100
No. 4	30 – 50
No. 200	0 - 5

3. Type C (sand backfill): Sand with 100 percent passing a 3/8-inch sieve, at least 90 percent passing a No. 4 sieve, and a sand equivalent value not less than 30.
   a. This material to be used only when approved by Engineer.

4. Type D: (pipe bedding material): Crushed rock or gravel with 100 percent passing a 1/2-inch sieve and not more than 5 percent passing a No. 10 sieve and 1 to 2 percent passing a No. 200 sieve.

5. Type E (pea gravel backfill): Crushed rock or gravel with 100 percent passing a 1/2-inch sieve and not more than 10 percent passing a No. 4 sieve.

6. Type F (coarse drain rock): Crushed rock or gravel meeting the following gradation requirements:

Sieve Size	Percentage Passing
2-inch	100
1-1/2-inch	90- 100
1-inch	20 – 55
3/4-inch	0 – 15

No. 200	0 – 3

7. Type G (aggregate base, base course) as follows:

Sieve Size	Percentage Passing
1-inch	100
3/4 inch	80-100
No.4	30-60
No.10	20-45
No. 200	3-10

8. Type H (graded drain rock): Drain rock shall be crushed rock or gravel, durable and free from slaking or decomposition under the action of alternate wetting or drying. The material shall be uniformly graded and shall meet the following gradation requirements:

Sieve Size	Percentage Passing
1-inch	100
3/4-inch	90 - 100
3/8-inch	40 - 100
No. 4	25 – 40
No. 8	18 – 33
No. 30	5 – 15
No. 50	0 – 7
No. 200	0 – 3

9. Type I Not Used

10. Type J (cement-treated backfill): Material which consists of Type H material, or any mixture of Types B, C, G, and H materials which has been cement-treated so that the cement content of the material is not less than 5 percent by weight when tested in accordance with ASTM D2901 - Test Method for Cement Content of Freshly Mixed Soil Cement. The ultimate compressive strength at 28 days shall be not less than 400 psi when tested in accordance with ASTM D1633 - Test Method for Compressive Strength of Molded Soil - Cement Cylinders.

11. Type K (topsoil): Stockpiled topsoil material which has been obtained at the site by removing soil to a depth not exceeding 2 feet. Removal of the topsoil shall be done after the area has been stripped of vegetation and debris.

12. Type L (controlled low strength material): Controlled low strength material, also referred to as ‘soil cement slurry’ or ‘flowable fill’ shall meet the following requirements:
    a. Slurry shall have a 7-day compressive strength of not less than 50 psi and not more than 150 psi. The compressive strength shall be determined in accordance with ASTM D4832.
    b. Typical cement content: 3 to 10 percent by dry weight of soil to obtain specified compressive strength.

c. The water-cement ratio of the mix shall not exceed 3.5:1. The water content shall not exceed that required to provide a mix that will flow and can be pumped.
d. The consistency of the slurry shall be such that the slurry flows easily into all openings between the pipe and the lower portion of the trench.

13. Type M (aggregate sub-base, structural fill). Well-graded crushed rock or natural gravel meeting the following gradation requirements:

Sieve Size	Percentage Passing
4-inch	100
3-inch	95 100
No. 200	3 - 15

B. Where these Specifications conflict with the requirements of any local agency having jurisdiction or with the requirements of a pipe material manufacturer, the Engineer shall be immediately notified. In case of conflict between types of pipe embedment backfills, the Contractor is to use the agency-specified backfill material if that material provides a greater degree of structural support to the pipe, as determined by the Engineer. In case of conflict between types of trench or final backfill types, the Contractor shall use the agency-specified backfill material if that material provides the greater in-place density after compaction.

C. Fill and backfill types, including use of native soil, shall be used in accordance with the following provisions. Native soil used for fill and backfill must meet the requirements of the type of material specified below and as shown for the corresponding type of material shown in 2.1.A above.
1. Embankment fills shall be constructed of Type M material, as defined herein, or other material approved by the Project Engineer. Drainage structures embankments shall be backfilled with materials used in original construction.
2. Pipe zone backfill shall consist of the following materials for each pipe material listed below. All pipe bedding material shall receive prior approval by the Engineer before use.
    a. Concrete pipe, shall be provided Type A or B pipe bedding and embedment backfill material, or native material that meets the criteria described below, and is acceptable to the Engineer.
    b. Plastic pipe shall be provided Type D bedding and embedment zone material, or native material that meets the criteria described below, and is acceptable to the Engineer.
        1) In trenches where dewatering is required, the pipe bedding material and embankment backfill shall be Type A or B as directed by the Engineer.
    c. Excavated native material will be allowed, provided that it is free draining and contains no organic materials, no rocks larger than 1/2-inch, clods or frozen lumps. A proctor of this material shall be submitted to the Engineer for review and approval before use. If native backfill material is approved, on-site screening may be required by Engineer to remove any rock material larger than 1/2-inch at no additional expense to the Owner. The location of such sites must be coordinated with the Owner.

3. Trench zone backfill for pipelines shall be any of Types A through H backfill materials or any mixture thereof.
4. Final backfill material for pipelines under paved areas shall be Type G backfill material.
5. Final backfill under areas not paved shall be the same material as that used for trench backfill, unless otherwise indicated.
6. Trench backfill and final backfill for pipelines under structures shall be the same material as used in the pipe zone, except where concrete encasement is required by the Contract Documents.
7. Aggregate base materials under pavements, curb and gutter, and sidewalk shall be Type G material constructed to the thickness indicated.
8. Aggregate sub-base shall be Type M material.
9. Backfill around structures shall be Types A through Type H materials, or any mixture thereof.
10. Under structures where groundwater must be removed to allow placement of concrete, Type F material shall be used. Before the Type F material is placed, filter fabric shall be placed over the exposed foundation. Filter fabric shall be Mirafi 140 N, Mirafi 700X, or equal.
11. Under all other structures, Type G or H material shall be used.
12. Backfill used to replace pipeline trench over-excavation shall be a layer of Type F material with a 6-inch top filter layer of Type E material or filter fabric to prevent migration of fines for wet trench conditions or the same material as used for the pipe zone backfill if the trench conditions are not wet.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Coordination and project conditions.

B. Verify subdrainage, dampproofing, or waterproofing installation has been inspected.

C. Verify underground tanks are anchored to their own foundations to avoid flotation after backfilling.

D. Verify structural ability of unsupported walls to support loads imposed by fill.

3.2 PREPARATION

A. Compact subgrade to density requirements for subsequent backfill materials.

B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with structural fill and compact to density equal to or greater than requirements for subsequent fill material.

C. Scarify subgrade surface to depth of 8 inches.

D. Proof roll to identify soft spots; fill and compact to density equal to or greater than requirements for subsequent fill material.

3.3 BACKFILLING FOR STRUCTURES, SITE WORK AND APPURTENANCES

A. Backfill areas to contours and elevations with unfrozen materials as indicated on the Drawings or as directed by the Engineer.

B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.

C. Each layer shall be thoroughly mixed as necessary to promote uniformity of material in each layer.

D. Place material in continuous layers as follows:
1. Subsoil Fill: Maximum 8 inches compacted depth.
2. Structural Fill: Maximum 6 inches compacted depth.
3. Granular Fill: Maximum 6 inches compacted depth.

E. Employ placement method that does not disturb or damage other work.

F. Maintain optimum moisture content of backfill materials to attain required compaction density.

G. Slope grade away from building minimum 6 inches in 10 ft, unless noted otherwise.

H. Make gradual grade changes. Blend slope into level areas.

I. Shape and drain embankments and excavations, maintain ditches and drains to provide drainage at all times. Protect graded areas against action of elements prior to acceptance of work, and reestablish grade where settlement or erosion occurs.

J. Bench hillside slopes or fills to key the embankment. Remove and re-compact a minimum of 12 inches normal to the slope of the hillside or fill as the embankment or fill is brought up in layers.

K. Under surfaced or paved roads, driveways or parking areas, apply base course at uppermost layer of backfill to same thickness as existing driving surface, or 6 inches, whichever is greater. If paved, apply pavement patch to thickness equal to or greater than existing pavement.

L. Remove surplus backfill materials from site.

M. Leave fill material stockpile areas free of excess fill materials.

N. Repair or replace remaining items damaged by excavation or filling.

3.4 BACKFILLING OF TRENCHES

A. Place a minimum of 4 inches of bedding material in pipe trenches to lines and grades indicated on Drawings or as directed by Engineer and compact before pipe is laid. Grade bedding material parallel to bottom of pipe.

B. Do not place material when either the material or the surface upon which it is to be placed is frozen.

C. Pipe zone backfill materials shall be manually spread around the pipe so that, when compacted, the pipe zone backfill will provide uniform bearing and side support.
   1. Exercise care not to damage pipe or appurtenances when placing embedment material.
   2. Maintain optimum moisture content of fill materials to attain required compaction density.
   3. Ensure material is placed to equal height on both sides of pipe to avoid unequal loading and possible lateral displacement of the pipe. Elevation difference of embedment between each side of pipe shall not exceed 6 inches.
   4. Place material in uniform layers.
   5. Work material into pipe haunches to prevent voids and achieve specified compaction under the haunches.
   6. No backfilling by machine methods permitted until a minimum of one foot of material has been placed by hand over the top of the pipe.
   7. Place material to a compacted depth of 12 inches over the top of the pipe, 15 inches of compacted depth over the top of the pipe in paved or traffic areas, and compacted by hand held compacting tools before other backfilling is done.

D. If pipe laying operations are interrupted for more than 24 hours, cover pipe laid in the trench with backfill.

E. When the bottom of the trench is unstable, an additional 4 inches shall be over-excavated and filled with bedding material before pipe is laid.

F. Where rock is present and where there is concern that settling rocks in the surrounding material may rupture the pipeline, the amount of bedding material below and above the pipe shall be increased. In these cases there will be 8 inches of bedding material below the pipe and 15 inches above, as directed by the Engineer.

G. When using free-draining crushed rock or gravel for embedment on stretches longer than 300 feet, install trench plugs composed of silty, non-plastic material at 300 foot intervals to impede flow of trench water through the embedment.

H. Under surfaced or paved roads, driveways or parking areas, apply base course at uppermost layer of backfill to same thickness as existing driving surface, or 6 inches, whichever is greater. If paved, apply pavement patch to thickness equal to or greater than existing pavement.

3.5 COMPACTION

A. Do not place and compact soil under the following conditions:
   1. Ambient air temperature below freezing.
   2. Rain that creates puddles in clayey or silty materials.
   3. Ice or snow pockets visible in material being placed.

B. Surface Preparation:
   1. Prepare surface so that first compacted lift will be placed on firm, stable base. Compact surface to specified percent compaction, if necessary.
   2. For water-retaining compacted fill, scarify and moisten surface to provide satisfactory bonding surface before placing first layer of material to be compacted.
   3. Do not place material to be compacted on frozen surface.

C. Compact material in trenches in layers having approximately the same top elevation on both sides of the pipeline to avoid unequal loading and displacement of the pipe.

D. Placement:
   1. Place soil to be compacted in horizontal layers.
   2. Blend materials as needed to ensure compacted fill is homogenous and free from lenses, pockets, streaks, voids, laminations and other imperfections.

E. Compaction Procedures:
   1. Silty or Clayey Material:
      a. Compact with mechanical impact tampers, tamping rollers, vibrating pad foot rollers, rubber tire rollers or other suitable compaction equipment.
      b. Uniformly distribute equipment passes.
      c. Compact in horizontal layers to compacted thickness of 6 inches or less.
   2. Cohesionless Free-Draining Material: Compact in horizontal layers to maximum compacted thickness of:
      a. Tampers and rollers: 6 inches
      b. Crawler-type tractors, vibrating drum rollers, surface vibrators or similar equipment: 12 inches
      c. Saturation and internal vibration: Penetrating depth of vibrator.
   3. When compacting pipe embedment material, exercise care not to damage the pipe or appurtenances with compaction equipment. Do not apply compaction equipment directly above the pipe.
   4. Demonstration: Lift thicknesses may vary depending on equipment and methods. Field adjustments to the specified lift thicknesses may be allowed or required. Contractor shall demonstrate that proposed equipment and methods will meet required compaction for the proposed lift thickness.
   5. Flooding and jetting is not allowed unless specifically approved by the Engineer.

F. Moisture Content:
   1. Optimum moisture content for each soil type, whether native soil or imported material, shall be determined by the Modified Proctor method, ASTM D1557.
   2. Moisture content during compaction shall be no more than 2 percentage points wet or dry of optimum moisture content.

3. Moisten or aerate material, as necessary, to provide specified moisture content. Add water to soil in increments that will permit moisture content to be uniform and homogenous through each layer after mixing.
4. Add no more than 2 percent water to fill by sprinkling just prior to compaction when fill is clayey and contains dry clods of clay.
   a. If clayey soil is more than 2 percent below optimum moisture, pre-conditioning and curing may be required to obtain uniform and homogenous distribution of moisture in clods.
   b. Use of disks, harrows or rakes may be required to blend moisture prior to placement and compaction.
5. For cohesionless soils, add water as necessary during compaction, as these soils are free-draining.

G. Minimum Percent Compaction:
1. Over-excavation: Backfill of over-excavation to specified or directed lines shall be compacted to same percent compaction as embedment material or undisturbed foundation material, whichever is greater. If the in-place compaction of the undisturbed foundation material is greater than 95%, the over-excavation backfill may be compacted to 95%.
2. Pipe Bedding Material: Place and compact pipe bedding material as indicated on Drawings for given soil classification, pipe wall thickness, and depth of cover. If native material meets grading requirements and is used, compact to 95%.
3. Initial and Final Backfill: For trenches outside of roads, driveways, parking areas or wash crossings, compact to 90%, or to a density equal to that of the adjacent undisturbed soil, as directed by the Engineer. For trenches within the driving surfaces of roads, driveways or parking areas (both paved and unpaved) or within wash crossings, compact to 95%.
4. Embankments: Compact to same requirements as Final Backfill.
5. Under buildings, tanks, slabs and other structures: Compact in accordance with Geotechnical reports provided in Exhibit A.
6. Note that all Percent Compaction values in these Technical Specifications and Drawings are based on Modified Proctor, ASTM D1557, unless otherwise noted.

H. Soil Cement Slurry may be used in trenches, at Contractor's option and expense, to replace bedding, embedment or backfill materials where it is not practical to reach minimum compaction requirements using select material.
1. If soil cement slurry is to be used in lieu of embedment material, soil cement slurry shall also replace the bedding material. Do not use soil cement slurry for embedment on top of select material bedding.

3.6 TOLERANCES

A. Section 01 00 00 - Quality Requirements: Tolerances.

B. Top Surface of Backfilling within Building Areas: Plus or minus 1 inch from required elevations.

C. Top Surface of Backfilling under Paved Areas: Plus or minus 1 inch from required elevations.

D. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.

E. Percent Compaction: Shall meet minimum required compaction as set forth in these specifications

F. Moisture Content: As set forth in these specifications.

3.7 FIELD QUALITY CONTROL

A. Section 01 00 00 - Execution Requirements: Testing, Adjusting, and Balancing.

B. Perform laboratory material tests in accordance with ASTM D1557.

C. Perform in place compaction tests in accordance with the following:
1. Density Tests: ASTM D1556, ASTM D2167, or ASTM D6938.
2. Moisture Tests: ASTM D6938.

D. When tests indicate Work does not meet specified requirements, remove material, replace, compact, and retest.

E. Provide test trenches and excavations including excavation, trench support, and groundwater removal for the soils testing operations, at the locations and depths required. The cost of all work associated with accessing, preparing, or time delays for testing to be included in the unit price of the applicable pay item being tested.

F. Compaction testing shall be done to the extent such that the Owner and Engineer can be reasonably assured that the backfill has been placed in accordance with the requirements of the Contract Documents, or as required by the utility for which the trenching is being provided, whichever is the more stringent. When a testing allowance is established on the Bid Form, the Owner and Engineer will determine the testing frequency to be used throughout the project. If no allowance is included, the frequency of testing shall be at least once every 400 linear feet of trenching, or at least once every 200 square feet below structural slabs.

G. Correction of Substandard Work: All fill and backfill represented by tests that fail to meet compaction, moisture content, soil classification or other specifications shall be uncovered as needed, replaced as needed, re-compacted and re-tested until all specifications are met, at no additional expense to the Owner.
1. Elevations, lines and grades of replaced material, as well as of pipe and other structures resting against such material, shall be re-surveyed at the direction of the Engineer. Contractor shall correct elevations, lines and grades as needed, at no additional expense to the Owner.

3.8 PROTECTION OF FINISHED WORK

A. Section 01 00 00 - Execution Requirements: Protecting Installed Construction.

B. Reshape and re-compact fills subjected to vehicular traffic.

3.9 SCHEDULE

A. Interior Slab-On-Grade:
   1. Per Geotech Report.

B. Exterior Side of Foundation Walls, Retaining Walls and Over Granular Filter Material and Foundation Perimeter Drainage:
   1. Fill Type A – H or any mixture thereof, to subgrade elevation. 6 inches thick, each lift, compact uniformly to 90 percent of maximum density.

C. Fill Under Asphalt and Concrete Paving:
   1. Compact subsoil to 95 percent of its maximum dry density.
   2. Fill Type G, to 2 inches below finish paving elevation, or to match existing conditions, whichever is greater, compact uniformly to 95 percent of maximum density.

D. Fill Over Drainage Piping Gravel Cover:
   1. Fill Type H, to 6 inches below finish grade, compact uniformly to 90 percent of maximum density.

END OF SECTION

SECTION 31 37 00

RIPRAP AND ROCK LINING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Riprap placed loose.

B. Related Sections:

1. Section 31 22 13 - Rough Grading.
2. Section 31 23 23 - Backfill.
3. Section 31 23 17 - Trenching.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Check dams and riprap placed loose:

1. Basis of Measurement: By cubic yard of riprap volume, including riprap and geotextile fabric.
2. Basis of Payment: Includes preparation of surface, compaction, placing of geotextile fabric and riprap material.

B. Bid items for riprap, rock check dams or other specific erosion control features that appear on the Bid Form apply only to features designed and directed by the Engineer. They do not include preparation of the Storm Water Pollution Prevention Plan (SWPPP) or implementation of any Best Management Practices (BMPs) stipulated therein. Separate bid items are provided for preparation and implementation of the SWPPP. Contractor is wholly responsible to prepare and implement the SWPPP to the satisfaction of relevant governmental authorities for the prices given under the SWPPP bid items.

1.3 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Gradation of rock.

1.4 QUALITY ASSURANCE

A. Furnish each aggregate material from single source throughout the Work.

B. Perform Work in accordance with State of New Mexico Department of Transportation standard, if related to roadway construction or drainage.

C. Samples of riprap material shall be provided to the Engineer for inspection and approval.

PART 2 PRODUCTS

2.1 MATERIALS

A. Furnish materials in accordance with State of New Mexico Department of Transportation standards, Section 602.

B. Riprap:

1. Shall comply with New Mexico Department of Transportation standards, Section 602.2

2. Irregular shaped rock:

a. Minimum size (as measured in the smallest dimension):

1) Loose riprap and rock check dams:

a) 6” minimum rock dimension, measured in the smallest dimension.

b. Solid and nonfriable.

C. Geotextile Fabric:

1. Provide non-woven geotextile (filter fabric) Class 1, as per New Mexico Department of Transportation standards, Section 604.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Do not place riprap over frozen or spongy subgrade surfaces.

3.2 PLACEMENT

A. Riprap locations, dimensions, and quantities shown on Drawings are approximations only, and are subject to change based on finished grade. Final quantities, dimensions, and locations of riprap to be determined in field by Engineer after installation of pipeline and related facilities.

B. Filter fabric:

1. Place Class 1 non-woven geotextile (filter fabric) between the riprap and the supporting soil.

C. Installed Thickness: As shown on Drawings, or as directed in field by Engineer.

END OF SECTION

AGGREGATE BASE COURSE AND GRAVEL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aggregate base course.
2. Clean gravel.

B. Related Sections:

1. Section 31 22 13 - Rough Grading: Preparation of site for base course.
2. Section 31 23 17 - Trenching: Compacted fill under base course.
3. Section 31 23 23 - Backfill: Compacted fill under base course.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Aggregate Base Course:

1. Basis of Measurement: By the square yard to depth indicated on Drawings.
2. Basis of Payment: Includes supplying fill material, stockpiling, scarifying substrate surface, placing aggregate to the depths and at the locations indicated on the Drawings, and compacting.

B. Clean Gravel

1. Basis of Measurement: By the square yard to depth indicated on Drawings.
2. Basis of Payment: Includes supplying fill material, stockpiling, placing gravel to the depths and at the locations indicated on the Drawings, and compacting.

1.3 REFERENCES

A. New Mexico Department of Transportation (NMDOT) Standard Specifications for Highway and Bridge Construction.

B. American Association of State Highway and Transportation Officials:

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 10-lb Rammer and an 18-in. Drop.

C. ASTM International:

1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
2. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.4 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.

B. Materials Source: Submit name of imported materials suppliers.

C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

A. Furnish each aggregate material from single source throughout the Work.

B. Perform Work in accordance with NMDOT standards.

PART 2 PRODUCTS

2.1 MATERIALS

A. Aggregate Base Course:

1. Base course gradation shall have a percent passing sieve sizes as shown in TABLE 304, SECTION 304-BASE COURSE, New Mexico Department of Transportation Standard Specifications for Highway and Bridge Construction, latest edition.

B. Clean Gravel (Class I crushed stone):

1. Manufactured angular, crushed stone, crushed rock, or crushed slag with the following gradation requirements.

Sieve Size	Percentage Passing
3/4-inch	100
No. 4	30 – 50
No. 200	0 - 5

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify substrate has been inspected, gradients and elevations are correct, and is dry.

3.2 PREPARATION

A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.

B. Do not place fill on soft, muddy, or frozen surfaces.

C. Subgrade surface shall be kept at all times in such manner that it will drain readily and effectively.

D. Mix aggregate material to provide a homogenous mixture of uniformly dispersed materials as placed in position for compacting.

3.3 AGGREGATE PLACEMENT

A. Spread aggregate over prepared substrate in layers that will permit the required density be obtained. Density requirements will be determined by AASHTO T-180.

B. Compact each layer of material full width with: (1) two passes of a 50 ton compression type roller, or (2) two passes of a vibratory roller having a minimum dynamic force of 40,000 pounds impact per vibration and a minimum frequency of 1,000 vibrations per minute, or (3) eight passes of a 10 ton compression-type roller, or (4) eight passes of a vibratory roller having a minimum dynamic force of 30,000 pounds impact per vibration and a minimum frequency of 1,000 vibrations per minute.

C. No displacement (pumping) of subgrade soils shall be visually observed when loaded by heavy equipment traffic.

D. Level and contour surfaces to elevations and gradients indicated.

E. Incorporate only suitable roadway excavation material into embankments. Compact material placed in all embankment layers and the material scarified in cut sections to a uniform density of not less than 95% Standard Proctor density.

F. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.

G. Maintain optimum moisture content of fill materials to attain required compaction density.

H. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

3.4 TOLERANCES

A. Section 01 00 00 - Quality Requirements: Tolerances.

B. Maximum Variation from Flat Surface: 3/8 inch measured with 10-foot straight edge in any direction.

C. Maximum Variation from Thickness: 1/2 inch.

3.5 FIELD QUALITY CONTROL

A. Section 01 00 00 - Execution Requirements: Testing, adjusting, and balancing.

B. Field testing of density and moisture content of in-place material will be performed in accordance with Nuclear Method, ASTM D6938.

C. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

D. Frequency of Tests: One test every 2,500 square feet or portion thereof, at locations directed by Engineer.

END OF SECTION

SECTION 32 31 13

CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fence framework, fabric, and accessories.
2. Excavation for post bases.
3. Concrete foundation for posts.
4. Manual gates and related hardware.
5. Removal, relocation, salvage, and/or reconstruction of existing fence.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Fencing:

1. Basis of Measurement: By linear foot to fence height specified, based on specified post spacing.
2. Basis of Payment: Includes posts, rails, tension wire, fabric, gates, hardware, accessories, and attachments.

1.3 REFERENCES

A. ASTM International:

1. ASTM A121 - Standard Specification for Zinc-Coated (Galvanized) Steel Barbed Wire.
2. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
4. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.
5. ASTM A491 - Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric.
6. ASTM A585 - Standard Specification for Aluminum-Coated Steel Barbed Wire.
7. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
8. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
9. ASTM B429 - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.

10. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
11. ASTM F567 - Standard Practice for Installation of Chain-Link Fence.
12. ASTM F668 - Standard Specification for Poly (Vinyl Chloride) (PVC)-Coated Steel Chain Link Fence Fabric.
13. ASTM F900 - Standard Specification for Industrial and Commercial Swing Gates.
14. ASTM F934 - Standard Specification for Standard Colors for Polymer-Coated Chain Link Fence Materials.
15. ASTM F1043 - Standard Specification for Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework.
16. ASTM F1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.
17. ASTM F1184 - Standard Specification for Industrial and Commercial Horizontal Slide Gates.

B. Chain Link Fence Manufacturers Institute:

1. CLFMI - Product Manual.

1.4 SYSTEM DESCRIPTION

A. Fence Height: 8 feet nominal.

B. Line Post Spacing: At intervals not exceeding 10 feet.

C. Personnel Gates: 3 ft.

D. Vehicle Gates: 20 ft double-swing, consisting of two (2) 10 ft swinging sections.

1.5 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, gates, and schedule of components.

C. Product Data: Submit data on fabric, posts, accessories, fittings and hardware.

1.6 CLOSEOUT SUBMITTALS

A. Section 01 00 00 - Execution Requirements: Closeout procedures.

B. Project Record Documents: Accurately record actual locations of property perimeter posts relative to property lines and easements.

C. Operation and Maintenance Data: Procedures for submittals.

1.7 QUALITY ASSURANCE

A. Supply material in accordance with CLFMI - Product Manual.

B. Perform installation in accordance with ASTM F567.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing work of this section with minimum three years documented experience.

1.9 DELIVERY, STORAGE AND HANDLING

A. Section 01 00 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Deliver fence fabric and accessories in packed cartons or firmly tied rolls.

C. Identify each package with manufacturer's name.

D. Store fence fabric and accessories in secure and dry place.

PART 2 PRODUCTS

2.1 MATERIALS

A. Framing Steel: ASTM F1083 Schedule 40 galvanized steel pipe, welded construction; coating conforming to ASTM F1043 Type A on pipe exterior and interior.

B. Fabric Wire Steel: ASTM A392 zinc coated wire fabric.

C. Barbed Wire: ASTM A121 galvanized steel or ASTM A585 aluminum coated steel; 12 gage thick wire, 3 strands, and 4-point 14 gage barbs at approximately 5 inches on-center.

D. Concrete: 3,000 psi concrete.

2.2 COMPONENTS

A. Line Posts: 2.38-inch diameter.

B. Corner and Terminal Posts: 2.88 inch.

C. Gate Posts: 4.0-inch diameter.

D. Horizontal Rail: 1.66-inch diameter, plain end, sleeve coupled.

E. Gate Frame: 1.66-inch diameter for fittings and truss rod fabrication.

F. Fabric: 2-inch diamond-mesh interwoven wire, 9-gauge thick, top salvage twisted tight, bottom selvage knuckle end closed.

G. Tension Wire: 7 gauge thick steel, single strand, galvanized.

H. Tie Wire: Aluminum alloy steel wire.

2.3 ACCESSORIES

A. Caps: Cast steel, pressed steel, or malleable iron; galvanized, sized to post diameter, set screw retainer.

B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; galvanized steel.

C. Extension Arms: Galvanized cast steel or pressed steel, to accommodate 3 strands of barbed wire, single arm, sloped to 45 degrees.

D. Gate Hardware: Center gate stop and drop rod; two 180-degree gate hinges for each leaf.

2.4 GATES

A. General:

1. Gate Types, Opening Widths and Directions of Operation: As indicated on Drawings or by Engineer in the field.

2. Factory-assembled gates.

3. Design gates for operation by one person.

B. Swing Gates:

1. Fabricate gates to permit 180-degree swing.

2. Gates Construction: ASTM F900 with welded corners. Use of corner fittings is not permitted.

3. Gate center stop: Mushroom type, galvanized cast iron, 1 3/8” slot, 4” long anchor

2.5 FINISHES

A. Components and Fabric: Galvanized to ASTM A123/A123M; ASTM A153/A153M for components; ASTM A392 for fabric; 2.0 oz/sq ft coating.

B. Hardware: Galvanized to ASTM A153/A153M, 2.0 oz/sq ft coating.

C. Accessories: Same finish as framing.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install framework, fabric, accessories and gates in accordance with ASTM F567.

B. Set intermediate, terminal, and gateposts plumb, in concrete footings with top of footing 1 inch above finish grade of base course and 1 inch below top of gravel. Slope top of concrete for water runoff.

C. Line Post Footing Depth below Finish Grade: ASTM F567.

D. Corner, Gate and Terminal Post Footing Depth below Finish Grade: ASTM F567.

E. Brace each gate and corner post to adjacent line post with horizontal center brace rail and diagonal truss rods. Install brace rail one bay from end and gateposts.

F. Install top rail through line post tops and splice with 6-inch long rail sleeves.

G. Install center and bottom brace rail on corner gate leaves.

H. Place fabric on outside of posts and rails.

I. Do not stretch fabric until concrete foundation has cured 7 days.

J. Stretch fabric between terminal posts or at intervals of 100 feet maximum, whichever is less.

K. Position bottom of fabric 1 inch above finished base course grade.

L. Ensure final grade of gravel is 1 inch above bottom of fence material, leaving the fence fabric embedded 1 inch into the 2-inch thick gravel layer.

M. Fasten fabric to top rail, line posts, braces, and bottom tension wire with tie wire at maximum 15 inches on centers.

N. Attach fabric to end, corner, and gateposts with tension bars and tension bar clips.

O. Install bottom tension wire stretched taut between terminal posts.

P. Install support arms sloped outward and attach barbed wire; tension and secure, with barbed wire installed with lowest strand not less than 8 feet from ground level.

Q. Support gates from gateposts. Do not attach hinged side of gate from building wall.

R. Install gate with fabric and barbed wire overhang to match fence. Install three hinges on each gate leaf.

S. Provide concrete center drop to footing depth and drop rod retainers at center of double gate openings, if double gates are called for on the Drawings.

1. Use mushroom-type gate center stop, set in concrete.

T. Install posts with 6 inches maximum clear opening from end posts to buildings, fences and other structures.

U. Excavate holes for posts to diameter and spacing indicated on Drawings without disturbing underlying materials.

V. Center and align posts. Place concrete around posts, and vibrate or tamp for consolidation. Verify vertical and top alignment of posts and make necessary corrections.

W. Extend concrete footings 2 inches above grade, and trowel, forming crown to shed water.

X. Allow footings to cure minimum 7 days before installing fabric and other materials attached to posts.

3.2 REMOVING EXISTING FENCE

A. All existing fences to be removed shall be recorded photographically or by video prior to removal or modification, to document pre-existing condition.

B. Existing fences requiring removal and reconstruction shall be rebuilt to the same condition as the original fence or better.

C. The materials in existing fences to be removed and rebuilt shall be salvaged and incorporated in the rebuilt fences. Fence materials damaged beyond reuse during removal or handling must be replaced at no additional expense to the Owner.

D. The costs associated with the removal and rebuilding of existing fences at the original location is considered incidental to the construction of the utility. If the fence is relocated as instructed by the Engineer, a separate bid item will be included in the Bid Schedule.

E. Existing fence materials to be removed that will not be reused within the project shall be provided to the Owner at a location within the project area specified by the Owner. Contractor shall take reasonable care to avoid damage to removed materials, so that the Owner may reuse such materials at another location. Costs to transport and reinstall removed materials outside the project area shall be borne by the Owner.

F. Posts shall be firmly reset to the line shown on the Drawings, or as directed by the Engineer. The spacing of the posts and the material to be strung and secured to the posts is to be the same as the original fence.

G. New tie material or staples must be used to fasten the fence material to the posts.

3.3 ERECTION TOLERANCES

A. Section 01 00 00 - Quality Requirements: Tolerances.

B. Maximum Variation From Plumb: 1/4 inch.

C. Maximum Offset From Indicated Position: 1 inch.

D. Minimum distance from property line: 6 inches.

END OF SECTION

SECTION 32 92 19

SEEDING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Preparation of subsoil.
2. Placing topsoil.
3. Seeding, Hydroseeding, Seed Drilling.
4. Seed Protection, Mulching
5. Maintenance.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Grassed Areas:

1. Basis of Measurement: Lump sum
2. Basis of Payment: Includes preparation of subsoil, topsoil, placing topsoil, seeding, watering and maintenance to specified time limit.

1.3 REFERENCES

A. Federal Specifications:

1. OF-241 - Fertilizers, Mixed, Commercial.

B. ASTM International:

1. ASTM C602 - Standard Specification for Agricultural Liming Materials.

1.4 DEFINITIONS

A. Weeds: Vegetative species other than specified species to be established in given area.

B. NNAD: Navajo Nation Department of Agriculture

1.5 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data for seed mix, fertilizer, and other accessories.

1.6 QUALITY ASSURANCE

A. Provide seed mixture in containers showing percentage of seed mix, germination percentage, inert matter percentage, weed percentage, year of production, net weight, date of packaging, and location of packaging.

B. Perform Work in accordance with Navajo Nation Department of Agriculture standards.

C. Seed mixtures must be certified. There shall be no primary or secondary noxious weeds in the seed mixtures.

D. Temporary Best Management Practices (BMPs) must be installed along areas where sediment is being transported out of the construction area. Fiber rolls (mulch socks) rip rap blankets, rip rap check dams, soil cement, soil berms, surface roughening, or other appropriate BMPs shall be used in these areas. Such BMPs shall be included in the Storm Water Pollution Prevention Plan (SWPPP) provided and implemented by the Contractor.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Product storage and handling requirements shall be as specified in applicable sections of these Specifications and in accordance with recommendations of the supplier.

B. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable.

C. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

1.8 COORDINATION

A. Section 01 00 00 - Administrative Requirements: Requirements for coordination.

B. Contractor is advised that there are three seed mixtures included in the appendices. Selection of specific mixture will depend on existing vegetation and soil type at each location. Contractor shall coordinate with Engineer prior to purchasing seed to determine exactly where to use each seed mixture.

C. Contractor shall coordinate seeding dates to coincide with the dates stipulated in the NNAD re-vegetation requirements and stipulations.

1. Contractor shall indicate exact proposed re-seeding dates in project schedule, and shall notify the Engineer as early as possible of any deviations from this proposed seeding schedule.

1.9 MAINTENANCE SERVICE

A. Section 01 00 00 - Execution Requirements: Requirements for maintenance service.

B. The cover will be maintained by occasional mowing, spot spraying, reseeding weak areas, or by controlled burns. Maintain seeded areas for three months from Date of Substantial Completion. Maintenance shall include weekly watering.

C. After the first full season of growth (not the first year) the cover should be mowed or grazed to control annual weeds to encourage good growth. Timing of mowing should avoid nesting times of birds (indicated in Environmental Requirements, Appendix C).

PART 2 PRODUCTS

2.1 SEED MIXTURE

A. Furnish materials in accordance with Navajo Nation Department of Agriculture standards. Refer to seed mixtures provided in Appendix C.

B. Engineer, in consultation with NNAD, shall determine which seed mixture applies at each location within the project. Contractor is responsible to coordinate with Engineer to determine proper seed mix prior to purchasing seed.

C. In developing seed mixtures, the percentage of each included species should first be determined. This percentage, which should total 100, is then multiplied by the recommended seeding rate for the concerned species. This will give the required pounds PLS for that species in the mix.

2.2 SOIL MATERIALS

A. Topsoil: Excavated from site and free of weeds.

2.3 ACCESSORIES

A. Water: Clean, fresh and free of substances or matter capable of inhibiting vigorous growth of grass.

B. Erosion Fabric: Jute matting, open weave.

C. Herbicide: If required, Owner and Engineer's approval must be obtained prior to use.

D. Stakes: Softwood lumber, chisel pointed.

E. String: Inorganic fiber.

PART 3 EXECUTION

3.1 GENERAL

A. Prepare and restore site per applicable NNAD, included in Appendix C to the Contract Documents.

B. Seed and reclaim all disturbed areas, including temporary construction easements and any areas disturbed by construction traffic.

C. Temporary fence gates along the pipeline and access alignments must be kept closed to manage the livestock in the and pipeline and access area.

3.2 EXAMINATION

A. Verify prepared soil base is ready to receive the Work of this section.

3.3 PREPARATION OF SUBSOIL

A. Prepare sub-soil to eliminate uneven areas and low spots. Maintain lines, levels, profiles and contours. Make changes in grade gradual. Blend slopes into level areas. The heel of a boot should not sink in more than ½ to 1 inch.

B. Remove foreign materials, weeds and undesirable plants and their roots. Remove contaminated sub-soil.

C. Topsoil removed from the right-of-way must not be mixed with sagebrush debris which may impede seed germination during the revegetation process.

D. In areas needing reseeding, the top layer of soil shall be softened by ripping and disking prior to seeding to create the soil structure necessary to allow for seed germination.

E. Scarify subsoil to depth of 6 inches where topsoil is to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted sub-soil.

3.4 PLACING TOPSOIL

A. Spread topsoil to minimum depth of 6 inches over area to be seeded. Rake until smooth.

B. Place topsoil during dry weather and on dry unfrozen subgrade.

C. Remove vegetable matter and foreign non-organic material from topsoil while spreading.

D. Grade topsoil to eliminate rough, low or soft areas, and to ensure positive drainage.

3.5 SEEDING

A. Use seed mixture indicated by Engineer, based on land ownership and native vegetation.

B. Apply seed at rates specified by NNAD. Use seed drill followed by drag packer over area to incorporate seed approximately ½ inch deep.

C. Planting Season: See Article 1.8. of this Section.

D. Do not sow immediately following rain, when ground is too dry, or when winds are over 12 mph.

E. Seed placement rows on steep slopes should not be placed parallel to the down slope, but at angles to the down slope to prevent the formation of gullies and rills.

F. A seed drill followed by a drag packer shall be required unless specific exceptions are authorized in writing by the Engineer.

G. Some hand seeding may be needed along steep slopes where equipment is difficult to use.

H. Apply water with a fine spray immediately after each area has been seeded. Saturate to 4 inches of soil.

3.6 HYDROSEEDING

A. Hydroseeding shall only be allowed where it is physically unfeasible to seed drill.

B. Hydroseeding shall not be performed without prior written authorization by the Engineer.

C. Apply fertilizer and seeded slurry with hydraulic seeder at an approved rate evenly in one pass.

D. After application, apply water with fine spray immediately after each area has been hydroseeded. Saturate to 4 inches of soil and maintain moisture levels two to four inches.

E. If hydroseeding is used, the specified rates of seed application shall be doubled.

3.7 SEED PROTECTION

A. Cover seeded slopes where grade is 3:1 or greater with erosion fabric. Roll fabric onto slopes without stretching or pulling.

1. All slopes around the perimeters of tank and pump station sites shall be covered with erosion fabric, regardless of grade.

B. Lay fabric smoothly on surface, bury top end of each section in 6 inch deep excavated topsoil trench. Overlap edges and ends of adjacent rolls minimum 12 inches. Backfill trench and rake smooth, level with adjacent soil.

C. Secure outside edges and overlaps at 36 inch intervals with stakes.

D. Lightly dress slopes with topsoil to ensure close contact between fabric and soil.

E. At sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges minimum 6 inches.

F. Protection of seeded areas from traffic: Contractor shall take measures as required by the Owner, Engineer, and/or land controlling agencies to prevent traffic on re-seeded areas. Such measures may include warning signs, fence post barricades, earthen berms, and/or other measures at intersections of seeded ROW and existing roadways and driveways, and at other locations as directed by Engineer. Earthen berms shall extend the full width of the disturbed area, with dimensions as directed in field by Engineer.

3.8 MULCHING

A. Do not apply mulch on Tribal lands.

3.9 MAINTENANCE

A. Immediately reseed areas showing bare spots.

B. Repair washouts or gullies.

C. Protect seeded areas with warning signs during maintenance period.

3.10 SCHEDULE

A. All utility routes, disturbed areas, vault areas, and non-traveled areas in road rights-of-way to be reseeded when Work is completed in affected areas.

END OF SECTION

SECTION 33 11 00

WATER UTILITY DISTRIBUTION PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Pipe and fittings for public line including potable water line.
2. Tapping Sleeves and Tees.
3. Underground and Aboveground Pipe Markers.
4. Bedding and Cover Materials.

B. Related Sections:
1. Section 03 30 00 - Cast-in-Place Concrete: Concrete materials.
2. Section 31 23 17 - Trenching: Execution requirements for trenching.
3. Section 31 23 23 - Backfill: Requirements for backfill to be placed.
4. Section 33 12 16 - Water Utility Distribution Valves.
5. Section 33 13 00 - Disinfection of Water Utility Distribution.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Pipe and Fittings:

1. Basis of Measurement: By the linear foot.

2. Basis of Payment: Includes hand trimming, excavation, trenching, piping and fittings, all valves and appurtenances not listed separately on the Bid Form, bedding, backfill, compaction, tracer wire, detectable warning tape, above ground pipe marker posts, concrete thrust restraints (where applicable), mechanical joint restraints, connection to public utility water source (if not separately listed on Bid Form). Special excavation methods for trenching in rock or hard soils, rock removal and disposal, and/or imported bedding material, if required to meet the project specifications, shall be considered incidental to the cost of the pipe installation. Soil cement, if used, shall be considered incidental to the cost of the pipe installation.

3. The cost of work associated with hydrostatic pressure testing for main pipeline shall be paid via a separate bid item. The cost of work associated with hydrostatic pressure testing for all other facilities for which a separate bid item is not provided shall be considered incidental to their respective bid items.

4. The cost of work associated with disinfection and bacteriological testing for main pipeline shall be paid via a separate bid item. The cost of Contractor's work associated with disinfection and bacteriological testing for all other facilities for which a separate bid item is not provided shall be considered incidental to their respective bid items.

a. Laboratory costs associated with bacteriological testing shall be considered incidental, and are not eligible for reimbursement under the testing allowance.

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO):
1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. American Society of Mechanical Engineers (ASME):
1. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.

C. American Society for Testing and Materials International (ASTM):
1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
2. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
4. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
5. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
6. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
7. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
8. ASTM D2487 - Classifications of Soils for Engineering Purposes (Unified Soil Classification System).
9. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
10. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
11. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
12. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
13. ASTM F714 - Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
14. ASTM F2164 - Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure.
15. ASTM F2620 - Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings.
16. ASTM F2634 - Standard Test Method for Laboratory Testing of Polyethylene (PE) Butt Fusion Joints using Tensile-Impact Method.

D. American Water Works Association (AWWA):
1. AWWA C104 - ANSI Standard for Cement Mortar Lining for Ductile-Iron Pipe and Fittings for Water.

2. AWWA C105 - ANSI Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
3. AWWA C110 - ANSI Standard for Ductile-Iron and Gray-Iron Fittings, 3 In. through 48 In. (76 mm through 1,219 mm), for Water.
4. AWWA C111 - ANSI Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
5. AWWA C115 - ANSI Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
6. AWWA C116 - ANSI Standard for Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service.
7. AWWA C151 - ANSI Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids.
8. AWWA C153 - ANSI Standard for Ductile-Iron Compact Fittings for Water Service.
9. AWWA C200 - Steel Water Pipe 6 In. (150 mm) and Larger.
10. AWWA C205 - Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 In. and Larger - Shop Applied.
11. AWWA C206 - Field Welding of Steel Water Pipe.
12. AWWA C207 - Steel Pipe Flanges for Waterworks Service - Sizes 4 In. through 144 In. (100 mm through 3,600 mm).
13. AWWA C208 - Dimensions for Fabricated Steel Water Pipe Fittings.
14. AWWA C209 - Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
15. AWWA C213 - Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
16. AWWA C600 - Installation of Ductile-Iron Water Mains and their Appurtenances.
17. AWWA C605 - Underground Installation of Polyvinyl Chloride PVC Pressure Pipe and Fittings for Water.
18. AWWA C606 - Grooved and Shouldered Joints.
19. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. through 12 In. (100 mm through 300 mm), for Water Distribution.
20. AWWA C901 - Polyethylene Pressure Pipe and Tubing, 1/2 In. through 3 In. (13 mm through 76 mm), for Water Service.
21. AWWA C905 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. through 48 In. (350 mm through 1,200 mm), for Water Transmission and Distribution.
22. AWWA C906 - Polyethylene Pressure Pipe and Fittings, 4 In. through 63 In. (100 mm through 1,575 mm), for Water Distribution and Transmission).

E. Manufacturer's Standardization Society of the Valve and Fittings Industry:
1. MSS SP-60 - Connecting Flange Joint between Tapping Sleeves and Tapping Valves.

F. National Fire Protection Agency
1. NFPA 24 - Standard for the Installation of Private Fire Service Mains and Their Appurtenances.

G. National Sanitation Foundation (NSF):

1. NSF-14 - Plastics Piping System Components and Related Materials
2. NSF-61 - Drinking Water System Components-Health Effects

H. New Mexico Standard Specifications for Public Works Construction (NMSSPWC):
1. NMSSPWC Sections 701, 801 & 802 “Trenching, Excavation and Backfill”.

I. Plastic Pipe Institute (PPI):
1. TR-33 - Generic Butt Fusion Joining Procedure for Field Joining of Polyethylene Pipe.

J. American Welding Society (AWS):
1. AWS D1.1 - Structural Welding Code

1.4 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data on pipe materials, pipe fittings and accessories, and testing equipment.

C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

D. Testing Plan: Contractor must submit proposed testing procedure specific to the project, including identifying filling locations, and equipment to be employed for hydrostatic testing of lines, as well as continuity testing for tracer wire, for approval by Engineer.

E. Contractor shall submit a joint restraint table for all types of restrained joints to be used for the project based on the manufacturer’s specifications and calculations.

F. Submittal for all coatings which demonstrate compliance with relevant AWWA and NACE standards.

G. As-built drawings and any Contractor-provided survey data. Refer to Sections 01 00 00 – Basic Requirements.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 00 00 - Execution Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations of piping mains, connections, thrust restraints, and invert elevations.

C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with these specifications, as well as the most recent edition of New Mexico Standard Specifications for Public Works Construction.

B. All piping, fittings, valves, hydrants and any other potable water system appurtenances shall comply with the "Reduction of Lead in Drinking Water Act", in effect as of 2014, or any subsequent revision thereof.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01 00 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Block individual and stockpiled pipe lengths to prevent moving.

C. Do not place pipe or pipe materials on private property without prior authorization, or in areas obstructing pedestrian or vehicular traffic.

D. Store PVC materials out of sunlight. Contractor shall, at Contractor's expense, provide and maintain tarps, temporary shelters, or other such measures as necessary to protect PVC materials from sunlight. Such tarps or shelters must be adequately vented to prevent excess heat accumulation

1. Any PVC materials judged by the Engineer to be sun-damaged, including tan to brown discoloration, blistering, roughening or cracking of surface, or embrittlement, prior to installation shall be rejected.

E. Coated pipe shall be shipped on bunks and secured with nylon belt tie down straps or padded banding over braces, and shall be stored on padded skids or other suitable means to prevent damage to coating.

F. Coated pipe and other components shall be handled with wide belt slings, padded forks or other means to prevent damage to coating. Chains, cables or other equipment likely to damage coating or pipe shall not be used.

G. PVC pipe shall be bundled or stacked throughout the shipping, storage and handling process in accordance with AWWA M23 and pipe supplier's recommendations, whichever is most stringent. Excessive bundling or stacking that results in bends, kinks, gashes or uncorrectable ovality shall be rejected. Transport and handle pipe in accordance with AWWAM23 and pipe supplier's recommendations, whichever is most stringent. Off-loading devices such as chains, wire rope, chokers, or other pipe handling implements that may scratch, nick, cut, or gouge the pipe are strictly prohibited.

1. Any pipe showing a crack or which has received a blow that may have caused an incident fracture, even though no fracture can be seen, shall be rejected.

2. Any pipe with a scratch or gouge greater than 10% of the wall thickness will be rejected.

H. Prior to shipment and again prior to installation, all materials shall be visually inspected for damage, including coatings and surfaces. Any damaged materials shall be repaired to original standards or replaced.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.1 WATER PIPING AND FITTINGS

A. Polyvinyl Chloride (PVC):

1. All PVC pipe, whether jointed or fusible, shall conform to AWWA C900 and AWWA C905, on all PVC pipe 4" diameter and greater, and ASTM D1785, Schedule 80, on all PVC pipe less than 4" diameter. Testing shall be in accordance with the referenced AWWA standard for all pipe types.
2. All piping shall be made from PVC compound conforming to cell classification 12454 per ASTM D1784.
3. Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or other visible deleterious faults.
4. Pipe shall be blue in color for potable water use.
5. Nominal laying length:
    a. Jointed PVC pipe: 20 feet.
6. Gasketed Joints:
    a. Joints per ASTM D3139.
    b. Use rubber gaskets manufactured and tested in accordance with ASTM F477.
    c. For all PVC at petroleum line crossings or where otherwise indicated on Drawings, use petroleum-resistant gaskets in accordance with ASTM F477 or fusible PVC pipe joints.
7. Fittings:
    a. Ductile iron on all PVC pipe 4" diameter and greater.
        1) Refer to specifications for ductile iron fittings in this section, below.
    b. All PVC pipe and fittings less than 4" diameter shall be solvent welded Schedule 80.
    c. Solvent-weld joints are not permitted on pipe 4" diameter and greater.
8. Mechanical Joint Restraints:
    a. Refer to specifications for ductile iron joint restraints in this section, below.
9. Mechanical bell harnesses:
    a. Refer to specifications for ductile iron bell restraint harnesses in this section, below.

B. Ductile Iron Pipe, Joints, and Fittings:

1. Manufacturers:
    a. US Pipe

b. American Pipe

c. Substitutions: Approved Equal

2. Ductile iron pipe:

a. Pipe Class: AWWA C151, for nominal thickness, rated water working pressure and maximum depth of cover.

b. 350 psi working pressure.

c. Cement Mortar Lining: AWWA C104, standard thickness.

d. Exterior coating:

1) Buried service (site piping only, excluding chlorination building): Bituminous coating, per AWWA C151.

2) Inside and underneath chlorination building: TNEMEC N140 Pota-Pox Plus, rated for use in corrosive environments.

3. Fittings: Ductile iron.

a. Compact MJ fittings conforming to AWWA C153 or AWWA C110, unless otherwise noted on Drawings.

b. Flanged fittings shall conform to AWWA C110. Do not use flanged fittings for buried installations unless otherwise noted on Drawings.

1) Contractor responsible to ensure that all mating flanges have compatible diameters, bolt sizes and drill patterns. Overdrill bolt holes as necessary, provided such overdrlling is within manufacturer's recommended tolerances.

c. Pressure rating of joints, fittings and gaskets shall be at least 350 psi, unless otherwise noted on the Drawings.

d. Pressure rating of flanged fittings and gaskets shall at least match that of the attached pipe, unless otherwise noted on the Drawings.

e. Marked with pressure rating, nominal diameter of opening, manufacturers' identification, country where cast, and degree of bend.

f. Coatings:
1) Bituminous Coating: AWWA C110.
2) Cement Mortar Lining: AWWA C104, standard thickness.

g. Provide sacrificial anode cathodic protection where indicated in this Section.

4. Joints:

a. Mechanical and Push-On Joints: AWWA C111.

b. Flanged Joints: AWWA C115; ASME B16.1.

5. Mechanical Joint Restraints:

a. Mechanical joint restraints for all fittings and appurtenances, unless otherwise noted on Drawings.

b. Mechanical joint restraints shall be Star, "EBAA Iron, Megalug®" Series 2000PV, 2200, Smith-Blair Cam-Lock, or approved equal, for all pipe 4" diameter and greater.

c. Wedge assemblies and glands shall be fusion bonded epoxy coating in accordance with AWWA C116 or Mega-Bond coated, interior and exterior

d. Provide sacrificial anode cathodic protection where indicated in this Section.

e. Stainless steel 304 bolts, nuts and washers for all buried applications, provided by manufacturer especially for use with their respective components. If fitting manufacturer cannot supply stainless steel bolts contractor may provide bolts from another source; however, contractor is solely responsible to ensure fit and compatibility of said bolts.

6. Mechanical Bell Restraint Harnesses:

a. Mechanical bell restraint harnesses shall be used to obtain required restraint lengths noted on Drawings.

b. Mechanical joint restraints shall be Star, "EBAA Iron, Megalug®" Series 1700 for Ductile Iron or 1900 or 2800 for PVC, or approved equal, for all pipe 4" diameter and greater.

c. Wedge assemblies and glands shall be fusion bonded epoxy coating in accordance with AWWA C116 or Mega-Bond coated, interior and exterior

d. Stainless steel 304 bolts, nuts and washers for all buried applications, provided by manufacturer especially for use with their respective components. If fitting manufacturer cannot supply stainless steel bolts contractor may provide bolts from another source; however, contractor is solely responsible to ensure fit and compatibility of said bolts.

7. Flanges:

a. Ductile or Cast Iron: ANSI/AWWA C110/A21.10 / ANSI B16.1, Class 125, unless otherwise noted on Drawings.

b. Pressure rating of flanges and gaskets shall meet or exceed surge pressure rating of attached pipe.

c. Coatings and linings shall be continuous to the ends of pipe and backs of flanges.

d. Do not apply coatings to mating surfaces of flanges.

e. Gaskets shall be rubber annular ring flange gasket in accordance with AWWA C115. Installation according to manufacturer's recommendations.

f. All bolts, nuts and washers shall be stainless steel 304, unless otherwise noted. All bolts shall be provided by manufacturer especially for use with their respective fittings. If manufacturer cannot supply stainless steel bolts, Contractor may provide bolts from another source; however, Contractor is solely responsible to ensure fit and compatibility of bolts.

g. Bolt shall be long enough to protrude through the assembled nut at least two threads but not more than ½-inch.

h. Contractor is responsible to ensure that all pipe flanges that connect to valve body flanges have the same dimensions, drill pattern, bolt hole diameter and equal or higher pressure rating as the valves to which they are connected.

1) Overdrill bolt holes as necessary, provided such overdrlling is within manufacturer's recommended tolerances.

i. Contractor shall be responsible to verify compatibility of all flange bolt patterns prior to purchasing materials and shall notify the Engineer in the event that alternate bolt patterns are required to mate flanges.

8. Jackets:

a. AWWA C105 polyethylene jacket, Installation Method "A".

b. Double-wrap all ductile iron components.
1) Inner PE jacket shall be V-Bio enhanced, minimum thickness: 8 mil
2) Outer PE jacket shall be standard polyethylene, minimum thickness: 8 mil

c. Secure PE jackets with ultra-high molecular weight (UHMW) polyethylene film tape, 10 mil thickness.

1) Do not use duct tape to tape the PE jackets.

C. Polyethylene Pipe: AWWA C901 and ASTM D3035 for sizes up to 3" diameter; AWWA C906 and ASTM F714 for sizes 4" diameter and above.

1. Each production lot of pipe shall be tested for melt index, density, percent carbon, dimensions and ring tensile strength.

2. Polyethylene pipe and fittings shall be PE4710 high-density polyethylene meeting ASTM D3350 cell classification 44547C. The material shall be listed and approved for potable water in accordance with NSF Standard 61.

3. Four permanent co-extruded, equally spaced, blue color stripes in outside surface of pipe.

4. Molded fittings in accordance with ASTM D3261, and tested in accordance with AWWA C906.

5. Fabricated fittings shall be made by heat fusion joining specially machined shapes cut from pipe, polyethylene sheet stock or molded fittings; rated for internal pressure service at least equal to the full service pressure rating of the mating pipe; and tested in accordance with AWWA C906.

6. Polyethylene flange adapters made with sufficient through-bore to be clamped in a butt fusion-joining machine without use of a stub-end holder, as per pipe manufacturer's instructions.

7. All HDPE fabricated MJ adapters shall have steel stiffeners.

8. HDPE pipe and fittings shall have a working pressure (as set forth in ASTM F714) of not less than 200 psi for DR 11, not less than 160 psi for DR 13.5, not less than 138 psi for DR 15.5, and not less than 125 psi for DR 17, with a recurring surge pressure allowance (total pressure) of 1.50 times working pressure and occasional surge allowance (total pressure) of 2.00 times working pressure (surge allowances shall be based on AWWA C906 and/or AWWA M55).
9. Nominal sizes indicated on Drawings for both pipe and fittings denote iron pipe size (IPS) unless otherwise noted.
10. All HDPE pipe and fittings shall be manufactured of PPI listed materials.
11. Pre-fabricated HDPE mitered bends and other fittings shall have internal weld bead completely removed prior to installation, using approved method for weld bead removal.

D. Steel Pipe and Fittings:

1. Pipe fabrication:
    a. For pipe 26" diameter and greater, fabricate arc-welded spiral seam steel pipe: ASTM A139, Grade B, C, D or E. For pipe 26" diameter or less, fabricate pipe per ASTM A-53 B.
    b. Fabricated in accordance with AWWA C200, except:
        1) Steel plate: ASTM A283, Grade C or D, or ASTM A36.
        2) Steel sheet: ASTM A1011, Designation SS, Grade 40, 45 or 50; or ASTM A1018, Designation SS, Grade 40.
        3) Standard wall thickness, unless otherwise indicated on Drawings.
2. Fittings and Special Sections:
    a. Steel for fittings: ASTM A283, Grade C or D, or ASTM A36 for carbon steel.
    b. Welding: Per AWS D1.1. All welding must be completed prior to application of lining and coatings, unless otherwise permitted by the Engineer. In no case shall any welding damage lining or coatings.
    c. Dimensions in accordance with AWWA C208.
    d. Custom fabricated fittings shall be designed and fabricated in accordance with AWWA M11, with outlet reinforcements per AWWA M11. All other standards and specifications for steel, welds, coatings, flanges and dimensions of component fittings provided herein shall apply equally to custom fabricated fittings.
    e. No custom-made fittings shall be used without prior written approval by the Engineer.
3. Coatings: Interior and exterior surfaces of all non-stainless steel pipe and fittings shall be coated as follows:
    a. Galvanized
    b. All coatings shall be NSF 61-approved.

c. All surfaces shall be ground smooth. All weld splatter and other defects shall be removed prior to blasting.

d. Surface preparation shall conform to SSPC-SP5 White Blast Clean with surface profile of 2.0 to 3.0 mils.

e. Coating thickness for both interior and exterior per manufacturer's recommended maximum thickness.

f. All wetted surfaces of pipe interior shall be coated. All exposed surfaces of pipe exterior shall be coated.

g. Do not apply coating to mating surfaces of flanges.

h. Typical water temperature: Less than 140 degrees Fahrenheit.

i. Road crossing casings:
   1) Open cut casings shall be coated in bituminous paint.

4. Additional Coatings:

   a. Exterior surfaces of all buried non-stainless steel pipe and welded fittings shall include cold-applied tape coating, manufactured and installed in accordance with AWWA C209, applied with a minimum overlap width of 1-inch and a total coating thickness shall be a minimum of 80 mils. Such tape coating shall be applied in addition to fusion-bonded epoxy coatings specified above.

5. Flanges:

   a. Steel: ANSI Class 150 / AWWA C207 Class E / ASME B16.5 Class 150, unless otherwise noted on Drawings.

   b. Pressure rating of flanges and gaskets shall meet or exceed surge pressure rating of attached pipe.

   c. Coatings and linings shall be continuous to the ends of pipe and backs of flanges.

   d. Do not apply coatings to mating surfaces of flanges.

   e. Gaskets shall be ring-type, per AWWA C207, unless the flanged connection is between PVC and steel, in which case full face type gaskets with outer diameter equal to that of the flange shall be used.

   f. Retainers shall be fabricated of phenolic or other suitable material as recommended by manufacturer and conforming to NSF 61, with minimum thickness of 1/8 inch and minimum dielectric strength of 500 volts/mil.

   g. Nitrile sealing rings.

   h. Steel washers shall be 1/8-inch thick.

   i. All bolts, nuts and washers shall be stainless steel 304, unless otherwise noted. All bolts shall be provided by manufacturer especially for use with their respective fittings. If manufacturer cannot supply stainless steel bolts, Contractor may provide bolts from another source; however, Contractor is solely responsible to ensure fit and compatibility of said bolts.

j. Bolt shall be long enough to protrude through the assembled nut at least two threads but not more than ½-inch.

k. Contractor is responsible to ensure that all pipe flanges that connect to valve body flanges have the same dimensions, drill pattern, bolt hole diameter and equal or higher pressure rating as the valves to which they are connected.

1) Overdrill bolt holes as necessary, provided such overdrlling is within manufacturer's recommended tolerances.

l. Contractor shall be responsible to verify compatibility of all flange bolt patterns prior to purchasing materials and shall notify the Engineer in the event that alternate bolt patterns are required to mate flanges.

6. Field Welding Materials:

a. Pipe: AWWA C206.

7. Stainless Steel Pipe and Fittings

a. Use where called-out on Drawings as Stainless Steel

b. Stainless Steel 304

c. Pressure rating: Not less than 350 psi Cold Working Pressure

2.2 TAPPING SLEEVES, TEES AND VALVES

A. Tapping Sleeves and Saddles:

1. Manufacturers:

a. Mueller Co.

b. Kennedy Valve Co.

c. Romac Industries, Inc

d. JCM Industries

e. Ford Meter Box Company, Inc

f. Smith-Blair, Inc

g. Substitutions: Approved equal.

2. For taps 2-inches or smaller, use nylon coated ductile iron tapping saddles with stainless steel dual compression straps.

3. For taps larger than 2-inches, use fusion-bonded epoxy-coated steel.

4. All saddles shall be specifically designed for use on the type of piping that is being tapped.

5. All bands, straps, bolts, nuts and washers shall be SS 304. All bolts shall be provided by manufacturer especially for use with their respective components.

6. Saddle Working pressure rating: 350 psi.

7. Sleeve Working pressure rating: 250 psi

8. Tapped Outlet: FNPT as indicated on Drawings
9. All pipe taps shall be made with an engineer approved “tapping machine”.

2.3 UNDERGROUND PIPE MARKERS

A. Furnish materials in accordance with the most recent edition of New Mexico Standard Specifications for Public Works Construction, with latest revisions.

B. Tracer Wire: 12 AWG, Solid Copper, Single Conductor, 600V, UF-XHHW wire or equal, for underground installation.

C. Metal-backed detectable water marker tape: Bright colored, metallized for detection by above-ground metal detector, continuously printed, minimum 6 inches wide by 4-mil thick, manufactured for direct burial service, imprinted with "BURIED WATER SERVICE" in large letters.

2.4 ABOVE-GROUND PIPE MARKERS

A. Carsonite marker posts, blue, with Navajo Tribal Utility Authority (NTUA) decals. Decals to be specified by NTUA and provided by the Contractor. Place markers as specified on the Drawings.

2.5 PIPE SUPPORTS AND ANCHORING

A. Metal for pipe support brackets: ASTM A123/A123M, galvanized structural steel thoroughly coated with bituminous paint.

B. Metal tie rods and clamps or lugs: Galvanized steel sized in accordance with NFPA 24 thoroughly coated with bituminous paint.

2.6 BEDDING AND BACKFILL MATERIALS

A. Bedding: Fill Type as specified in Section 31 23 23.

B. Soil Backfill from Above Pipe to Finish Grade: Soil Type as specified in Section 31 23 23. Subsoil with no rocks over 6 inches in diameter, frozen earth or foreign matter.

2.7 CASING SPACERS

A. Polyethylene Casing Spacer

B. Two part or multi segmented

C. Stainless steel 304 bolts, nuts and washers. All bolts shall be provided by the fitting manufacturer especially for use with their respective components.

2.8 BOLTS AND NUTS

A. Zinc-plated or fluoropolymer coated bolts and nuts shall be used for the installation of pipelines up to 500 mm (20") diameter and shall be carbon steel conforming to ASTM A307, Grade A, unless otherwise indicated on the approved drawings. Bolts and nuts shall have standard ANSI B1.1, Class 2A coarse threads.

B. Stainless steel bolts and nuts shall be used for the installation of pipelines 600 mm (24") diameter and larger and for submerged flanges. Bolts and nuts shall be Type 316 stainless steel conforming to ASTM A193, Grade B8M for bolts, and Grade 8M for nuts.

C. All bolt heads and nuts shall be hexagonal, except where special shapes are required. Bolts shall be of such length that not less than 6.4 mm (¼") or more than 12.7 mm (½") shall project past the nut in tightened position.

2.9 ACCESSORIES

A. Concrete for Thrust Restraints: Conform to Section 03 30 00, with minimum compressive strength of 3,000 psi.

B. Steel rods, bolt, lugs and brackets
1. For applications not in contact with soil: ASTM A36/A36M or ASTM A307 carbon steel.
2. For buried applications: Stainless steel 304.

C. Field-applied Roskote coal tar epoxy coating on all buried steel bolts on all fittings and valves.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify existing utility water main size, location, and invert, are as indicated on Drawings.

3.2 PREPARATION

A. Pre-Construction Site Photos:
1. If required in the Contract Documents, take photographs or videotape along centerline of proposed pipe trench; minimum one photograph for each 50 feet of pipe trench.
2. Show mailboxes, curbing, lawns, driveways, signs, culverts, and other existing site features that may potentially be impacted by the construction work.
3. Include project description, date taken and sequential number on back of each photograph.

B. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs. Use only equipment specifically designed for pipe cutting. The use of chisels or hand saws will not be permitted. Grind edges smooth with beveled end for push-on connections.

C. Remove scale and dirt on inside and outside before assembly.

D. Prepare pipe connections to equipment with flanges or unions.

E. Excavate pipe trench in accordance with Section 31 23 17 for Work of this Section. Hand trim excavation for accurate placement of pipe to elevations indicated on Drawings.

F. Restricted Areas and Culturally Sensitive Areas:

1. Contractor shall notify Engineer prior to work within 100 feet of any restricted area as designated on the Drawings; refer to Section 01 00 00.

2. The Owner's Archaeologist will flag culturally sensitive sites as designated on the Drawings.

3. Contractor shall maintain all flags, stakes and barricades in place until the end of construction. Contractor shall notify Engineer in the event of damage or removal of said markers. Re-marking due to negligence by Contractor shall be subject to charge-backs to the Contractor.

4. No work shall be performed within 100 feet of any restricted area unless barricades and/or flags are up.

5. No work shall be performed within 100 feet of any restricted area designated on the Drawings as requiring archaeological monitoring unless the Owner's archaeologist is physically present at the site.

3.3 TRENCHING AND BACKFILL

A. Excavate trenches in accordance with Section 31 23 17, including dewatering of excavations as required, to maintain dry conditions and preserve final grades at bottom of excavation.

B. Place bedding and trench backfill material in accordance with Section 31 23 23.

3.4 INSTALLATION - PIPE

A. Install bell-and-spigot PVC pipe in accordance with AWWA C605, AWWA M23 and pipe manufacturer's instructions, whichever is most stringent.

1. Use only lubricants supplied by the pipe manufacturer and apply to both bell and spigot ends of the joint, in accordance with manufacturer's recommendations.

2. Clean the gasket, bell, groove and spigot immediately prior to connecting pipe joints.

3. Do not over-insert pipe joints. Any over-inserted pipe joints shall be removed and the pipe bell and gasket inspected for damage. Any damaged bells or gaskets shall be discarded and replaced.

4. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs. Use only equipment specifically designed for pipe cutting. The use of chisels or hand saws will not be permitted. Grind edges smooth with beveled end for push-on connections.

B. Install ductile iron piping and fittings according to AWWA C600.

1. Encase all ductile iron pipe and fittings that are not cathodically protected in polyethylene, per AWWA C105, Method "A".

a. Use two (2) separate polyethylene jackets.

1) Inner jacket: V-bio enhanced polyethylene

2) Outer jacket: standard polyethylene

b. No tears, cuts, rips or other breaks in the polyethylene encasement shall be acceptable. No dirt, water or debris inside the encasement shall be acceptable.

c. When installing ductile iron pipe floor penetrations under buildings and concrete slabs, bring both layers of polyethylene into the slab inside the roof felt isolation joint. Trim and tape the PE at the mid-point of the slab thickness (e.g. 6" below the floor for a 12" slab). Wrap the felt outside both layers of polyethylene. Trim the felt to 2" above the floor and seal with silicone.

d. When installing ductile iron floor drain lines, bring both layers of polyethylene into the slab, trim, and tape to pipe just below the inset floor drain.

e. Use only 10-mil UHMW polyethylene film to tape the PE jackets. Do not use duct tape.

2. Any damaged shop-applied coatings shall be repaired in accordance with manufacturers specification or this section for FBE coated pipes. In the event that field repair is required due to damage of shop-applied coating, Contractor shall notify Engineer prior to making the repair.

C. Install steel pipe in accordance with AWWA M11. Field weld and test steel pipe, as needed, in accordance with AWWA C206, except as follows:

1. Test field welds by ultrasonic or radiographic method, in accordance with AWS D1.1.

2. Do not field weld pipe without permission from the Engineer.

Any damaged shop-applied coatings shall be repaired in accordance with this Section. In the event that field repair is required due to damage of shop-applied coating, Contractor shall notify Engineer prior to making the repair.

D. Handle and assemble pipe in accordance with manufacturer's instructions and as indicated on Drawings. Inspect each pipe and fitting prior to lowering into trench to ensure there is no damage to the pipe, fitting or coatings. Repair any damage prior to installation. Clean ends of pipe and remove foreign material from inside of pipe and fittings.

E. Maintain 10 ft horizontal separation of water main from sewer piping in accordance with local code.

F. Lay pipe in straight line and center pipe within trench. Re-lay pipe that is out of alignment.

G. Horizontal and vertical pipe bending, angles and joint deflections

1. All ells shall be one of the following standard angles: 11.25, 22.5, 45, 60 or 90 degrees. No other ell angles shall be allowed.

2. Actual horizontal and vertical angles required in the field shall be accomplished by a combination of allowable DI ells, and/or pipe deflection (i.e. pipe bending for fused pipe or joint deflection for jointed pipe).

a. At most locations, the plan and profile sheets show horizontal bends without specifying whether the horizontal bend is to be accomplished by DI ells or joint deflection of jointed PVC pipe. At such locations, the method of bending is at Contractor's option, provided all design requirements set forth in the Drawings and Specifications are met.

b. If the Contractor chooses to use DI ells at any given location, the required length of restrained pipe must be used on both sides of the bend, whether the restraint length is shown on the plan and profile sheet, or not.

3. Lateral pipe bending forces shall be isolated from all fittings.

4. PVC pipe deflections may be made either at joints or by pipe bending, as allowed by AWWA C605.

a. For jointed PVC pipes 12-inch diameter or smaller, pipe bending shall be allowed, provided that such bending complies with AWWA C605 and/or pipe manufacturer's minimum allowable bending radius, whichever is more stringent.

b. For jointed PVC pipes 14-inch diameter or larger, deflections shall be made at the pipe joints only.

c. For all pipe diameters, jointed PVC pipe joint deflection shall not exceed 1 degree per joint.

5. Steel and ductile iron pipe deflections shall be made at joints, provided pipe manufacturer's allowable deflection limits are not exceeded.

6. Mechanical Joints: contractor to abide by manufacturer's recommended maximum allowable deflection

H. Instal HDPE pipe per AWWA C605.

1. Allow all HDPE pipe to acclimate to sub-surface soil temperature prior to connecting pipe to any fitting or appurtenance.

2. Heat Fusion Joining: Joints between plain end pipes and fitting shall be made by butt fusion. Joints between the main and saddle branch fittings shall be made using saddle fusion. Either procedure used must be recommended by the pipe and fitting manufacturer.

3. Polyethylene pipe and fittings may be joined together or to other materials by means of:
   a. Flanged connections (flange adapters and back-up rings);
   b. Mechanical coupling designed for joining polyethylene pipe or for joining polyethylene pipe to another material;
   c. MJ adapters; or
   d. Electrofusion.

4. Mechanical bolted joining may be used where the butt fusion method cannot be used. Flange joining will be accomplished by using a HDPE flange adapter with a ductile iron back-up ring. Mechanical joint joining will be accomplished using either a

molded mechanical joint adapter or an ID stiffener and restraint. Either mechanical joint joining method will have a ductile iron mechanical joint gland.

5. ID Stiffener and Restraint: A stiffener shall be installed in the bore of the polyethylene pipe when an OD compression mechanical coupling is used and when connecting plain end PE pipe to a mechanical joint pipe, fitting or appurtenance. External clamp and tie rod restraint shall be installed where PE pipe is connected to the socket of a mechanical joint pipe, fitting or appurtenance except where an MJ adapter is used.

6. Mechanical Joint and Flange Installation: Mechanical joint and flange connections shall be installed in accordance with the manufacturer's recommended procedure. MJ adapter and flanges shall be centered and aligned to the mating component before assembling and tightening bolts. In no case shall MJ gland or flange bolts be used to draw the connection into alignment.

7. Mechanical couplings shall be fully pressure rated and fully thrust restrained such that when installed in accordance with manufacturer's recommendations, a longitudinal load applied to the mechanical coupling will cause the pipe to yield before the mechanical coupling disjoins. External joint restraints shall not be used in lieu of fully restrained mechanical couplings.

8. Do not perform fusions during adverse weather conditions, including high wind, any amount of blowing dust or precipitation events. Protect exposed pipe faces after facing and surface preparation from blowing dust. Engineer shall have the right to shut down fusing operations if weather conditions are not suitable or if weld quality is suspect. Contractor shall not be entitled to additional compensation for any such additional testing or shut-downs; however, shut-downs required by the Engineer through no fault of the Contractor (i.e. due to weather) shall be considered excused weather delays.

9. In the event of inclement weather, a tent, shelter, weld screen may be used to protect the fusion environment from dust, precipitation and heater plate variance. Any such enclosures must be approved by the Engineer. Engineer reserves the right to reject such enclosures and shut down operations if the enclosures do not adequately protect the pipe faces or fusion environment.

10. HDPE pipe may be welded into strings ("tie-in joining") and dragged into place, provided that pipe manufacturer's recommendations for maximum length, dragging velocity and other criteria are met.

11. All HDPE pipe butt fusions shall be performed in accordance with PPI Technical Report TR-33 and ASTM F2620 (latest edition). To the extent that these standards allow for accelerated cooling of HDPE butt fusion welds using chilled air, such methods may be used. However, all welds must be made in strict accordance with PPI and ASTM standards.

12. Internal weld beads from all HDPE welds (on both pipe and fittings) shall be completely removed prior to installation, using Engineer-approved method for weld bead removal.

13. Protect HDPE at all times during handling, storage, transport, cutting and fusion from oil contamination.

14. Polyethylene pipe fusion machine data loggers:
    a. All polyethylene pipe fusion machines shall be equipped with data loggers to record, at a minimum, joint temperature, pressure and time.
    b. Data loggers shall be used during all joint fusions.
    c. The Contractor shall provide data on any and all fusion joints upon request of the Owner or Engineer.

I. Horizontal and vertical pipe line and grade

1. The horizontal and vertical lines and grades shown on the Drawings indicate the intent of the design. Actual horizontal and vertical lines and grades in the field may deviate from those shown on the Drawings, provided all of the following conditions are met:
    a. Actual minimum slope of pipe shall not be less than 0.00100 ft/ft.
    b. Actual maximum slope of pipe shall not be greater than 0.40000 ft/ft, except where otherwise noted on the Drawings.
    c. Direction of pipe slope shall not differ from that shown on Drawings.
    d. Minimum pipe cover of 4 feet shall be maintained throughout the project.
    e. Additional minimum cover or specific minimum vertical clearances called out on the Drawings at specific locations, such as wash crossings, road crossings or pipeline crossings, shall be maintained.
    f. In the case of horizontal bends, the outer wall of the pipe must remain at least 12 horizontal feet within the permanent right-of-way boundaries.
    g. At bends near casings, pipe bending and/or off-set from centerline shall be done on the far side of the PI from the casing, to maximize the length of straight pipe in the sleeve on each side of the casing.
    h. In certain locations, the pipe elevation and/or slope must remain as shown on drawings to facilitate pipe draining, maintain pressures, or other performance criteria. In such cases, deviation from the Drawings may not be allowed.
    i. All deviations from the Drawings shall be documented by the Contractor and must be approved in advance by the Engineer.
    j. All other specifications shall be met.
    k. Any exceptions to the foregoing conditions must receive prior written approval by the Engineer.
2. No high points of any magnitude shall be allowed without an approved air valve. If the As-Built survey of the pipeline reveals high points not shown on the Drawings, Contractor shall correct the pipe grade or install additional air valves, as directed by Engineer.
    a. Additional air valves required due to unforeseen field conditions not the fault of the Contractor shall be paid for at the prices established in the Bid.

b. Additional air valves or pipe re-installation required due to high points caused through fault of the Contractor shall be provided at no additional cost to the Owner. This includes failure of Contractor to meet lines and grades set forth in the Drawings or failure to meet minimum pipe slope.

J. Install pipe to bear on the trench bottom along entire length of pipe. For jointed pipe, excavate bell holes in the bottom of the trench to prevent the bell from coming into contact with the sub-grade.

K. Do not lay pipe in wet or frozen trench.

L. Direction of pipe bells may be reversed for ease of installation, provided that all pipe material and installation meets applicable AWWA, ASTM, NTUA and material manufacturer's standards. On grades greater than 10%, install jointed pipe uphill.

M. Pipe expansion and contraction

1. Install pipe to allow for expansion and contraction without stressing pipe or joints.

N. Do not allow trench water, dirt, debris or other foreign material to enter the pipe during or after installation.

1. Keep pipe ends sealed after joining pipes, both while pipe string is laying on top of ground and after pipe is lowered into trench.

2. Close pipe openings with watertight plugs during work stoppages.

O. Install tracer wire continuous, taped to top of pipeline; coordinate with Sections 31 23 17 and 31 23 23.

P. Install metal-backed detectable water marker tape continuous over top of pipe, buried 18 inches above pipe; coordinate with Section 31 23 17 and 31 23 23.

Q. Install thrust blocks at locations indicated on Drawings. Installation of thrust blocks shall not relieve the Contractor of responsibility to provide pipe restraints as indicated on Drawings and Specifications.

R. Flanged Joints: Not to be used in underground installations except within accessible structures or as shown on Drawings.

S. All pipes, fittings and appurtenances must remain within designated permanent rights-of-way. All construction activities must remain within the right-of-way or temporary construction easement. Do not encroach on adjacent properties or culturally sensitive areas.

T. Embed pipe within 100 feet behind pipe-laying operations, unless otherwise permitted by the Engineer.

U. Do not backfill pipe prior to as-built surveying; refer to Section 02 21 13 - Surveying.

3.5 INSTALLATION - TAPPING SLEEVES AND GAUGES

A. Install tapping sleeves and gauges in accordance with Drawings and in accordance with manufacturer's instructions.

3.6 THRUST RESTRAINTS

A. Install tie rods, clamps, setscrew retainer glands, or restrained joints. Protect metal restrained joint components against corrosion by applying a bituminous coating, or by concrete mortar encasement of metal area. Do not encase pipe and fitting joints to flanges.

B. Install thrust blocks or restrained fittings in accordance with Drawings and in accordance with manufacturer's instruction.

C. Install thrust blocks, tie rods, and joint restraint at dead ends of water main.

3.7 BACKFILLING

A. Backfill trenches for piping in accordance with Section 31 23 23.

3.8 DISINFECTION OF POTABLE WATER PIPING SYSTEM

A. Flush and disinfect system in accordance with Section 33 13 00.

3.9 TAPPING EXISTING WATER DISTRIBUTION FACILITIES

A. Obtain permission to tap from the Navajo Tribal Utility Authority (NTUA). A blank Permission to Tap application form is provided in Appendix F. Contractor shall not connect to existing system without written permission from NTUA and the Engineer to proceed with connection to the existing system.

B. Coordinate with NTUA's designated representative regarding schedule, means and methods, maximum allowable shut-off time, water usage rates (both gpm and gpd) and other parameters stipulated by NTUA.

C. Contractor is advised that a Water Use Permit from Navajo Nation Water Code Administration is required for use of the NTUA water. Contact Wayne Williams at (928) 729 – 4132 or wwilliamsjr@navajo-nsn.gov for more information.

D. Perform all work in conformance with the tapping permit and all written and verbal instructions from NTUA personnel, including notification and coordination with NTUA, maximum water usage rates, time and duration of shut-offs, and disinfection requirements.

E. Minimize shut-off time during connections to existing facilities. Contractor shall have all tools and materials for actual field conditions as well as foreseeable problems on hand in order to minimize shut-off time.

F. Taps on existing NTUA pipelines shall be by cut-in tees, with NTUA's approval. Wet taps shall not be permitted.

G. Prevent contamination of existing facilities with trench water, mud, debris, chemicals or other substances.

H. All new materials shall be thoroughly cleaned and disinfected with a strong (200 ppm) chlorine solution prior to connecting to existing NTUA facilities.

3.10 INITIAL FILLING OF PIPELINE

A. "Initial filling" refers to first introduction of water and evacuation of air in the pipeline.

B. Initial filling of pipeline shall not exceed maximum instantaneous flow rate (in gpm) or maximum

3.11 PIPELINE RIGHT-OF-WAY GRADING

A. Establish finished grade to provide a minimum of four (4) foot of cover over the pipe. Measure depth of cover from final surface grade (not including dirt mound) to top of pipe barrel.

1. At certain locations such as wash crossings, road crossings, utility line crossings or to prevent high points, the Drawings indicate greater than 4 ft minimum cover. At such locations, Contractor shall maintain the site-specific minimum cover.

B. Mound soil over top of pipe in accordance with Drawings, except at wash crossings, road crossings, or where prohibited by landowner.

C. Do not place fill material or raise the finished grade above existing grade in the flow lines of washes or surface water drainages, regardless of size.

D. Finished grade along pipeline right-of-way and temporary construction easement shall have a maximum longitudinal slope of 4:1 and maximum side slope of 4:1, unless otherwise noted on Drawings.

E. The pipeline right-of-way shall be leveled from side-to-side to slow down surface run-off from causing erosion rills perpendicular to the pipeline, as well as to make the ROW accessible to the Owner for future maintenance.

1. The entire right-of-way shall be re-seeded and reclaimed after construction. Do not build any new roads. Refer to Section 32 92 19 – Seeding for re-seeding requirements.

2. The right-of-way shall not be open to the general public and shall have minimal impact on the environment. Upon completion of construction, the right-of-way shall be reclaimed to visually blend in with the surrounding environment and minimize its visual impact.

F. All construction activities, including clearing and grading, must remain within the designated right-of-way and temporary construction easement. Do not encroach on adjacent properties or culturally sensitive areas.

3.12 FIELD QUALITY CONTROL

A. Section 01 00 00 - Execution Requirements: Field inspecting, testing, adjusting, and balancing.

B. The Contractor shall be required to hydrostatic pressure test all water mains, appurtenances and plumbing trains.

1. Perform testing in accordance with applicable standards:

a. PVC pipe: Simultaneous hydrostatic pressure and leakage test. The system shall be pressure tested in accordance with AWWA C605 and M23, with the exceptions noted below:

1) Test pressure: In accordance with test pressure summary table provided as Appendix to Contract Documents.

2) In no case shall the test pressure exceed the manufacturers' recommended maximum safe test pressure for the pipe, fittings or appurtenances.

3) Test duration: 2 hours minimum.

a) Engineer may require longer duration test (up to 24 hours) if there is any doubt as to integrity of a particular section of pipe or appurtenances.

b. Ductile iron pipe: AWWA C600

c. Steel pipe: AWWA C200

2. Hydrostatic pressure testing of main line shall be performed in sections between each pair of adjacent isolation valves. Do not skip any isolation valves in delineating test sections, without express written permission by Engineer.

3. No observable leakage is allowed. Measurable leakage must be within the maximum allowable limits set forth by applicable AWWA and ASTM standards.

4. Any leaks detected during testing shall be repaired. After repairs are completed, another full duration test shall be performed on the section of the pipeline to which the repairs were made.

5. All air must be vented from the pipeline prior to pressurization.

6. The pipeline must be fully restrained prior to pressurization, including permanently installed items and any temporary appurtenances used for testing.

7. All hydrostatic pressure tests must be witnessed by NTUA personnel. Contractor is responsible for coordination of testing schedule with NTUA to allow NTUA's representative to be present.

C. Testing of field welds on steel pipe and fittings shall be by ultrasonic or radiographic method in accordance with AWS D1.1.

1. The Engineer reserves the right to demand evidence of welder's certification for all personnel performing field welding of steel pipe and fittings.

D. Compaction Testing: Refer to Section 31 23 23 – Backfill.

E. When tests indicate Work does not meet specified requirements, remove Work, replace and retest at no additional cost to the Owner.

3.13 TOLERANCES

A. Line and grade surveying tolerances:

1. Flange alignment tolerances as specified in AWWA C207 and AWWA M11.

END OF SECTION

SECTION 33 12 16

WATER UTILITY DISTRIBUTION VALVES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Valves.
2. Air Valves.
3. Valve boxes.

B. Related Sections:
1. Section 03 30 00 - Cast-in-Place Concrete: Concrete materials.
2. Section 31 22 13 - Rough Grading.
3. Section 31 23 23 - Backfill.
4. Section 33 11 00 - Water Utility Distribution Piping.
5. Section 33 13 00 - Disinfection of Water Utility Distribution.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Gate Valve Assemblies:
1. Basis of Measurement: Each.
2. Basis of Payment: Includes excavation, gate valves, adaptors, fittings, valve boxes, lids, collars, accessories, and backfill.

B. Air Valves:
1. Basis of Measurement: By the unit.
2. Basis of Payment: Includes excavation, vault, air valve, fittings, accessories, backfill and compaction.

C. Flush Valve Assemblies:
1. Basis of Measurement: Each.
2. Basis of Payment: Includes excavation, 2-inch piping, 2-inch gate valve assembly as shown on plans, above-grade discharge pipe, gravel pack at weep hole, accessories and backfill.

1.3 REFERENCES

A. American Water Works Association (AWWA):
1. AWWA C500 - Metal-Seated Gate Valves for Water Supply Service.
2. AWWA C509 - Resilient-Seated Gate Valves for Water-Supply Service.
3. AWWA C515 - Reduced Wall, Resilient-Seated Gate Valves for Water Supply Service.
4. AWWA C550 - Protecting Epoxy Interior Coating for Valves and Hydrants.

B. National Sanitation Foundation (NSF):
1. NSF/ANSI Standard 61 - Drinking Water Components - Health Effects.

C. New Mexico Standard Specifications for Public Works Construction (NMSSPWC):
   1. 801 - Installation of Water Transmission, Collector, and Distribution Lines.
   2. 802 - Installation of Water Service Lines.

1.4 SUBMITTALS

A. Design Data: Submit manufacturer's latest published literature. Include illustrations, installation instructions, maintenance instructions and parts lists.

B. Manufacturer’s Certificates: Submit Statement of Compliance, supporting data, from material suppliers attesting that valves and accessories provided meet or exceed AWWA Standards and specification requirements.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of all valves. Provide completed Water Valve Cards for each valve installed per NMSSPWC Section 801.4.

B. Provide Operation and Maintenance Data for each type of valve installed.

1.6 QUALITY ASSURANCE

A. Perform work in accordance with NTUA standards and the National Fire Protection Act (NFPA).

B. All piping, fittings, valves and any other potable water system appurtenances shall comply with the “Reduction of Lead in Drinking Water Act”, in effect as of 2014, or any subsequent revision thereof.

C. Valves: Mark valve body with manufacturer's name and pressure rating.

1.7 QUALIFICATIONS

A. Manufacturer: company specializing in manufacturing Products specified in this section with minimum three years’ experience.

1.8 DELIVERY, STORAGE AND HANDLING

A. Prepare valves and accessories for shipment according to AWWA Standards and seal valve ends to prevent entry of foreign matter into product body.

B. Deliver and store valves in shipping containers with labeling in place.

C. Store products in areas protected from weather, moisture, or possible damage; do not store products directly on ground; handle products to prevent damage to interior or exterior surfaces.

D. Coated valves and appurtenances shall be shipped on bunks and secured with nylon belt tie down straps or padded banding over braces, and shall be stored on padded skids or other suitable means to prevent damage to coating.

E. Coated valves shall be handled with wide belt slings, padded forks or other means to prevent damage to coating. Chains, cables or other equipment likely to damage coating or valves shall not be used.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures or utilities, and landscape in immediate or adjacent areas.

1.10 COORDINATION

A. Coordinate work with NTUA, Newcomb Chapter, the local fire department, and utilities within construction area.

1.11 MAINTENANCE MATERIALS

A. Furnish two (2) tee wrenches to Owner (required length) for each valve type.

PART 2 PRODUCTS

2.1 GENERAL

A. All valves shall be American made, unless otherwise specified.

B. All non-stainless steel and iron valves and appurtenances shall be fusion bonded epoxy coated, interior and exterior, conforming to AWWA C550 and NSF 61.

C. All valves and coatings shall be NSF 61-certified.

2.2 RESILIENT WEDGE GATE VALVES

A. Manufacturers:

1. Mueller Company
    a. A-2361
2. Substitutions: Approved Equal

B. Resilient Wedge Gate Valves: AWWA C515, NSF 61, American-made; ductile iron.

1. Resilient seats.
2. Stem: Non-rising bronze stem.
3. Operating Nut: Square; open counterclockwise unless otherwise indicated.
4. Gearing
    a. Bevel geared for horizontal installation.
    b. Spur geared for vertical installation.

5. Valve Ends:
    a. Mechanical joint or flanged, as indicated on Drawings.
    b. Flanged ends shall be drilled in accordance with ANSI Class 125/150 bolt pattern, unless otherwise noted on Drawings.
    c. Pressure rating not less than that of valve body.
6. Working pressure rating: 350 psi.
7. Pressure testing: Seat test – 525 psi for 15 seconds, test seat from each side of valve separately per UL262. Shell test pressure: 700 psi.
8. Inside and outside of valve fully coated with Fusion Bonded Epoxy, 10 mils nominal, conforming to AWWA C550 and NSF 61 requirements.

C. Where waterline is buried at a depth greater than 4 feet, provide valve stem extensions, complete with extension stem stabilizers, until depth of extension nut matches depth of operating nuts on valves installed at four-foot depth.

2.3 COMBINATION AIR VALVE:

A. Manufacturer:
    1. Val-Matic Valve and Manufacturing Corporation, Model # 15A.32SV, Single Body Type.
    2. Substitutions: Not permitted

B. Working pressure: 175 psi

C. Test Pressure: 263 psi

D. Intlet: 1” NPT

E. Cast iron body, cover and baffle; stainless steel trim, float, and fasteners.

F. Seat: Resilient Buna N.

G. Valve to perform functions of air release, pipe fill air exhaust and vacuum relief.

2.4 VALVE BOXES

A. 12-inch diameter Valves and Smaller: Cast iron, two-piece, slip type.

B. Valves larger than 12-inch diameter: Domestic cast iron, three-piece, slip type; round base.

C. Where waterline is buried at a depth greater than 4 feet, provide valve box extensions as required.

D. Cast iron lid marked “Water”.

E. Heavy duty, traffic rated.

F. Locking Lids

2.5 METER CANS & PITS

A. Meter Box for Combination Air Release Valves:
    1. Body material LLDPE

2. 30” inner diameter, 3/8” wall thickness, length per detail drawing.

B. Contractor responsible to ensure compatibility between meter pit / box, flange, ring, and cover.

2.6 ACCESSORIES

A. Joint Restraints: “EBAA Iron, Megalug®”, or approved equal, for all pipe 4” diameter and greater, “EBAA Iron, Series 6500 and 7500”, or approved equal, for all pipe from 2” to 3-1/2” diameter, installation and spacing as per manufacturer's specifications.

B. Concrete for Thrust Restraints: Concrete type specified in Section 03 30 00.

PART 3 EXECUTION

3.1 EXAMINATION

A. Determine exact location and size of valves from Drawings; obtain clarification and directions from Engineer prior to execution of work.

B. Verify invert elevations prior to excavation and installation of valves.

3.2 PREPARATION

A. Identify required lines, levels, contours and datum locations.

B. Locate, identify, and protect utilities to remain from damage.

C. Do not interrupt existing utilities without permission and without making arrangements to provide temporary utility services.
1. Notify Engineer not less than 48 hours in advance of proposed utility interruption.
2. Do not proceed without written permission from the Engineer.

D. Perform trench excavation, backfilling and compaction in accordance with Sections 31 23 17 and 31 23 23.

3.3 INSTALLATION

A. Gate Valves:

1. Install in accordance with AWWA standards and manufacturer’s recommendations

2. Install valves in conjunction with pipe laying; set valves plumb.

3. Assemble complete valve assembly and place in open excavation at proper line and grade.

4. Provide buried valves with valve boxes or meter boxes installed flush with finished grade.

a. Any valve box lids, meter can lids, or collars that do not meet grade requirements shown on Drawings shall be removed and replaced.

5. Install valve stem risers, collars and valve box extensions as required to match finished grade.

6. Gate valves and ball valves shall require the same joint restraint lengths as dead-ends of similar size and pipe material.

B. Combination Air Valve Assemblies

1. Install in accordance with AWWA standards and manufacturer's recommendations

2. After drilling into the main line, remove all pipe cuttings and other debris with a vacuum or other method approved by the engineer prior to installing the valve assembly.

3. Install air valve assemblies in vertical position.

4. Where indicated at high points in pipe on Drawings, install at actual high points, as determined by as-built pipeline survey data.

5. Secure assemblies to Unistruts as shown on Drawings to prevent lateral movement or stresses.

C. No high points in the pipe of any magnitude shall be allowed without an appropriate air valve. If the As-Built survey of the pipeline reveals high points not shown on the Drawings, Contractor shall correct the pipe grade or install additional air valves, as directed by Engineer.

1. Additional air valves required due to unforeseen field conditions not the fault of the Contractor shall be paid for at the prices established in the Bid. Contractor shall promptly report such conditions to the Engineer.

2. Additional air valves required due to high points caused through fault of the Contractor shall be provided at no additional cost to the Owner. This includes failure of Contractor to meet lines and grades set forth in the Drawings or failure to meet minimum pipe slope.

D. FLUSH VALVE ASSEMBLIES

1. Components of flush valve assembly shall be as provided elsewhere in project specifications.
2. Steel piping underground shall be tape wrapped.
3. Steel piping above ground shall be painted blue.

E. Tracer Wire:

1. For direct buried valves with surface valve box lids, tape tracer wire to outside of valve box up to last section of box. Bring tracer wire into the valve box above the operating nut. Coil 18" tracer wire inside valve box under the lid.

2. For direct buried valves with valve box lids inside meter cans, bring tracer wire into the meter can outside of the valve box. Coil 18" tracer wire inside meter can.

3. For all valve vaults and meter pits, coil min. 24" tracer wire against wall on each side of vault.

3.4 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Flush and disinfect system in accordance with Section 33 13 00.

3.5 FIELD QUALITY CONTROL

A. Section 01 00 00 - Execution Requirements: Field inspecting, testing, adjusting, and balancing.

B. Perform pressure test on domestic site water transmission system in accordance with AWWA C605.

C. All valves shall be manually actuated through their full cycle to ensure proper operation prior to installation.

1. The Contractor shall provide the Engineer the opportunity to witness all valve actuations prior to valve installation.

D. Inspect coatings of all valves immediately prior to installation and repair all damaged coatings.

E. Properly align all pipes, valves and fittings prior to making connections. Do not install any pipes or fittings with internal longitudinal or shear stresses. Engineer reserves the right to disassemble any flange, joint, or union to check for internal stresses. Contractor shall correct any connection with internal stress at no additional cost to the Owner.

F. All tracer wire must be field checked for continuity after all excavation is completed, but prior to Final Completion of the project.

END OF SECTION

SECTION 33 13 00

DISINFECTION OF WATER UTILITY TRANSMISSION SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes disinfection of potable water transmission system; and testing and reporting results.

B. Related Sections:

1. Section 33 11 00 – Water Utility Distribution Piping: Product and Execution requirements for installation, testing, of site domestic water transmission system piping.

2. Section 33 12 16 - Water Utility Valves.

1.2 MEASUREMENT AND BASIS OF PAYMENT

A. Basis of Measurement: By the linear foot for pipeline. Incidental to work for all other facilities.

B. Basis of Payment: Payment for pipeline disinfection will be made based on linear footage, upon successfully passing bacteriological testing. Disinfection of other facilities shall be incidental to their respective bid items.

1. This includes all costs incidental to disinfection and testing, including chlorination, flushing, water for flushing, de-chlorination, sampling, sample transport, laboratory testing fees, and any other costs incidental to flushing, disinfection, and bacteriological testing activities.

2. Bacteriological testing costs shall not be allowed under the Testing Allowance.

1.3 REFERENCES

A. American Water Works Association (AWWA):

1. AWWA B300 - Hypochlorites.

2. AWWA B301 - Liquid Chlorine.

3. AWWA B302 - Ammonium Sulfate.

4. AWWA B303 - Sodium Chlorite.

5. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.

6. AWWA C651 - Disinfecting Water Mains.

B. New Mexico Administrative Code (NMAC) - Title 20, Chapter 7, Part 10:

1. Section 201: Application for Public Water System Project Approval.

2. Section 400: General Operating Requirements.

1.4 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit procedures, proposed chemicals, and treatment levels for review.

C. Test Reports: Indicate results comparative to specified requirements.

D. Certificate: Certify cleanliness of water transmission system meets or exceeds specified requirements.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 00 00 - Execution Requirements: Requirements for submittals.

B. Disinfection Report:

1. Type and form of disinfectant used.
2. Date and time of disinfectant injection start and time of completion.
3. Test locations.
4. Name of person collecting samples.
5. Initial and 24 hour disinfectant residuals in treated water in ppm for each outlet tested.
6. Date and time of flushing start and completion.
7. Disinfectant residual after flushing in ppm for each outlet tested.

C. Bacteriological Report:

1. Date issued, project name, and testing laboratory name, address, and telephone number.
2. Time and date of water sample collection.
3. Name of person collecting samples.
4. Test locations.
5. Initial and 24 hour disinfectant residuals in ppm for each outlet tested.
6. Coliform bacteria test results for each outlet tested.
7. Certify water conforms, or fails to conform, to bacterial standards of authority having jurisdiction.

D. Water Quality Certificate: Certify water conforms to quality standards of authority having jurisdiction, suitable for human consumption.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with AWWA C651.

1.7 QUALIFICATIONS

A. Testing Firm: Company specializing in testing potable water systems, certified by State of New Mexico.

B. Submit bacteriologist's signature and authority associated with testing.

PART 2 PRODUCTS

2.1 DISINFECTION CHEMICALS

A. Chemicals: AWWA B300, Hypochlorite, AWWA B301, Liquid Chlorine, AWWA B302, Ammonium Sulfate, and AWWA B303, Sodium Chlorite.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify piping system has been cleaned, inspected, and pressure tested.

C. Perform scheduling and disinfecting activity with start-up, water pressure testing, adjusting and balancing, demonstration procedures, including coordination with related systems.

3.2 INSTALLATION

A. Coordinate with NTUA and the Engineer prior to filling, flushing or disinfecting the pipeline. Refer to Section 01 00 00 – Basic Requirements for coordination requirements.

B. Prior to disinfection, thoroughly flush the system with potable, disinfected water. A minimum flow velocity of 3 feet per second (fps) is required, or as otherwise approved by Engineer.

C. Provide and attach required equipment to perform the Work of this section.

D. Introduce treatment into piping system and perform disinfection in accordance with AWWA C651. A minimum chlorine concentration of 50 ppm shall be measurable throughout all parts of the system.

1. Measure chlorine concentration at all sampling ports provided on the Drawings, including air valve vaults and building plumbing.

E. Maintain disinfectant in system for 24 hours, or 48 hours if the temperature is less than 41 degrees Fahrenheit.

F. Flush, circulate, and clean using domestic water.

1. Contractor shall coordinate with NTUA and Engineer prior to using domestic water, to avoid interruption of service to existing customers. Contract shall not exceed maximum allowable instantaneous flow (gpm) or daily flow (gpd), as specified in the field by NTUA and Engineer.

2. Neutralize residual chlorine to levels normally associated with potable water prior to discharging water to the environment.

G. Replace permanent system devices removed for disinfection.

3.3 FIELD QUALITY CONTROL

A. Section 01 00 00 - Execution Requirements: Field inspecting, testing, adjusting, and balancing.

B. Disinfection, Flushing, and Sampling:

1. Disinfect and test pipeline installation in accordance with AWWA C651.
2. Upon completion of retention period required for disinfection, flush pipeline until chlorine concentration in water leaving pipeline is no higher than that of the water used for flushing or 0.4 ppm, whichever is greater.
3. After final flushing and before pipeline is connected to existing system, or placed in service, employ an approved independent testing laboratory, approved by the Engineer, to sample, test and certify water quality suitable for human consumption, in accordance with AWWA C651.
    a. At least one set of bacteriological samples shall be collected from every 1,200 LF of new waterline, plus one set at each end of the line, unless otherwise approved by NTUA and the Engineer.
    b. Contractor shall install testing saddles, if needed to comply with spacing requirements for bacteriological testing under AWWA C-651 and NTUA's requirements. Such testing saddles are not shown on the plans, but shall be considered incidental to the project.
    c. The number and locations of specific sampling sites shall be submitted by the Contractor and must be approved by the Engineer prior to sampling.
    d. Bacteriological tests are typically only valid for 30 days. Two consecutive passing test results at every sample location must therefore be obtained within 30 days of Final Completion and Transfer of completed project to NTUA. Note that NTUA will not accept project transfer until all punch list items have been completed and the project has been inspected by NTUA personnel. NTUA typically requires 21 days notice prior to final inspection and Transfer. Contractor is solely responsible for coordination with NTUA. If punch list inspection, Final Completion, and NTUA Transfer cannot be completed within 30 days of all bacteriological tests, regardless of the reason for delay, Contractor shall be responsible for re-testing at Contractor's expense.
4. Contractor shall not connect to existing system until all testing and disinfection is complete and shall obtain written permission from the Engineer to proceed with connection to the existing system.

C. Re-Disinfection:

1. In the event the performed water quality testing fails, the Contractor will disinfect the affected portions of the system again, and the approved testing laboratory shall sample, test and certify water quality as described in these specifications. Re-disinfection shall be performed at no additional cost to the Owner.

END OF SECTION

SECTION 33 21 13

PUBLIC WATER SUPPLY WELLS

PART 1 GENERAL

1.1 SUMMARY

A. The work by the Contractor includes the furnishing of all labor, material, transportation, tools, supplies, plant, equipment, and appurtenances necessary to complete a municipal water supply well, to be located within the Thoreau Chapter, Navajo Nation, McKinley County, New Mexico for the Navajo Nation (herein referred to as Owner). The work shall be completed in strict accordance with the specifications and drawings that are included in this document. All aspects of the well drilling, installation, materials, and development shall generally conform to the American Water Works Association Standard for Water Wells, ANSI/AWWA A100, most recent edition. While some of the ANSI/AWWA A100 specifications are outlined below, it is the Contractor's responsibility to ensure conformance with the ANSI/AWWA A100 standards, except as specifically stated. The well including all equipment and appurtenances shall be disinfected per AWWA C654, most recent edition, unless stricter requirements are included in this specification.

1.2 SYSTEM DESCRIPTION

A. Well construction already completed: All work pertaining to the well drilling, casing, and initial development and testing has been completed in a previous construction phase of the project. A Well Record for the constructed well and testing results obtained to date have been made available to bidders.

B. Equipping of production well to be completed: The remaining work to be completed as identified on the bid form is associated with equipping the completed well with all downhole equipment and surface completion. In the course of this work, re-development of the completed well, additional disinfection, and testing are also anticipated as described on the bid form.

C. Work required for construction and equipping of the supply well includes, but is not limited to, the following:

1. Prepare & improve access drive to well site.
2. Move equipment on-site and rig up.
3. Maintain drilling-time and daily drilling reports.
4. Develop the well by swabbing, zoned-air-lift pumping and bailing.
5. Disinfect the well, as specified.

6. Supply and install test pump and transducer line.
7. Develop the well by pumping.
8. Clean-up and restore well site.
9. Surface completion including installation of pitless adapter
10. Install production pump, drop pipe, check valves, wire, sounder tube, and transducer.
11. Collect final sample for water quality constituent analysis and bacteriological testing to ensure adequate disinfection.

1.3 LOCATION AND GENERAL DESCRIPTION

A. The wells shall be drilled in the location staked by the Owner or Engineer and to the depth indicated on the drawings unless otherwise directed by the Engineer. The Contractor shall drill the wells by either the direct-mud or the reverse-mud rotary method. The well shall be of the gravel/sand-pack type. The construction and overall diameter of the wells is specified herein and shown on the drawings. The Engineer may order drilling to depths shallower or deeper than specified. Unit bid prices will prevail.

1.4 GEOLOGY AND ANTICIPATED CONDITIONS

A. The well shall be completed in the San Andres/Glorieta Formations. The San Andres/Glorieta Formations consist of a thin bed of limestone overlying well sorted sandstone. In the project area, these formations are estimated to be encountered at approximately 1,300 feet below ground surface.

B. The first water in the area is anticipated to be encountered at approximately 700 feet below the ground surface, and will likely be artesian, rising to a Fstatic water level of approximately 200 feet. If during the drilling or completion stage of well construction, the borehole or well starts to flow, the Contractor shall control the flow. The Contractor shall be reimbursed by the Owner at the customary rates for time and materials for costs associated with the control of flow.

1.5 RIGHT-OF-ENTRY AND ACCESS

A. The Owner will provide the necessary rights-of-entry to the site. Where special conditions are specified in connection with rights-of-entry, Owner will inform Contractor so that Contractor may meet these conditions. Owner shall furnish an uninterrupted access to and from the site for all equipment, supplies, material, and personnel associated with the work. Where temporary or permanent access roads are required to be built, Owner shall determine the route to the drill hole, and shall obtain the necessary permission, if required.

B. The Contractor shall improve the existing roads or build access roads capable of accommodating all necessary equipment near the proposed drill site. Proposed

new access roads or improvements to existing roads are shown on the Design Drawings. Roads should be constructed and maintained such that access to nearby residences is not impeded by rutting or damage to the road during periods of inclement weather.

1. Material and material placement for access improvements called for within the culturally sensitive area shown on the drawings shall be paid to the contractor at the unit price.
2. All other access improvements necessary for the Contractor to access the site are incidental to the work.

C. The Contractor shall be solely responsible for locating all existing underground installations in advance of any excavation or trenching by contacting the owners thereof. The Contractor shall not enter or occupy with personnel, tools, equipment or material, any ground outside the construction area without approval of the Engineer. Other contractors, employees or agents of the Owner may, for business purposes, enter the work site and premises used by the Contractor. The Contractor shall not impede any work being done by others on or adjacent to the site unless necessary as determined by the Engineer.

D. The Contractor shall prevent damage to all structures, roads, or other operations during the progress of his work and shall remove from the location all cuttings, debris, and unused materials. Upon completion of the work, the Contractor shall restore the site to a condition as near to the original condition of the site as possible.

E. The Contractor shall be responsible for disposing of all debris, including but not limited to, drilling fluid and water produced by test pumping or other operations, by such methods such that damage to, or interference with structures, roads or utilities, or with other construction projects will not occur. All costs incurred in connection with the disposal of drilling fluid, cuttings and water shall be incidental to the Contract and shall be included in the Contract Price.

1.6 DRILLING REQUIREMENTS

A. Contractor shall be responsible for complying with the standard of care of the industry. Contractor shall assume all liability connected with settling or caving for a period of six months following drilling and hold Owner harmless from such for this period.

B. The completed well shall be sufficiently straight and plumb for the free installation and operation of a submersible pump regularly built for 8-inch casing and shall meet AWWA specifications for plumbness and alignment for the full depth of casing and perforated casing. The alignment shall be such that the center line of the well casing from ground level to 1500 feet below ground shall not deviate from vertical more than two thirds of the inside diameter of the casing per 100 feet of depth.

1.7 CONTRACTOR'S EQUIPMENT

A. With the bid, the Contractor shall furnish to the Owner and the Engineer a complete list of equipment, which he proposes to use for the work, together with a description of the methods by which he proposes to drill, develop, and test the well. The rig shall be of sufficient size and horsepower to safely and adequately carry out those operations for which it is to be used. If the Contractor fails to submit, or if the equipment and methods he proposes to use is not approved by the Engineer, the bidder will be considered non-responsive and his bid will not be considered. The Contractor shall not use equipment that has a smaller capacity than that provided with his bid. The Contractor shall include, with his bid, a list of three projects performed similar in scope to this project, and three references with current phone numbers.

B. The following equipment information shall be submitted with the Contractor's bid:

1. Rated hook-load of drilling rig
2. Mast height
3. Rotary-table size
4. Available rotary table horsepower
5. Sizes and weights of drill collars and drill pipe
6. Size and horsepower of each mud pump
7. Maximum circulation rate capability
8. Compressor rating

C. The drilling rig shall be equipped with the following required accessory equipment. With his bid, the Contractor shall acknowledge that the following equipment will be on hand during well drilling. Drilling may not begin until this equipment is installed and operating properly.

1. Weight indicator
2. Mud pressure gage (direct rotary only)
3. Drilling-rate recorder
4. Approved equipment for measuring drilling fluid properties
5. Deviation-survey tool

D. The Contractor shall employ only competent workers for the execution of the work, which shall be under direct supervision of an experienced drilling superintendent. The competency of the workers and superintendent shall be subject to the approval of the Engineer. The Contractor must provide for continuous operations from the time production casing begins to be run into the borehole until all annular materials are installed.

E. No unnecessary delays or work stoppages will be tolerated. The Contractor shall be held responsible and payment will be withheld for damages to the well due to any act of omission, error, or faulty operation by the Contactor, his employees, or agents. Resulting repairs shall be completed by the Contractor to the satisfaction of the Engineer or a replacement well shall be drilled and completed in accordance with these specifications by the Contractor at no additional cost to the Owner and without claim against the Owner, Engineer, or agents.

1.8 DRILLING METHODS

A. The Contractor shall drill the pilot hole and perform all reaming by either the direct-mud-rotary or the reverse-mud-rotary method. Strict control of the drilling fluid properties shall be adhered to at all specified times. Drilling fluid shall consist of a bentonite-based mud with approved additives for ease of drilling, filtrate control, and protection of the aquifer.

B. The Contractor shall, within fifteen (15) days after award of the contract, submit to the Engineer a schedule of work, presenting proposed completion dates of the activities listed in Article 1.2 SYSTEM DESCRIPTION. The methods or combination of methods to be utilized shall be adequate, as determined by Engineer, to meet the completion schedule for the work.

C. The Contractor shall drill and install the specified surface prior to the drilling of the borehole below 120 feet. Should the Contractor elect to install an additional conductor pipe to facilitate drilling and installation of the surface casing, the drilling and installation of the conductor pipe shall be incidental to the work. The Contractor will be paid for surface casing if, after logging the pilot hole, the Owner decides to abandon the project.

1.9 DRILLING WATER SUPPLY

A. The Contractor shall be responsible for purchasing of construction water. Contractor shall be responsible for hauling water from the source to the drilling site. Construction water is incidental to well construction and is not reimbursable.

B. The Navajo Tribal Utility Authority (NTUA) may have construction water available for purchase. NTUA provides a meter for water use. Water use payments must be to NTUA.

1. Additionally, the Owner has already secured a water use permit and paid fees to the Navajo Nation Water Code Administration (NNWCA) for an estimated volume of construction water to be used. See Appendix C for the Water Use Permit. Contractor shall pay additional fees to NNWCA for volumes used beyond what already indicated in permit.

C. All costs associated with the purchase, maintenance, transportation, and disposal of drilling and development water as required to fulfill the terms of the Contract shall be the responsibility of the Contractor. All water should be carefully conserved.

1.10 DRILLER'S LOG and RECORDS, AND SAMPLES

A. The Contractor shall keep an accurate, up-to-date log of operations at all times in the form of a Daily Drilling Report. The Contractor's Daily Drilling Report shall include the following information at a minimum:

1. In-hole drilling assembly, including bit, hole-openers, subs, collars, and Drill pipe lengths and diameters, and water consumption (water haulage)
2. Time devoted to each activity
3. Rotary RPM
4. Pump pressure
5. String weight and weight on bit
6. Drilling-fluid density and funnel viscosity
7. Record of deviation surveys
8. Description of formation drilled and depth at each change
9. Depth of lost-circulation zones and volumes of fluid lost
10. Water-meter readings for drilling-water source
11. Lengths, diameters, and types of casing and perforated casing run
12. As-built depths of screens, dissimilar metal connectors and production casing.
13. Volumes of gravel, bentonite, and grout placed
14. The depth of the sand pack, bentonite seal, and surface seal
15. Time devoted to each stage of development, estimated production, and characteristics of fluid produced
16. The depth to the static water level (SWL) and observable changes in SWL
17. Measurements and observations during aquifer testing of time at start and end of pumping, time at start and end of recovery, flowrate and water level as time elapses, and characteristics of fluid produced.
18. The sealing off of any water bearing zone, if any, and the exact location thereof
19. Any other pertinent information

B. The Contractor shall provide a copy of the Daily Drilling Report to the Engineer on a daily basis.

C. Each joint of the in-hole drilling assembly, including bit, hole-openers, subs, collars and drill pipe, or other pipe run into the borehole shall be measured to the nearest 0.01 foot prior to running into the borehole. All pipe tallies shall be kept current at all times.

D. The depth reference of each depth given in the report shall be denoted as "KB" (Kelly bushing), "DF" (drilling floor), or "GL" (ground level). The distance from ground level to the drilling floor and to the Kelly bushing shall be measured and included in the report. One copy of each Daily Drilling Report shall be furnished to the Engineer at the end of each day.

E. A drilling-rate recorder approved by the Engineer shall be in operation during all drilling operations. The driller shall mark the depth at each connection on the charts. The driller shall also record the drilling fluid viscosity and weight on the charts each time it is measured. One copy of each chart shall be furnished to the Engineer at the end of each day.

F. Cuttings samples shall be laid out on plastic sheeting by the Contractor, in a place agreed to by the Engineer. Samples shall be taken at intervals no greater than each 10 feet of drilling; additional samples shall be collected at formation changes. At least 1 quart of cuttings shall be collected from each 10-foot interval to allow for completion of a sieve analysis of intervals proposed for screening.

1.11 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Mobilization and Demobilization

1. Basis of Measurement: By lump sum.

2. Basis of Payment: Includes transportation of all machinery to and from the site, coordination, protection of the well throughout project, disposal of fluids and cuttings, and site restoration, including all equipment necessary to construct and equip the well.

B. Surface casing:

1. Basis of Measurement: By vertical foot of casing installed

2. Basis of Payment: Includes drilling of specified diameter borehole and casing installation, with all materials, equipment, labor, and construction water.

C. Drilling:

1. Basis of Measurement: By vertical foot of borehole depth

2. Basis of Payment: Includes drilling of specified diameter borehole and all equipment costs, labor, deviation surveys, materials, and construction water costs associated with completion of borehole.

D. Production well casing:

1. Basis of Measurement: By vertical foot of well depth.

2. Basis of Payment: Includes materials and installation of casing (blank casing or screen), landing clamp, end cap, and other appurtenances not separately listed on bid form.

E. Well Development, Aquifer Testing, and Standby Time:

1. Basis of Measurement: By hour.

2. Basis of Payment: Includes well development by swabbing, airlifting, bailing and pumping, step and constant-rate discharge tests, and any requested standby time. Incl. any labor, materials and equipment needed that are not separately listed on bid form. Required recovery periods after pumping are incidental to the work.

F. Grouting, Bentonite Seal, Pea Gravel, and Filter Pack:

1. Basis of Measurement: By cubic foot.

2. Basis of Payment: Includes materials, disinfection and placement of filter pack material, grout, pea gravel, and bentonite seals.

G. Discreet Interval Sampling:

1. Basis of Measurement: By each.

2. Basis of Payment: Per Discreet Zone Sampled, including construction of temporary well with all materials, labor, and equipment to estimate flowrate and collect water sample from zone, incl. up to 8 hours of pumping per zone. Does not include cost of laboratory analysis.

H. Disinfect Well and Perform Bacteriological Testing:

1. Basis of Measurement: By lump sum.

2. Basis of Payment: Includes disinfection of equipment and materials placed in the well, and collection and delivery of bacteriological samples to laboratory. In the event of failed bacteriological tests, contractor is responsible for up to three additional disinfection procedures at no cost to the Owner.

I. Drop Pipe, Sounding Line, and Pump Wire

1. Basis of Measurement: By linear foot

2. Basis of Payment: Includes installation and pipe, pipe couplings, pipe fittings, fasteners, connections and terminations for sounding tube, drop pipe, and pump wire as specified.

J. Check Valve:

1. Basis of Measurement: By each

2. Basis of Payment: Includes pipe fittings, check valve, and installation.

K. Pitless Adapter:

1. Basis of Measurement: By lump sum

2. Basis of Payment: Includes pipe fittings, pitless adapter, accessories, and installation.

L. Pump:

1. Basis of Measurement: By each.

2. Basis of Payment: Includes pump, motor drive, flow inducer sleeve, centering bolts, fittings, sensor, and accessories; includes equipment and materials needed to perform start-up testing of installed pump. Excludes pump drive to be provided and installed as part of pumphouse electrical work.

M. Transducer:

1. Basis of Measurement: By lump sum.

2. Basis of Payment: Includes provision of transducer, transducer cable and all accessories as specified. Includes installation of transducer within sounding tube and securing and coiling of cable within the wellhead. Excludes installation of transducer cable from wellhead to pumphouse and accessories at termination of cable within pumphouse (to be completed by Contractor's Electrician and paid elsewhere).

N. Electrical

1. Basis of Measurement: By lump sum.

2. Basis of Payment: Includes provision of well site electrical, meter pole and socket and all accessories. Includes installation of all electrical not noted in other bid items.

O. SCADA

1. Basis of Measurement: By lump sum

2. Basis of Payment: Includes provision of all SCADA equipment, radios, antennas, PLC, boxes, and all accessories as specified. Includes installation of all SCADA equipment. Excludes SCADA programming (to be completed by Contractor's SCADA Programmer and paid elsewhere).

P. Other Items:

1. Basis of Measurement: As indicated in the Bid Schedule.

1.12 REFERENCES

A. American Petroleum Institute:

1. API 10A - Specification for Cements and Materials for Well Cementing.

B. American Society of Mechanical Engineers:

1. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.

C. ASTM International:

1. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
2. ASTM C150 - Standard Specification for Portland Cement.
3. ASTM A312/A312M – Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes

D. American Water Works Association:

1. AWWA A100 - Standard for Water Wells.
2. AWWA C654 - Disinfection of Wells.

E. National Electrical Manufacturers Association:

1. NEMA MG 1 - Motors and Generators.
2. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.13 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Include material properties, dimensions, rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams for all items listed on the submittals checklist and products listed in Part 2 of this specification.

C. Manufacturer's Installation Instructions: Indicate rigging, assembly, and installation instructions.

1.14 CLOSEOUT SUBMITTALS

A. Section 01 00 00 - Execution Requirements: Requirements for submittals.

B. Project Record Documents: Accurately record actual locations of well, depth, subsoil strata, and drilling difficulties encountered.

C. Submit signed copy of the Contractor’s Daily Drilling Report as specified in Article 1.11.

D. Submit executed certification of well pump after performance testing.

E. Submit copies of Driller’s Logs, Analysis results, and other records to the Engineer for submittal of a completed Well Record to the Navajo Nation Water Code Administration within ten (10) days of the completion of the well.

F. Operation and Maintenance Data: Submit equipment manuals.

PART 2 PRODUCTS

2.1 MATERIALS AND PRODUCTS IN CONTACT WITH DRINKING WATER

A. Well casings, drop pipes, well screens, coatings, adhesives, pumps, switches, electrical wire, sensors and all other equipment or surfaces which may be in contact with drinking water must comply with ANSI/NSF Standard 61 or 60 as available.

B. All substances introduced into the well during construction or development shall comply with ANSI/NSF Standard 60 or 61 as available. This requirement applies to drilling fluids (biocides, clay thinners, defoamers, foamers, lubricants, oxygen scavengers, viscosifiers, weighting agents) and regenerants. This requirement also applies to well grouting and sealing materials which may come in direct contact with the drinking water.

2.2 MATERIALS

A. Surface Casing:

1. Surface casing shall be new, low-carbon steel well casing manufactured in accordance with ASTM Specification A53, Grade B or ASTM A139, Grade B. Casing diameter shall be 18 inches. Casing thickness shall be Schedule 40 (0.375-inch).

B. Blank Production Casing:

1. Production casing shall be Schedule 40 (0.322-inch wall thickness) 8-inch low-carbon steel well casing and be continuous and watertight from top to bottom, except for well screens. Casing shall be new and free of rust, pits, or other defects.

2. Blank production casing shall conform to ASTM A53, Grade B or A139, Grade B well casing. The casing shall be factory assembled in not less than 20-foot sections.

3. All casing joints shall be furnished with a collar for field welding, welded at the top of each section at the factory.

a. Weld collars shall be the same thickness and have the same chemical and physical properties as the corresponding casing section.

b. Three alignment holes shall be drilled or punched in each collar to ensure proper joining of the sections.

C. Perforations:

1. Well screens shall be Johnson, or approved equal, continuous-slot 304 stainless steel, and contain 0.050 inch slot size. Screens shall be 0.13 inch x 0.25 inch wire, 0.250 inch rod, 44 count; 550 psi collapse strength; and 22,700 lbs safe hang.

a. Substitutions: Section 01 00 00 – Product Requirements

2. The final screen lengths, position, and slot size will be determined by the Engineer after reviewing the lithological logs, geophysical logs, and pilot well results.

3. The screened intervals shall have Johnson, or approved equal, dissimilar metal connections at the top and bottom, between the stainless-steel screen and the low-carbon casing.

4. A bull nose cap shall be included and fabricated of the same material as the well screens, to be installed where shown on the Design Drawings.

    a. Substitutions: Section 01 00 00 – Product Requirements

D. Filter Pack:

1. The filter pack shall be composed of sound, durable, well-rounded particles, free from organic matter, sift, clay, or other deleterious materials provided by Colorado Silica Sand or approved equal and shall be disinfected using a 50 mg/L chlorine solution prior to placement in the well.

    a. Substitutions: Section 01 00 00 – Product Requirements

2. Filter-pack material shall be well-graded and specified by the Engineer based on size distribution of aquifer material, estimated by the Engineer to be 8-16 Colorado Silica Sand, or approved equal. Minor variation, as approved by the Engineer, may be required due to the size distribution of the aquifer materials. Under no circumstances shall crushed rock or any material with an excess of flat faces be installed in the well.

E. Neat Cement Grout:

1. Grout shall consist of a mixture of Portland cement meeting the requirements of ASTM C150 Type 11, and water in the ratio of 5.2 gallons of water per 94-lb sack. Grout density shall be approximately 15.6 lbs/gal (117 lbs/ft^3).

2. A maximum of 2 percent by weight of bentonite and 2 percent by weight of calcium chloride may be added. If bentonite is added, mixing water shall be increased by 0.6 gallons per sack for each 1-percent-by-weight addition of bentonite.

F. Sand Cement Grout:

1. Grout shall consist of a mixture of Portland cement meeting the requirements of ASTM C150 Type 11, sand and water. Proportions shall not exceed 2 parts by weight of sand to 1 part of cement, with not more than 6 gallons of water per 94-lb sack of cement.

G. Well Development Additives:

1. All fluids introduced into the well shall be National Sanitation Foundation Certified
2. Mud-thinning polymer: Nu-Well 310 Polymer
    a. Substitutions: Section 01 00 00 – Product Requirements

H. Pressure transducer:

1. Pressure transducer to be installed for Owner's use in production well
    a. Druck Model PTX 1835 Series, OAE
        1) 4-20 mA signal
        2) Polyurethane cable, with adequate length for termination inside panel within pumphouse as indicated on Construction Drawings.
        3) Lightning Surge Arrestor
        4) Accessories
            a) STE Moistureproof sensor termination enclosure
            b) Slimline sink weight
2. The pressure transducer used for testing purposes shall be provided and operated by the Contractor.

I. Data logger:

1. Shall be provided and operated by the Contractor.

J. Sounding tube:

1. The sounding tube (transducer pipe) shall be 1-inch or 1½-inch (ID), hot-dipped galvanized iron Schedule 40 pipe, as indicated on the Design Drawings.
2. API couplings
3. Connect sounder tube to the drop pipe with ½" stainless steel bands.
4. Includes all fittings at pitless adaptor, as well as capped, perforated end of sounding tube per Design Drawings.

K. Pump wire

1. Sufficient for the pump with 10 extra feet to be left coiled at the well head
2. #2 wire, jacketed

L. Drop pipe for pump:

1. 3" hot-dipped galvanized iron Schedule 40 pipe manufactured in accordance with ASTM Specification A53
2. Galvanized API Couplings

M. Check valves:

1. Manufacturers:

a. Flomatic Model 80DI, or approved equal with breakoff plugs.

b. Substitutions: Section 01 00 00 – Product Requirements.

N. Formed and poured concrete slab around the well head:

1. 48” x 48” x 4” concrete slab, 2% slope away from casing

O. Pitless Adapter (includes cast iron spool and watertight, cast iron, vented well cap with 24 mesh [or smaller] screen):

1. Manufacturers:

a. Baker Manufacturing Co. Model 5PS810WBWE23M4SP, or approved equal

b. Substitutions: Section 01 00 00 - Product Requirements.

P. Pump (with 3” discharge outlet):

1. Manufacturers:

a. Grundfos Model 150S500-24. (3-Phase, 460V, 50HP Pump), or approved equal

b. Substitutions: Section 01 00 00 - Product Requirements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify site conditions are capable of supporting equipment for performing drilling operations and testing.

C. The Contractor must provide written notification to the Engineer of mobilization and anticipated commencement of drilling at least ten business days prior to beginning work on site.

3.2 MOBILIZATION/ DEMOBILIZATION

A. Mobilization/Demobilization includes the major move(s) to and from the drilling site. Also included is project coordination, site clean-up, maintenance of access to the site, and any necessary support equipment.

3.3 PROTECTION OF THE WELL

A. The open annulus shall be protected from entry of unwanted material at all times. The Contractor shall construct and maintain drainage berms around the wellhead to prevent surface runoff from reaching and entering the well during construction.

B. After installing the filter pack, the Contractor shall continue to guard against entry of unwanted objects and contaminants from entering the well casing and gage line.

C. The Contractor shall place plastic below the rig, mud pump, compressors, generators, and all other equipment, which has the potential to leak hydrocarbons. The plastic shall be bermed on all sides of the equipment such that it will contain any fluid that is spilled or leaks from the equipment.

D. The drilling rig and all drilling tools must be steam-cleaned prior to commencing operations, to ensure that bacteria are not transferred from previous drilling sites to the project site.

3.4 WELDING

A. All welding shall be done by competent and experienced workmen with adequate equipment, using shielded arc welding, or other process approved by Engineer. Welders employed for field assembly of all casing shall be qualified in accordance with the latest revision of the section titled "Welding Procedure" of the ASME Boiler Construction Code, or by the AWS Standard Qualification Procedures.

1. Welders shall be qualified to weld stainless steel, carbon steel, and/or other materials, according to the materials being welded.

2. Electrodes used shall be selected and appropriate for the process used and material or materials being joined.

3.5 SURFACE CASING

A. The Contractor shall drill and ream the pilot hole to the 120-foot depth specified for the surface casing, and set and cement the surface casing prior to the drilling of the borehole below that depth. The Contractor shall be paid for surface casing if, after logging the pilot hole, the Owner decides to abandon the project.

B. The space between the 18-inch diameter surface casing and the 24-inch diameter boring shall then be cemented with neat cement grout or sand cement grout, as specified in this Section, placed through a tremie pipe. Cement grout shall be placed from the total depth of the reamed borehole to 5 feet below ground surface. Allow for the accommodation of the pitless adapter. The placing of the cement grout shall be done in a manner that shall seal the annulus against infiltration of water. Regardless of the cementing method used, the difference in density between the cement outside the surface casing and the fluid within the casing must not be greater that 6.5 lbs/gal, and the casing must be kept completely full of liquid at all times until cement is set. The cementing of the surface casing shall be approved by the Engineer. The grout shall be allowed to set for a minimum period of 24 hours, or longer if directed by the Engineer. However, the time shall not exceed 72 hours.

3.6 PILOT HOLE

A. The pilot hole shall be drilled for the purpose of determining the thickness and characteristics of formations from ground surface to the bottom of the hole, the location of water-bearing strata, and other geologic and hydrologic information. Plumbness and alignment of the pilot hole shall be carefully monitored and, if found to exceed specifications, corrected by the Contractor before proceeding.

B. The pilot hole shall be a minimum of 10 inches in diameter. It shall be drilled from the bottom of the surface casing to the full depth as directed by the Engineer.

C. To obtain accurate depth determination, representative cuttings samples, and a straight and plumb hole, the Contractor shall comply with the following:

1. Maintain a reasonably constant rotary speed.
2. Maintain reasonably constant weight on the bit.
3. Maintain specified drilling fluid properties.
4. Maintain adequate facilities for the collection of representative cuttings samples.
5. Operate and maintain a drilling-rate recorder.
6. Use drill collars of appropriate diameter, weight, and length. Drill collar diameter should be of the maximum size allowable without interference with fluid circulation.

D. To assure that the pilot hole is started straight and plumb, the drilling rig shall be leveled so the drilling tools hang free and plumb in the center of the rotary table. The drilling rig shall be supported on jack pads properly designed and constructed so that undue settling does not occur. The Contractor shall periodically check the drilling rig level and make adjustments as necessary to correct the level.

3.7 DRILLING FLUID

A. Drilling fluid shall consist of a mixture of water and high-yield bentonite gel, with additives as approved by the Engineer. The drilling fluid is to contain a minimum of drilled clay and sand in order to deposit a thin, soft, easily removable filter cake on the face of the aquifers. If there is a conflict between the drilling fluid requirements for ease in drilling, and the drilling fluid requirements for protection of the aquifers, then the drilling fluid requirements for aquifer protection shall govern.

B. Acceptable drilling fluid constituents include high-yield bentonite, synthetic polymers, inorganic-phosphate thinning agents, and drilling detergents and foaming agents. Use of weighting materials will be avoided if possible. Lost-circulation materials shall not be used without prior approval of the Engineer and, except in extreme conditions, shall be limited to acid-wool. Use of polymer mud without bentonite to contribute to wall-cake development will not be allowed.

C. Drilling-fluid samples shall be collected at the flow line or point of discharge from the hole at least every 4 hours during drilling and reaming. The Contractor shall maintain careful drilling fluid control and have, on-site, the equipment necessary to measure and log the following drilling-fluid properties when requested by the Engineer:

1. Temperature, to the nearest one degree Fahrenheit.
2. Weight, in pounds per gallon.
3. Funnel viscosity, in seconds.
4. Thirty-minute water loss, filter-cake thickness, and sand content.

D. The Contractor shall consult with a drilling fluid Engineer agreed to by the Contractor, Engineer, and Owner regarding the proposed drilling fluid program. The drilling fluid Engineer shall check the drilling fluid within the initial 24 hours of drilling and as needed during pilot hole drilling and reaming. The drilling fluid Engineer will be available on a 24-hour basis to monitor the drilling-fluid properties.

E. The drilling fluid shall have the following properties in accordance with American Petroleum Institute (API) Code RP 138, "Recommended Standard Field Procedures for Testing Drilling Fluid." In the event that the following properties cannot be attained, the drilling fluid shall be replaced.

1. Weight: Drilling fluid weights below 9 pounds per gallon (lbs/gal; 67 lbs/ft^3) are recommended to speed drilling, minimize lost circulation, and prevent tight hole.
2. Funnel Viscosity: Normal viscosities of 30-40 seconds per quart are recommended with bentonite fluids to adequately clean the pilot hole. Viscosities of 40-60 may be needed for reaming by the direct-rotary method.
3. Water Loss: Filtrate values below 10 cc/30 minute should be maintained while drilling the pilot hole to allow time for logging and testing. Filtrate control should be maintained at 13 cc/30 minute or below while reaming.
4. Filter Cake: Filter cake thickness shall be 3/32-inch maximum.
5. Sand Content: Sand content of fluid entering the hole should not exceed 2 percent by volume.

F. Containment: The uncontrolled discharge of drilling mud onto the surface of the ground should be prevented by the use of portable or excavated mud pits.

1. If used, the portable drilling mud storage unit shall be appropriately sized to contain drilling fluids utilized for the well installation. Shale shakers and weir boxes shall be utilized as needed to process drill cuttings to maintain adequate drilling fluid characteristics.

2. If used, excavated mud pits should be sized large enough to contain drill cuttings estimated to be produced throughout the drilling process plus drilling fluid volume required for drilling method utilized.

    a. Should mucking pits become necessary due to higher production of cuttings that anticipated, or other unexpected conditions, circulation shall be stopped while pits are mucked. Mud pits shall be allowed time to settle after mucking is completed. Following mucking, contractor shall confirm acceptable mud-weight prior to restarting circulation.

3. The cuttings should be spread thinly at an area designated by the Owner Representative to avoid destroying the grass and vegetation. The Contractor shall restore the land surface at the well site to the original condition following completion of drilling activities.

3.8 DEVIATION SURVEYS

A. The Contractor shall make deviation surveys at intervals of not more than 100 feet during drilling between ground level and the total depth of the well or as necessary to maintain specified plumbness and alignment. The maximum horizontal deviation shall not exceed two-thirds the inside diameter of the casing per 100 feet of depth. Plumbness and alignment shall follow the standard set forth in Section 8 of the American Water Works Association (AWWA). Surveys shall be made with a Totco Self-Checking Mechanical Drift Indicator or approved equal. Alternate plans that call for deviation surveys at longer intervals or no deviation surveys during drilling of the pilot hole will not be approved.

B. The drift survey tool shall be tested above ground surface prior to performing any deviation surveys to assess if it is operating properly. The test shall consist of suspending the tool vertically from a thin wire attached to the top of the tool. The tool shall be set and allowed to shoot and the deviation noted. The tool shall then be set at an angle of several degrees from horizontal and shot again. The angle at which the tool was set and the deviation shall be noted.

3.9 DRILL CUTTING DISPOSAL

A. The Contractor shall dispose of cuttings in an area on-site approved by the Owner.

3.10 DRILL CUTTING SIEVE ANALYSES

A. During pilot hole advancement, the Contractor shall collect drill cuttings as specified in Article 1.11.E at 10-foot intervals and of sufficient quantity (minimum of 1 quart by volume) to allow for sieve analyses of up to 25 soil samples as directed by the Engineer.

B. Sieve Analysis of said intervals shall be the responsibility of the Contractor. If Sieve Analysis is required by the Engineer, an allowance included in the Bid Schedule will be used to cover the cost of the sieve analyses. On the completion

of this work, the Contractor shall invoice the Owner for the actual cost of the analyses plus a 10% processing fee to cover expenses incurred by the Contractor in handling the arrangement.

3.11 GEOPHYSICAL LOGS

A. Upon completion of the pilot hole, the hole may be surveyed by means of geophysical well log equipment, such as that provided by reputable contractors approved by the Engineer. The survey shall include the following logs, or as agreed upon between the Engineer and the geophysical survey company:

1. Resistivity (short and long normal)
2. Spontaneous potential
3. Gamma ray
4. Sonic
5. Caliper
6. Hole deviation

B. In the event that geophysical survey of the hole is found necessary, the Contractor shall enter into an agreement with the geophysical survey company to conduct the scope of work specified by the Engineer. On the completion of this work, the Contractor shall invoice the Owner for the actual cost of the geophysical survey plus 10% processing fee to cover expenses incurred by the Contractor in handling the arrangement. An allowance is included in the Bid Schedule to cover the cost of the possible geophysical logging of the drill hole.

C. There will be no additional payment for rig time or standby time while performing the Geophysical Log. No standby time will be paid for a 16-hour period after the geophysical log has been completed while the Engineer interprets the results and identifies discrete interval water sampling zones.

3.12 DISCRETE-INTERVAL WATER SAMPLING

A. After reviewing the geophysical logs, along with the lithological logs, the Engineer may elect to collect discrete-interval water samples from up to two (2) separate zones in the pilot hole. The general method for isolating and collecting a water sample shall be to construct a temporary well on the drill pipe and pump or air-lift pump the water to the surface. The samples shall be collected by running a 10- or 20-foot long, 4-inch diameter perforated steel section with machined 0.05-inch wide (or larger, if compatible with filter pack) horizontal openings on the bottom of the drill pipe. Ten-foot (10) thick bentonite seals shall be installed above and below the targeted sample interval. The seals shall be tremied to the base and above the zone to be sampled. The seal shall consist of a mixture containing approximately 65% granular bentonite and 35% 10-20 gradation Colorado Silica Sand or approved equal. A filter pack, consisting of 3/8” diameter

pea gravel, or other approved material, shall be tremied around the perforated pipe and extend approximately 5 feet above the top of the perforations.

B. In order to allow for collection of samples, the Contractor will place a submersible pump (if using a mechanical pump) or place an air-induction pipe inside the drill pipe to provide an air source (if sampling using air-lifting). The air compressor used for air-lift pumping shall be sized so that lifting of the water sample from the bottom of the borehole shall not be a problem. The air induction pipe shall be set at a depth which shall provide sufficient submergence to efficiently air-lift water to the surface.

C. In order to ensure that the seals effectively isolate the zone intended to be sampled, the water level above the upper seal, if present, shall be monitored during air-lift pumping.

D. The Contractor shall provide an estimate of flow/production from each sampling interval during pumping.

E. The Engineer shall collect the discharged water sample when the return water is relatively clear and free of fine-grained sediments, or after 8 hours of pumping. Arrangements for water analysis shall be the responsibility of the Engineer. Water samples will be analyzed for the list of constituents specified below:

Metals	**Anions/Dissolved Species**
Aluminum	Chloride
Antimony	Fluoride
Arsenic	Nitrate (measured as Nitrogen)
Barium	Nitrite (measured as Nitrogen)
Beryllium	Sulfate
Calcium	TDS
Cadmium	Phosphate
Chromium	Alkalinity
Copper	Carbonate
Lead	Bicarbonate
Iron	Total Hardness
Magnesium	Turbidity
Manganese	pH
Mercury (inorganic)	**Radiogenics**
Potassium	Gross Alpha
Selenium	Gross Beta
Sodium	Radium 226 and Radium 228 (combined)
Silver	**Dissolved Metals**
Strontium	Iron
Thallium	Manganese
Uranium	Silica
Zinc	

3.13 PILOT HOLE ABANDONMENT

A. If the results of the discreet interval sampling or other information indicate that completion of the production well is not justified, then the Contractor shall abandon the pilot borehole at the request of the Owner. The Contractor shall complete the pilot hole abandonment by plugging with neat cement grout, in accordance with the requirements of the Navajo Nation Primary Drinking Water Regulations, Minimum Design Regulations, subpart 1506.

3.14 WELL INSTALLATION AND COMPLETION

A. Work in connection with the production well shall commence after completion of all work pertaining to the pilot hole for the well. Materials for the well completion shall not be ordered until the Engineer has reviewed the drill cuttings, sieve analysis of the cuttings, geophysical logs, water sample analysis, and flow estimates, as applicable.

1. Should the contractor elect to partially or fully demobilize and remobilize between pilot well and production well completion phases, this work is incidental to the mobilization/demobilization item or items listed on the Bid Form.

2. At a minimum, it is anticipated that one month will be needed for the Owner and Engineer to obtain and evaluate water quality analysis results before proceeding to the well installation and completion phase.

3.15 REAMING BELOW THE SURFACE CASING

A. The pilot hole shall be reamed to a 14.75-inch diameter from the bottom of the surface casing to the total drilled depth. The Contractor shall not begin the reaming until it has been ascertained that the drilling fluid can be maintained within specified limits and the casing, perforated casing, and filter pack will be available when needed so as to provide for continuous well construction after the well has been reamed. The Contractor shall keep the borehole completely filled with drilling fluid from the time the borehole is drilled to total depth until the well is completed.

3.16 WELL CASING INSTALLATION

A. Casing installation shall be handled by methods that will cause no damage. Installation of casing shall not begin until all required materials are on-site, tallied and marked. The Contractor shall provide the casing tally for review to Owner's representative before beginning casing installation. The Contractor shall be responsible for ensuring well casing and screens are installed at the depths indicated on the Design Drawings or as directed by the Engineer.

B. The casing shall be suspended above the bottom of the hole a sufficient distance to assure that none of the casing is supported from the bottom. The weight

indicator shall be monitored continuously while the casing string is being lowered; at no time shall the casing string be placed in compression.

C. Inspect the end of each section to be joined for debris, residue, burrs or other conditions that may prevent proper alignment and joining of the sections.

D. Verify casing is properly seated and plumb at the alignment holes prior to commencing welding.

E. Complete casing welding with qualified personnel, approved methods, and appropriate electrodes for the material or materials being joined, according to Part 3.4, titled "Welding", of this Technical Specification.

F. Perforations

1. Exact depths for the screen shall be determined based on lithological logs, geophysical logs and discrete-interval water sampling results by the Engineer.

2. Dissimilar metal connections shall be installed between the low-carbon steel casing and the stainless-steel screens using welding methods described in this Specification.

3. A 0.5-inch bull nose end cap of the same material will be attached to the end of the casing, below the lowermost screened interval.

G. Centralizers

1. All centralizers shall consist of a minimum of three 1-foot long rigid guides, composed of the same screen or blank casing material to which they are being welded.

2. All guides shall be welded to the casing with 2-inches minimum standoff from the casing, spaced evenly around the circumference of casing.

3. Centralizing guides shall be installed throughout the perforated section of the casing by the Contractor, at no more than 100-foot intervals, including guides at the top and bottom of each perforated section.

   a. Guides within screened intervals shall be placed across the welded joint of the two sections and never on the screen itself.

4. Centralizing guides shall also be placed on blank casing sections every 100 feet or as directed by Engineer.

H. Landing Clamp

1. After the casing has been successfully installed in the well, and suspended in tension, the casing string shall be landed. The casing string shall be landed on the surface casing with the casing clamp resting on the stiffener ring. The casing clamp shall be installed on the production casing as instructed by the Engineer, first bolted to and then welded top and bottom to the casing. The casing clamp arms shall be inserted into notches cut into

the surface casing so that they rest on the stiffener ring. The casing clamp shall then be welded to the surface casing and the stiffener ring.

3.17 THINNING OF DRILLING FLUID

A. After the assembled casing is centered in the borehole, tubing or drill pipe shall be inserted into the casing to total depth. The drilling fluid shall be thinned by introducing a steady stream of clear water to the settling pit at the well discharge trench as fluid is circulated through the hole.

B. While clear water is being added, heavy fluid shall be pumped to waste from the lower part of the suction pit. The fluid shall be circulated through the tremie pipe in the annulus and tubing, or drill pipe inside the casing, until the drilling fluid has been thinned until it has the following properties:

1. Weight: Drilling fluid weight shall be a maximum of 8.5 lbs/gal (64 lbs/ft^3).

2. Viscosity: Funnel viscosity shall be a maximum of 28 seconds.

3. Sand Content: Sand content of mud entering the well bore shall be a maximum of 1 percent by volume.

C. The Contractor shall make adequate preparations to ensure that circulation will be continuous from the time that watering-back of the drilling fluid begins until the time the filter pack is completely in place.

3.18 FILTER-PACK PLACEMENT

A. The annular space between the borehole and the casing shall be filled with the specified filter pack to the depths above and below the screened interval or intervals as shown on the Design Drawings or directed by the Engineer. The sand shall be placed to ensure continuity without bridging, voids, or segregation.

B. Gravel/sand must be placed through a string of tremie tubing installed in the borehole by the Contractor prior to installation of the well casing. Bottom of the tremie tubing shall run to within 80 feet of the bottom of the borehole. During filter pack installation, the tremie pipe shall be no more than 80 feet above the top of the filter pack level during placement. A minimum of 1/2 gallon of 12.5 percent sodium hypochlorite solution shall be added to every 1 cubic yard of gravel/sand as it is placed. Calcium hypochlorite will not be allowed. The tremie line shall be gradually withdrawn as the filter pack is deposited.

C. The Contractor shall provide means of measuring the volume of gravel/sand as it is installed, and continual checks must be made to prevent voids or bridging of the filter pack. The volume of all gravel/sand added shall be calculated and recorded at all times. Any amount placed which is less than the computed amount required shall be deemed a sign of voids or bridging and corrective measures shall be undertaken by the Contractor.

D. For each screened interval, once the filter pack has been measured at or near the upper depth called for on the Design Drawings, before placing bentonite seal, the Contractor shall swab the screened interval in 20-foot sections to settle the filter pack, remeasure the filter pack depth, and add additional filter pack. Then the Contractor shall repeat this process until the filter pack is settled at the designed depth.

3.19 ANNULAR SEAL

A. Bentonite seals shall be placed via tremie above and below the screened intervals to prevent commingling of waters. The Design Drawings indicate the position and thickness of the seals.

3.20 ANNULAR FILL

A. Pea gravel or grout shall be placed between screened intervals as shown in the Design Drawings via tremie pipe, which shall be set no greater than 80 feet above the top of the fill as it is placed to prevent bridging.

3.21 CEMENT SEAL

A. The neat cement grout or the sand cement grout seal shall be placed in the annulus above the uppermost bentonite seal to within 60 inches of ground surface. The first stage of the cement seal immediately above the bentonite seal shall be placed in a stage not to exceed 100 feet. This stage shall be allowed to set for at least 12 hours prior to placing final cement stages. The cement shall be placed using a sufficient number of stages such that casing will not be damaged. Each stage of cement shall be allowed to set for 12 hours prior to placing the overlying stage.

B. The cement seal shall be placed through a tremie pipe, which shall be set no greater than 80 feet above the top of the area to be sealed.

3.22 STEEL ANNULAR-CAP PLATE

A. The Contractor shall supply and install by continuous welds a steel annular-cap plate to cover the space between the production casing and the surface casing.

3.23 STEEL CAP FOR CASING

A. The top of the production casing shall be provided with a steel cap securely welded to the casing to cover and protect the well until the permanent pump installation has begun. The cap shall be steel plate, not less than 3/8-inch thick, and it shall be joined to the casing with a continuous weld. A steel cap as specified above shall be welded to the casing at all times during which no member of the Contractor's crew is present at the well site. The Contractor shall protect the well casing from entry of unwanted material at all times.

3.24 DISPOSAL OF WASTEWATER

A. Water produced by development and test pumping or other operations shall be disposed of on-site in a manner and at the location specified by the Engineer. Disposal of wastewater will be by such methods and to such locations that damage to structures, roads, or utilities does not occur. All costs incurred in connection with the disposal of wastewater will be incidental to well drilling and be borne by the Contractor.

1. The Contractor shall obtain a USEPA 402 water discharge permit, and any other permits required for disposal of wastewater not already provided by Owner.

3.25 DISPOSAL OF DRILLING MUD

A. Waste drilling mud shall be removed from the site upon completion of drilling operations, prior to development. The disposal location shall be the responsibility of the Contractor and be in accordance with all local, State and Federal regulations. Any applicable permitting and all costs incurred in connection with the disposal of the drilling mud will be incidental to well drilling and be borne by the Contractor.

3.26 WELL DEVELOPMENT, DISINFECTION AND WATER QUALITY TESTING

A. Well Development and Disinfection consists of the application of appropriate techniques designed to bring the well to its maximum production capacity with attendant optimization of well efficiency, specific capacity, stabilization of aquifer material, and control of suspended solids.

3.27 WELL DEVELOPMENT BY SWABBING AND ZONED AIR-LIFT PUMPING

A. The perforated portion of the well shall be developed by zoned air-lift pumping in contiguous 20-foot sections, from the bottom of the well to the top of the perforated casing. The air-lift pumping device for isolating the air-lift pump zones shall consist of a 20-foot length of pipe with 8-inch double-disc rubber washers, which fit tightly to the inside of the perforated casing, placed at each end. The design of the rubber washers shall be such that they will fold over if they become sanded in, but are firm enough to create thorough mechanical agitation of the filter pack. The pipe shall be perforated with holes no greater than 1-inch diameter to allow formation water to enter the device. The device shall be constructed such that the holes do not significantly reduce the strength of the pipe. The bottom of the pipe shall be sealed.

B. An air-induction pipe shall be run within the column pipe to provide an air source. The air compressor used for air-lift pumping shall be capable of producing a minimum flow of 120 gpm from the well. The air-induction pipe shall be set above the top of the perforated casing, or a depth (agreed upon with the Engineer) having sufficient submergence to perform air-lift development and maintained at

that depth as the zoned air-lift pumping device is withdrawn from the well, zone by zone.

C. The general procedure to be used during air-lift pumping development for each zone shall be:

1. Begin air-lift pumping a zone, measuring average flow and noting color and sand content of the water.
2. As the water clears, the air-lift tool shall be swabbed up and down several times and returned to the same zone. This shall be repeated until the discharged water remains relatively clean after swab throws.
3. The Contractor shall develop the perforated section with a minimum of two complete passes. The minimum amount of time devoted to each 20-foot zone during each pass is estimated at 60 minutes.
4. During development, the Contractor shall introduce through the column pipe a mud-thinning polymer to allow for break-up of fines.
5. Variation of the procedure, and additional time for development of each zone, shall be as directed by the Engineer. Additional development time, if any, shall be paid for at the unit bid price.

D. The Contractor shall discharge the produced water to a tank such that the pumping rate, appearance and sand content of the produced water can be measured. The Contractor shall record the time required for the water to clear, the pressure required to air-lift each zone, and the interval being developed for each period of pumping. Produced water in the tank will be discharged to a location approved by the Owner and Engineer prior to well development.

E. After air-lift pumping has been completed, the tool shall be withdrawn from the well. The well shall be sounded, and accumulated fill shall be bailed from the well to within 5 feet of the bottom of the casing.

3.28 DISINFECTION AFTER AIR-LIFT PUMPING

A. Immediately after well development by zoned air-lift pumping or swabbing is complete and prior to installing the test pump, the Contractor shall completely disinfect the well, per AWWA C-654 and AWWA 100 Section 4.9. Sixty-five percent HTH granular calcium hypochlorite shall be distributed evenly throughout the water column with a chlorine-basket. The chlorine basket shall have a fine mesh exterior and be of such design so that is can be lowered on a wire line to the full depth of the well and be capable of holding at least 10 lbs of chlorine. Disinfection with sodium hypochlorite will not be allowed with the exception of filter pack installation.

B. The quantity of chlorine used shall be equal to 1/2 lb for each 100 feet of water column in the well. The quantity of chlorine shall be sufficient to initially produce a chlorine concentration of 100 milligrams per liter (mg/l). Based on the above

ratio, the total quantity of chlorine shall be determined and placed in the chlorine basket. The basket shall then be run to the bottom of the well on a wire line and slowly retrieved. This process shall be repeated until all of the chlorine has dissolved. The chlorine-bearing solution shall remain in the well for a period of at least 24 hours.

C. In conjunction with disinfection with the chlorine basket, the Contractor shall wash the upper casing with a solution of chlorine and water. The solution shall be mixed in the ratio of 1 pound of chlorine for each 1,000 gallons of potable water, yielding a chlorine concentration of at least 100 mg/l. The inside of the production casing and the gage line shall be washed with the solution followed by thorough flushing with potable water.

D. During the time interval between disinfection, as described above and installation of the test pump, the well shall be capped with a 3/8-inch steel plate securely welded to the casing.

3.29 DEVELOPMENT BY PUMPING

A. The Contractor shall furnish, disinfect, install, operate, and remove a deep-well turbine pump or a submersible pump for developing the well. The permanent production pump furnished and installed for the Owner shall not be used for well development or well testing. The test pump and drop pipe shall be thoroughly disinfected pursuant to AWWA 100 Section 4.9 and AWWA C-654 prior to installation in the well. A chlorine solution of 100 mg/L minimum concentration shall be circulated through the pump for a minimum of 30 minutes. The exterior of the pump and the interior and exterior of the drop pipe shall be rinsed with the chlorine solution prior to installation. The pump and prime mover shall have a pumping range of 50 gpm to 200 gpm at a pumping level of 750 feet. If a turbine pump is used, the prime mover shall be a variable speed type. Development pumping shall be initiated within 7 (seven) days after development by air-lift pumping is complete.

B. The Contractor shall install and measure water depth with an electric-line probe, calibrated to 0.01 foot increments.

C. The initial pumping rate shall be restricted and, as the water clears, be gradually increased until the maximum rate is reached. The maximum rate will be determined by the Engineer after consideration of the well drawdown and discharge characteristics but is not anticipated to exceed 200 gpm. The Contractor shall be responsible for providing a flow meter, suitable to measure the rate of water discharge.

D. The pump shall not have a check valve. At proper intervals as determined by the Engineer, the pump shall be stopped and the water in the pump column shall be allowed to surge back through the pump and through the casing perforations.

E. The cycle of pumping and surging shall be repeated until the discharged water is clean of sand, silt, and mud and until there is no increase in specific capacity during at least 4 hours of continuous pumping and surging.

F. The Contractor shall continue development until the following conditions have been met, or as directed by Engineer:

1. Sand production is less than 15 parts per million (ppm) within 20 minutes after commencement of pumping at the maximum rate.

2. Average sand production does not exceed 5 ppm for a 2-hour cycle after commencement of pumping at the maximum rate as determined by the Engineer.

3. Specific capacity of the well is essentially stable for a minimum of 4 hours, and the specific capacity is the same for all of the different flow-rate steps after equal amounts of time.

G. Sand production shall be measured by a centrifugal-sand-separating meter as described in Journal of AWWA, Vol. 26, No. 2, February 1954 (Rossum sand sampler). The Contractor shall keep independent records of pumping time, flow rate, pumping level, sand production, and other discharge characteristics.

3.30 WELL TESTING

A. The Contractor shall furnish all necessary equipment and materials and make a complete pumping test of the well following development work. Test pumping shall consist of a 1,500-minute step-drawdown test (five 300-minute steps), a 24-hour constant-rate test, and associated recovery tests. The Contractor shall also supply an in-line flow meter to quantify discharge during the pump test. The Contractor will be responsible for providing equipment and collecting all flow and water-level measurements during the testing. Water level measurements shall be collected at one-minute intervals utilizing a transducer during all portions of the tests.

B. The step test shall commence no sooner than 24 hours after development pumping or other pumping is completed to allow the well to recover to static water level.

C. The flow rates for the step test shall be 50%, 75%, 100%, 150%, 200% of the design flowrate as specified by the engineer.

D. The driller shall supply an in-line sample port with a gate valve or other valve system approved by the Engineer, suitable for collecting water samples during the test. Upon completion of the step pumping test, the well shall be allowed to recover and remain shut off for 24 hours. Then a 24- hour constant-rate pumping test shall be conducted, followed by at least a 24-hour water-level-recovery period.

E. If the pump is shut off for any reason during the pumping portion of the test, or equipment problems interfere with maintaining a constant discharge rate, the

pump shall remain shut off for 24 hours and the complete test rerun at no additional cost to the Owner.

3.31 WATER QUALITY TESTING

A. Bacteriological Testing

1. In order to determine if the well contains unacceptable numbers of bacteria, the Contractor shall collect and properly preserve water samples from the well for bacteriological testing. No residual chlorine may be detected at the time of sampling. Bacteriological testing shall be performed and approved results received prior to the completion of pumping.

2. Bacteriological tests shall include total coliforms (presence/absence method). The water shall be deemed unacceptable if coliform bacteria are "present" in the collected water samples.

3. It shall be the Contractor's responsibility to see that the well is so tested and, if unacceptable, follow the disinfection procedures specified by the Engineer. Disinfection and subsequent testing shall continue until test results are approved, indicating acceptable conditions, or until a maximum of three disinfection procedures have been followed as outlined in the paragraph of this specification entitled "Disinfection After Air-Lift Pumping". If additional disinfection procedures are required, they shall be paid at the unit bid price.

4. Results of all bacteriological testing shall be provided for approval prior to the use of the well.

B. Constituent Sampling and Testing:

1. The Engineer shall collect the water sample for constituent analysis at the end of the constant-rate pumping test.

3.32 PRODUCTION PUMP INSTALLATION AND SURFACE COMPLETION

A. If an extended period of time passes between initial development and pump testing of the well and production pump installation, contractor shall perform additional development by pumping as directed by Engineer.

1. The production pump shall not be used for this development by pumping.

2. The pump used shall be of equivalent or greater capacity as pump specified in initial development by pumping.

B. Surface completion shall include the following:

1. Cutting of the surface casing to the appropriate depth for pitless installation;

2. Installation of the pitless adaptor with 2-foot casing stickup above grade and cast or forged, bolted, locking, watertight cap with screened air vent (24 mesh or smaller);
3. Installation of electrical conduit and discharge line stub-outs (capped and marked);
4. Installation of a minimum 4" thick, formed and poured concrete slab around the well head, sloped to drain away from the well head, and appurtenances.

C. The well shall be equipped with a production pump and necessary appurtenances to produce water, as directed by the Engineer after well production is determined by the well test. Other well appurtenances to be installed downhole will include:

1. Drop pipe and four (4) check valves.
2. Pump wire sufficient for the pump with 10 extra feet to be left coiled at the well head.
3. The sounding tube and pump wire shall be fastened to the drop pipe at ten foot intervals as the pump assembly is installed.
   a. See Design Drawings for sounding tube terminations at pump depth and at surface.
4. Transducer:
   a. Install transducer with slimline sink weight downhole within the sounding tube.
   b. Secure and coil transducer cable at the wellhead until installation within conduit to pumphouse by Contractor's Electrician.
   c. Contractor's Electrician shall connect transducer cable to the specified termination box within the pumphouse as per electrical Design Drawings.
   d. Ensure termination of transducer cable always remains dry and sealed from moisture.

D. The Contractor shall complete a start-up test of the pump and motor installed in the well. If necessary, a temporary pump control box, power source, temporary discharge piping, and other equipment needed to perform the start-up test are incidental to the work.

3.33 RESTORATION OF DISTURBED AREAS

A. After the work is completed, the Contractor shall fill the mud pits with cuttings. All trash and debris generated by the Contractor shall be contained and disposed of in a manner acceptable to the Owner. The Contractor shall restore the site to its original condition as approved by the Owner. Restoration of construction easements shall require reseeding as required in the Basic Requirements specification and further detailed in Technical Specification 32 92 19 (Seeding).

B. Contractor shall exercise care to minimize damage from the use of equipment in paved, lawn, or landscaped areas, and unless otherwise specified in the contract agreement. Contractor shall repair wheel ruts and track marks, patch pavements, and restore the ground or paved surface to the extent practicable, to its former condition. All surplus material shall be handled as specified above and the site left in a neat condition.

C. All costs associated with the restoration of the work site will be incidental to the Contractor.

3.34 SECURITY AND PROTECTION OF THE WELL

A. Security and protection of the water well prior to the installation of a final pitless adapter shall be ensured by a 3/8" steel plate lid fastened to the production casing. Between disinfection and well development activities the lid will be padlocked. Upon completion of the well and installation of the pitless adapter, the Contractor shall perform final bacteriological testing. Following Engineer's approval of the bacteriological testing confirming "absence" of total coliform, the casing shall be sealed. The well vent and all other openings will be screened (24 mesh or smaller).

END OF SECTION

SECTION 44 44 16

CHLORINATION EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section includes the following:

1. Vacuum operated sonically regulated gas feed system with automatic switchover, capable of both manual and automatic control having a feed range of 20:1 manual and 10:1 automatic and the capability to control within ±4% of the indicated feed rate.

2. Equipment for Chlorination:

a. Vacuum regulator with automatic switchover.

b. Control unit.

c. Chlorine vacuum switch

d. Injector.

e. Chlorine solution diffuser assembly.

f. Chlorine vent and vacuum tubing.

g. Electronic two cylinder scale.

h. Self-contained breathing apparatus and hard case.

i. Dual Vacuum Switch

1) Outputs.

a) Low Limit

b) High Limit

B. Related Sections:

1. Section 22 11 05 - Chlorination Facility Plumbing.

1.2 REFERENCES

A. ASTM International:

1. ASTM D1785 - Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120.

2. ASTM D2466 - Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40.

3. ASTM D2467 - Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80.

4. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.

5. ASTM D3035 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based for Controlled Outside Diameter.
6. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
7. ASTM F714 - Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.

B. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.3 PERFORMANCE REQUIREMENTS

A. Maximum capacity of 200 pounds per day (ppd) of chlorine and sized to feed 10 ppd.

1.4 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings:

1. Submit detailed certified dimensional shop drawings for materials and equipment, including wiring and control diagrams, performance charts and curves, installation and anchoring requirements, fasteners, and other details.
2. Submit complete listing of items being provided and schematic diagram of each system. Include in schematic diagram tag marks for each item of equipment cross-referenced to chlorine system equipment list. Include specialty valves and fittings on schematic and list.

C. Product Data:

1. Submit complete information concerning materials of construction, fabrication, and protective coatings.

D. Test Reports:

1. Submit certified field performance test results.

E. Manufacturer's Installation Instructions:

1. Submit detailed instructions on installation requirements including storage and handling procedures, anchoring, and layout.
2. Submit application, selection, and hookup configuration with pipe and accessory elevations. Submit hanging and support requirements and recommendations.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

G. Manufacturer's Field Reports: Indicate equipment has been installed in accordance with manufacturer’s instructions.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 00 00 - Execution Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations and final orientation of equipment and accessories.

C. Operation and Maintenance Data: Submit maintenance instructions for equipment and accessories.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with the contract documents and manufacturer's recommendations.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section.

B. Installer: Company specializing in performing work of this section.

1.8 PRE-INSTALLATION MEETINGS

A. Section 01 00 00 - Administrative Requirements: Pre-installation meeting.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 01 00 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspect for damage.

C. Store products in areas protected from weather, moisture, or possible damage; do not store products directly on ground; handle products to prevent damage to interior or exterior surfaces.

D. Protect systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Section 01 00 00 - Product Requirements: Environmental conditions affecting products on site.

B. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface structures or utilities, in immediate or adjacent areas.

1.11 SCHEDULING

A. Section 01 00 00 - Administrative Requirements: Requirements for scheduling.

B. Schedule work after concrete work for support pad and prior to connecting piping work.

1.12 COORDINATION

A. Section 01 00 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate installation and start-up with Engineer.

1.13 WARRANTY

A. Section 01 00 00 - Execution Requirements: Requirements for warranties.

2.1 VACUUM REGULATOR

A. Manufacturers:

1. Siemens/Wallace & Tiernan Model 210S

2. Substitutions: Section 01 00 00 - Product Requirements.

B. The cylinder mounted vacuum regulator shall be rated for 200 pounds per day (ppd).

C. Vacuum regulator shall be designed to reduce full supply pressure to a vacuum without venting.

D. A self-aligning yoke shall be provided as an integral part of the vacuum regulator.

E. The unit shall include a selector knob and icons to indicate the chlorine gas container status.

F. An off position shall be provided to isolate the diaphragm and internal components from atmospheric air when the operator changes containers.

G. It shall contain internal pressure relief.

H. Provide regulator with the following:

1. Spring loaded, diaphragm actuated pressure relief valve.

2. Gas vent.

3. Gas inlet filter.

4. Reset knob to return supply indicator back to standby when gas source is replenished.

5. Vent line connectors.

6. Vacuum line connections.

2.2 AUTOMATIC SWITCHOVER

A. Manufacturers:

1. Siemens/Wallace & Tiernan Model 210S.

2. Substitutions: Section 01 00 00 - Product Requirements.

B. An automatic switchover system shall be furnished to change over to a new supply as the on-line supply is depleted.

C. A pair of vacuum regulating valves with built-in switchover capability shall be furnished.

D. The regulator valve shall include a mechanical detent to keep the standby gas supply ready for on-line service.

E. When the switchover is accomplished gas shall continue to be drawn from the former source until the container is empty.

F. A separate switchover device will not be acceptable.

G. Each regulator shall include easy to read indication of stand-by, operating, empty, and off position.

2.3 CONTROL UNIT

A. Manufacturers:

1. Siemens/Wallace & Tiernan Model S10K.

2. Substitutions: Section 01 00 00 - Product Requirements.

B. Control unit shall consist of a 5 inch rotameter with a V-notch rate valve capable of local control.

C. Rotameter tube shall be serviceable without removing the frame from its mounting.

2.4 CHLORINE VACUUM SWITCH

A. Manufacturers:

1. Siemens/Wallace & Tiernan Model AAA-3380

2. Substitutions: Section 01 00 00 - Product Requirements.

B. Provide dual function vacuum switch to sense low or high gas vacuum condition on chlorine gas line. Switch shall be designed for chlorine service applications.

C. Switch shall be mounted on control panel adjacent to chlorine feeder and shall sense the vacuum level between the injector and rotameter assembly.

D. Include the following:

1. Two alarm outputs.

2. One high vacuum alarm contact and one low vacuum alarm contact

3. Two non-latching output relays with NO and NC contacts

E. Provide 1 to 100 second adjustable delay for latching alarm relay.

F. Adjustable low alarm within range of 0 to 10 in Hg. Adjustable high alarm within range of 20 to 30 in Hg.

G. Enclosure: NEMA 4X.

2.5 INJECTOR

A. Manufacturers:

1. Siemens/Wallace & Tiernan, Throat and Tailpiece Model 99-D.
   a. Confirm back pressure with Engineer during submittal review.

2. Substitutions: Section 01 00 00 - Product Requirements.

B. Gas feeder shall have a PVC 3/4 inch fixed throat injector rated 200 ppd to generate the operating vacuum for the system.

C. Injector shall include built-in double check valve protection to prevent water from back flooding into the vacuum regulator.

D. Injector shall include an integral mounting bracket, capable of mounting in either the vertical or horizontal plane.

2.6 CHLORINE SOLUTION DIFFUSER ASSEMBLY

A. Manufacturers:

1. Municipal Treatment Equipment, Inc.

2. Substitutions: Section 01 00 00 - Product Requirements.

B. Type: Pipe insertion.

C. Size and number of orifices in diffuser to disperse chlorine solution along entire length of diffuser to ensure adequate mixing of solution with water flowing through pipe.

D. Diffuser assembly shall be constructed of schedule 80 PVC.

E. Diffuser assembly shall incorporate a tru-union mounted isolation ball valve with TFE seats and Viton o-rings, as manufactured by Spears or Asahi. An additional Viton seal shall be installed between the isolation ball valve and the diffuser union to provide a water tight seal around the diffuser tube while it is being inserted or withdrawn from the process line.

2.7 CHLORINE VENT AND VACUUM TUBING

A. Flexible Polyethylene Pipe: Pipe and fitting shall conform to ASTM D3350, PE345444C, SDR 7, ASTM D3035, and ASTM F714.

2.8 ELECTRONIC TWO CYLINDER SCALE

A. Manufacturers:

1. Force Flow Chlor-Scale 150 Model GR150-2.

2. Substitutions: Section 01 00 00 - Product Requirements.

B. Scales:

1. A quantity of two (2) chlorine scales shall be provided and shall be of the digital readout/electronic load cell type.

2. Scale platform shall be constructed of non-corrosive PVC plastic and sized to accept 150 lb. cylinders from 10-1/4 to 10-1/2 inches diameter.

3. Platform height shall be no more than 1-5/8 inches to allow easy handling and unloading of cylinders.

4. Platform scale coating system shall be a minimum dry thickness of 80 mils and be resistant to moisture, chemicals, abrasion, impact, and UV light.

5. Scale shall be of the single load cell design.

6. Weight shall be transferred via a pivoted platform to a single stainless steel canister load cell of the electronic strain gauge type.

7. Load cell shall be mechanically sealed with o-rings.

8. Potted-type load cells shall not be accepted.

9. Flexible cable shall connect the load cell to the indicator to allow easy remote installation of the readout.
10. Cable length shall be 10 feet.
11. Cylinder chaining bracket shall be wall mounted and use a double coil chain and a spring loaded snap hook to sure cylinder.
12. Chaining bracket shall have an integral tool rack for storing cylinder change-out tools.

C. Indicator:

1. Indicator shall monitor 2 channels.
2. The remote mounted LCD indicator shall carry CE marking and shall be housed in a NEMA 4X, UL approved enclosure.
3. All operations shall be keypad operated and menu driven in order to avoid compromising the NEMA 4X seal at anytime.
4. The alphanumeric LCD readout shall have backlighting for readability in low light conditions.
5. Power requirement shall be 110-220 VAC.
6. A 6 digit numerical display shall give operator the ability to monitor chemical by weight (lb or kg) or volume (gallons or liters).
7. A bar graph display shall read 0-100% for the net contents.
8. A dual mode TARE key shall allow user to enter tare weight of the vessel or enter the net weight of the chemical depending on application needs.
9. A diagnostics menu shall allow recalibration without the need to apply field weight tests.
10. A user adjustable filter function shall stabilize display in the event of vibration from pumps or mixers in the immediate vicinity of the scale.
11. Indicator shall output net weight via a 4-20 mA signal and full scale output shall be user adjustable via the keypad.
12. Indicator shall have four adjustable set points to display low or high level conditions on the indicator.

D. Scale shall carry a full five (5) year factory warranty; “Limited” warranties shall be considered unacceptable.

E. Full scale accuracy shall be better than 1%.

2.9 SELF-CONTAINED BREATHING APPARATUS AND HARD CASE

A. Manufacturers:

1. Self-contained breathing apparatus: Survivair Cougar Model #6888888.
2. SCBA hard case: MSA Model # 983867.
3. Substitutions: Section 01 00 00 - Product Requirements.

B. Self-contained Breathing Apparatus:

1. Open-circuit, positive pressure self-contained breathing apparatus suitable for use in chlorine gas atmosphere.
2. Certified by NIOSH to provide a nominal service time of 30 minutes.
3. Low-pressure (2216 psig) aluminum air cylinder containing 30 minute air supply.
4. NIOSH-approved facepiece.
5. First stage regulator.
6. Second stage regulator.

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify layout and orientation of equipment, accessories and piping connections.

3.2 INSTALLATION

A. Install equipment and accessories as indicated on Drawings.

B. Install chlorine vent and vacuum tubing in Schedule 80 PVC pipe to location outside of building wall. Install turned down elbow and terminate with fine mesh insect screen.

C. Cleaning:

1. Clean portions of chlorine system to remove cutting oil, grease and other foreign materials; do not use hydrocarbons or alcohols, for cleaning residuals from these materials.
2. Before use, dismantle and clean new valves or other equipment received in oily condition. Test valves with clean dry air at 150 psi for seat tightness before installation.
3. Dry chlorine piping before use. Use steam and dry air. When steam and dry air are not available purge completed system with dry cylinder air or nitrogen to remove moisture.

3.3 FIELD QUALITY CONTROL

A. Section 01 00 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Preliminary Leakage Testing: Pressurize entire chlorine system with nitrogen to at least 150 psig. With system under pressure, test each joint and connection for leaks by application of soapy water to each joint and connection.

C. Final Leakage Testing: Test automatic chlorinators first to ensure chlorinators are operational. Use chlorinators to evacuate system in event leaks are found. Perform in the following sequence:

1. Check unions and pipe connections in chlorine system for tightness.
2. Open header and auxiliary valves one turn.
3. Soak rag with strong ammonia water (commercial 26 Be) and swab each joint and connection.
4. Momentarily open one chlorine cylinder valve to pressurize system to approximately 10 psig then shut off tight; observe chlorine leaks evident by formation of dense white smoke.
5. When leaks are found, turn on automatic chlorinators to evacuate system, then repair leaks; retest joints and connections after repairs are made.

D. Performance Testing: Test each piece of chlorination equipment under design conditions for two to four hours to demonstrate proper functioning and automatic regulation of system; test alarms and signal generation; exercise equipment control and manual override where applicable; demonstrate equipment safety features.

E. Equipment Acceptance: Adjust, repair, modify or replace components failing to perform as specified and rerun tests; make final adjustments to equipment under direction of manufacturer's representative.

3.4 MANUFACTURER'S FIELD SERVICES

A. Section 01 00 00 - Quality Requirements: Requirements for manufacturer’s field services.

B. Furnish services of manufacturer's representative experienced in installation of products supplied under this specification for one half day at project site for installation inspection and field testing, and instructing Owner's personnel in maintenance of equipment.

C. Furnish Installation Certificate from equipment manufacturer's representative attesting equipment has been properly installed and is ready for startup and testing.

3.5 SPARE PARTS

A. Contractor shall supply the following spare parts to NTUA, at a location to be specified by NTUA within 75 miles of the project site:

1. Two (2) SCBA units with hard cases
2. Four (4) PM Kit – 210/510 vacuum regulator
3. Two (2) PM Kit – ¾” standard injector
4. Two (2) PM Kit- 5” rotameter
5. Two (2) Orifice V-notch Teflon
6. 50 LF 3/8” OD PE tubing

END OF SECTION