

Lake Valley Residential Wells

Technical Specifications

DIVISION 1 - GENERAL REQUIREMENTS

01 00 00 Basic Requirements

DIVISION 3 – CONCRETE

03 05 00 Basic Concrete Materials and Methods

DIVISION 31 – EARTHWORK

31 10 00 Site Clearing
31 22 13 Rough Grading
31 23 17 Trenching
31 23 18 Rock Removal
31 23 23 Backfill

DIVISION 33 – UTILITIES

33 12 13 Water Service Connections
33 12 19 Hydrants
33 13 00 Disinfection of Water Utility Distribution
33 21 13 Water Supply Wells

DIVISION 26 – Electrical

26 01 00 General Provisions
26 11 00 Raceways
26 12 00 Wires and Cables
26 13 00 Outlet Boxes
26 13 30 Cabinets
26 14 00 Wiring Devices
26 15 00 Motors
26 16 00 Panelboards
26 19 00 Relays and Contractors
26 45 00 Grounding

SECTION 01 00 00
BASIC REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Summary:
 - 1.2: Contract description.
 - 1.3: Special considerations.
 - 1.4: Work by Owner.
 - 1.5: Contractor's use of premises.
 - 1.6: Specification conventions.
 - 1.7: Minimum wage rate determination.

- B. Price and Payment Procedures:
 - 1.8: Testing and inspection allowances.
 - 1.9: Schedule of values.
 - 1.10: Applications for payment.
 - 1.11: Change procedures.
 - 1.12: Unit prices.
 - 1.13: Alternates.

- C. Administrative Requirements:
 - 1.14: Coordination.
 - 1.15: Suspension of Work.
 - 1.16: Field engineering.
 - 1.17: Pre-Construction Conference.
 - 1.18: Progress meetings.
 - 1.19: Cutting and patching.

- D. Submittals:
 - 1.20: Submittal procedures.
 - 1.21: Construction progress schedules.
 - 1.22: Proposed products list.
 - 1.23: Product data.
 - 1.24: Shop drawings.
 - 1.25: Test reports.
 - 1.26: Manufacturer's instructions and certificates.

- E. Quality Requirements:
 - 1.27: Quality control.
 - 1.28: Tolerances.
 - 1.29: References.
 - 1.30: Manufacturer's field services and reports.
 - 1.31: Examination.

- F. Temporary Facilities and Controls:
 - 1.32: Temporary services.
 - 1.33: Access roads.
 - 1.34: Progress cleaning and waste removal.
 - 1.35: Project identification.
 - 1.36: Barriers and fencing.
 - 1.37: Protection of installed work.
 - 1.38: Security.
 - 1.39: Water control.
 - 1.40: Pollution and environmental control.
 - 1.41: Removal of utilities, facilities, and controls.

- G. Product Requirements:
 - 1.42: Products.
 - 1.43: Delivery, handling, storage, and protection.
 - 1.44: Substitutions.

- H. Execution Requirements:
 - 1.45: Closeout procedures.
 - 1.46: Final cleaning.
 - 1.47: Starting of systems.
 - 1.48: Demonstration and instructions.
 - 1.49: Testing, adjusting and balancing.
 - 1.50: Protecting installed construction.
 - 1.51: Project record documents.
 - 1.52: Operation and maintenance data.
 - 1.53: Spare parts and maintenance materials.
 - 1.54: Warranties and product registration.

1.2 CONTRACT DESCRIPTION

- A. Work of the Project includes construction of up to seven (7) domestic potable water supply wells, each to an estimated depth of 500 ft, including the necessary downhole and site electrical, plumbing and related appurtenances to serve water to existing homes within Lake Valley Navajo Chapter, McKinley County, NM

- B. The seven well sites are located at homesites of Lake Valley Navajo Chapter residents. The project area is north of Chaco Wash and east of Highway NM 371, approximately 35 miles North of I-40/Crownpoint, NM.

- C. 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 confine operations to the construction site and existing access routes.
- D. 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.
- E. 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.
- F. The allowable length of trench left open overnight is limited per Section 31 23 17 - Trenching. Contractor shall abide by all specified requirements included therein either directly or by reference.
- G. Contractor shall notify Engineer of any proposed grading or other improvements of existing roads desired to improve access to the project site.
- H. There may be no electric service to some sites. The Contractor is responsible for providing a suitable temporary power source adequate for running all equipment needed to perform the work. Providing this temporary power source is incidental to the work.
- I. Contractor must provide water for construction at the Contractor's expense. The Owner and Engineer will assist the Contractor to locate a water source if requested. Contractor shall obtain and abide by requirements of water use or import permits from the Navajo Nation Water Code Administration, as applicable, with assistance provided by the Engineer.
- J. Contractor shall obtain and abide by requirements of well drilling permits from the Navajo Nation Water Code Administration with assistance provided by the Engineer. Copies of the permits are required to be maintained on site by the Contractor at all times.
- K. Any Navajo Nation Water Code Administration Permit fees paid by Contractor shall be reimbursed via the allowance in the bid form.
- L. 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.
- M. Contractor shall submit a Testing and Disinfection schedule to the Engineer for approval prior to performing the respective activities. Hydrostatic testing of the waterline, disinfection and bacteriological testing shall follow specifications outlined in 33 13 00 Disinfection of Water Distribution, AWWA C600, AWWA C605, AWWA C651 and New Mexico Standard Specifications for Public Works Construction.

- N. Prior to beginning construction activities, the Contractor must furnish full-coverage video or photo documentation of the entire construction site, per SC-2.05.B of the EJCDC C-800 Supplementary Conditions. The video or photos must include coverage of all areas and adjacent features that may potentially be impacted by the impending construction work. Contractor must submit a copy of the video or photo documentation as part of the submittal process.
- O. Contractor shall prepare record drawing information using swing ties and as-built redlines on the drawings. Refer to Article 1.49 Project Record Documents below and General Notes on the Drawings for specific requirements related to As-Built Drawings.
- P. Contractor shall coordinate with Engineer for final location of infrastructure. Contractor shall notify Engineer prior to performing the respective activities.
- Q. Contractor must always maintain a full set of Drawings and Technical Specifications at the construction site 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.
- R. Contractor shall be responsible for notifying residents of construction. Access to driveways must be maintained at all times.
- S. Construction work will generally not be permitted on the following Federal-recognized holidays: New Year's Day, Martin Luther King, Jr.'s Birthday, President's Day, Memorial Day, Independence Day, Labor Day, Columbus Day, Veterans' Day, Thanksgiving Day, and Christmas Day. When any of the above holidays fall on a Saturday and the preceding Friday is established as a holiday for Government employees, or when any of the above holidays fall on a Sunday and the Monday following that day is established as a holiday for Government employees, no construction will be permitted on those days. However, the Owner, when in his/her opinion it is justified, may grant the Contractor permission to work on any of the above days upon advance written request by the Contractor.
- T. On occasion, with no set schedule, the Navajo Nation may call for religious observances lasting from one to several days when work is not to be completed on-site. The Contractor will be compensated for the suspension by an extension of time to the contract performance period equal to the number of suspension days due to the tribal religious holiday.
- U. Upon completion of the Work, ground surfaces will be restored to their original condition by grading.
- V. In the event the Contractor encounters items of historical importance, the Engineer and the Owner shall be notified immediately and the work in the area shall immediately cease. Activity will cease until the Owner has consulted the Resident Project Representative and informed the Contractor of any steps to be taken or told to proceed with construction.
- W. Archaeological Discovery in the Absence of Archaeological Monitoring: If the contractor discovers any 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. Activity will cease until the Engineer informs the Contractor if any steps are required to be taken prior to proceeding or told to proceed with construction.

- X. Contractor shall confine operations to the construction site. Contractor shall be responsible for obtaining permission for any activity outside of the established and approved construction areas.
- Y. Contractor shall propose and get approval from Owner of an area to store construction debris including unsuitable material from site grading and/or excavation where it will not be a nuisance. All debris shall be contained in such a manner that will prevent scattering. All debris, including trees and undergrowth, shall be disposed of properly within a properly permitted landfill. All debris shall be removed from the site prior to substantial completion. The handling, storage, and disposal of debris is incidental to the project.
- Z. Contractor shall implement the necessary site erosion control devices for inhibiting dust, wind, and air sediment movement offsite throughout construction in accordance with NPDES Best Management Practices and in accordance with the project SWPPP, if applicable.
- AA. Site access:
 - 1. During the pre-bid site visit, potential bidders will review the existing access route(s) to each well site.
 - 2. Prior to construction at each well site, the Contractor shall indicate to Engineer which route or routes available they wish to use, so that Contractor, Engineer and Owner can coordinate with homeowners and other land users on access use as needed.
 - a. Construction of new temporary or permanent access roads is not part of the project scope of work as defined in the bid form, technical specifications, and design drawings.
 - b. Contractor shall not build new access roads or routes unless such work is added to the bid form by addendum for payment at unit prices or permitted by the Owner for construction at the Contractor's expense.
 - 3. The Contractor may, with Owner's permission, improve the existing roads to ensure they are capable of accommodating transportation of all necessary equipment to the proposed well site(s). Roads should be maintained such that access to nearby residences is not impeded by rutting or damage to the road during periods of inclement weather.
 - a. Improvements to and maintenance of existing access routes necessary for the Contractor and Owner's Representative to access the sites are incidental to the work. Contractor shall notify Engineer or Owner's Representative onsite of any improvements to existing access roads that the Contractor desires to make.
 - b. Access to driveways and other roads along the project site access route must be maintained at all times.

- c. Any access gates should be kept closed at all times unless otherwise directed by the Owner.
 - d. Contractor shall restore fences and gates to original condition or better. Contract shall repair all gates and fences in a timely manner to prevent livestock ingress / egress.
 - e. The cost of this work is incidental to the project.
- BB. Upon completion of the Work, ground surfaces will be restored to their original condition and 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.

1.4 CONTRACTOR'S USE OF PREMISES

- A. Contractor should attempt to complete work as much as possible during typical working hours (between 7:00 A.M. and 7:00 P.M., Monday thru Friday). Contractor will, however, be allowed to perform work onsite twenty-four (24) hours per day, seven (7) days a week if needed. Contractor shall notify the Engineer 3 days prior to work planned outside typical working hours to allow for coordination with the Homeowner.
- B. The Contractor shall make every effort to minimize noise caused by his operations. Equipment shall be equipped with silencers or mufflers designed to operate with the least possible noise.
- 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 affirmative 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 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 and state laws and regulations relating to occupational health and safety. Authorized inspectors shall have unobstructed access to project sites and shall not be impeded in any way from performance of their duties.

1.5 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 Department
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
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
OSHA	Occupational Safety and Health Administration
SAE	Society of Automotive Engineers
SSPC	Steel Structure Painting Council
UL	Underwriters Laboratories, Inc.

1.6 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 is provided in the Appendix 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 Navajo Office of Labor Relations.
- B. The Federal Davis-Bacon Act and the New Mexico Public Works Minimum Wage Act do not apply to the present project.

1.7 TESTING AND INSPECTION ALLOWANCES

- A. Testing Allowance: The bid schedule includes predetermined sums to cover testing and inspections, including but not limited to 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.

1.8 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. Contractor's standard form or electronic media printout will be considered.
- B. Base structure of Schedule of Values on Bid Schedule with identical item numbering, quantities, and values.

1.9 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.
 - 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
- E. Payment Period: Monthly.

1.10 CHANGE PROCEDURES

- A. All Change Orders shall be prepared on the form provided in these Contract Documents.
- B. The Contract Price may only be changed by a Change Order. Any Claim for an adjustment in the Contract Price shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract.
- C. The value of any Work covered by a Change Order or of any Claim for an adjustment in the Contract Price will be determined as follows:
 - 1. where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved; or
 - 2. where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Article 1.11.D.2); or
 - 3. where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached under Article 1.11.C.2, on the basis of the Cost of the Work plus a Contractor's fee for overhead and profit (determined as provided in Article 1.11.D).
- D. Contractor's Fee: The Contractor's fee for overhead and profit shall be determined as follows:
 - 1. a mutually acceptable fixed fee; or
 - 2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:
 - a. for actual and accountable costs incurred, the Contractor's fee shall be 15 percent;
 - b. for subcontractor costs, the Contractor's markup fee shall be five percent;
 - c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Article 1.11.D.2.a is that the Subcontractor who actually performs the Work, at whatever tier, will be paid a fee of 15 percent of the actual and accountable costs incurred by such Subcontractor and that any higher tier Subcontractor and Contractor will each be paid a fee of five percent of the amount paid to the next lower tier Subcontractor;
 - d. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and
 - e. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Articles 1.11.D.2.a through 1.11.D.2.d, inclusive.

1.11 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.

1.12 ALTERNATES

- A. Any alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option.

1.13 COORDINATION

- A. See previous "Special Considerations" 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. Contractor is responsible for timely scheduling of any pertinent inspections with local, county and state agencies with jurisdiction, and as required by the permits.
- E. Coordinate space requirements and installation of mechanical and electrical work indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable.
- F. 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.

1.14 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.

1.15 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.

1.16 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.

1.17 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.
 15. Funding requirements.
- 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.

1.18 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 a copy the 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 a copy of the corresponding Project safety plan to the Engineer

1.19 CONSTRUCTION PROGRESS SCHEDULES

- A. Submit initial progress schedule 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.

1.20 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.

1.21 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.

1.22 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.
- 1.23 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.
- 1.24 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.
- 1.25 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.

1.26 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.

1.27 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.

1.28 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.

1.29 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, 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.

1.30 TEMPORARY SERVICES

- A. Provide, maintain and pay for suitable quality water service as required.
- B. Maintain uninterrupted water, wastewater, 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.

1.31 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 waterlines are located along the right-of-way.
- C. 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.

1.32 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.

1.33 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.

1.34 PROTECTION OF INSTALLED WORK

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

1.35 SECURITY

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

1.36 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.

1.37 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.

1.38 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.

1.39 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.

1.40 DELIVERY, HANDLING, STORAGE, AND PROTECTION

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

1.41 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. Specific manufacturers may be required for certain items in order to maintain consistency with the Owner’s existing inventory. In such cases, substitutions will not be allowed as indicated in each specification section where applicable.
- C. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.
- D. Submit a copy of request for Substitution to the Engineer for consideration. Limit each request to one proposed Substitution.

1.42 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. Among required closeout submittals include: Release of Liens, Consent of Surety, and Certification of Labor Standards.

1.43 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.

1.44 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.

1.45 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.

1.46 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.

1.47 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.

1.48 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 a set 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. Contractor shall prepare record drawing information. As-Built Record Drawings shall include ties to surface features for triangulation purposes in the field, using the table included in the site drawings.
- F. Submit documents to Engineer together with claim for final Application for Payment.

1.49 OPERATION AND MAINTENANCE DATA

- A. Submit 3 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.

1.50 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.

1.51 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. 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.
- C. Submit prior to final Application for Payment.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 03 05 00

BASIC CONCRETE MATERIALS AND METHODS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes formwork, reinforcement, accessories, cast-in-place concrete, transporting, placing, finishing, curing, and other pertinent items of construction.
- B. Concrete and Standards - Except as noted or modified in this section, all concrete materials, transporting, placing, finishing, curing, and sealing shall conform to requirements as follows:
 - 1. American Institute of Concrete (ACI)
 - a. 304R - Guide for Measuring, Mixing, Transporting and Placing Concrete.
 - b. 305.1 - Specification for Hot Weather Concreting.
 - c. 306.1 - Standard Specification for Cold Weather Concreting.
 - d. 308.1 - Standard Specification for Curing Concrete.
 - e. 347R - Guide to Formwork for Concrete.SP-66 - ACI Detailing Manual.
 - 2. ASTM International (ASTM)
 - a. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - b. ASTM A1064 - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
 - c. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 - d. ASTM C33 - Specifications for Concrete Aggregates.
 - e. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - f. ASTM C40 - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
 - g. ASTM C42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
 - h. ASTM C94 - Specification for Ready-Mixed Concrete.
 - i. ASTM C138 - Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
 - j. ASTM C143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
 - k. ASTM C150 - Standard Specification for Portland Cement.
 - l. ASTM C156 - Standard Test Method for Water Loss [from a Mortar Specimen] Through Liquid Membrane-Forming Curing Compounds for Concrete.
 - m. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.
 - n. ASTM C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
 - o. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.

- p. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
- q. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
- r. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
- s. ASTM C989 - Standard Specification for Slag Cement for Use in Concrete and Mortars.
- t. ASTM C1064 - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
- u. ASTM C1116 - Standard Specification for Fiber-Reinforced Concrete.
- v. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures.
- w. ASTM C1260 - Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method).
- x. ASTM C1550 - Standard Test Method for Flexural Toughness of Fiber Reinforced Concrete (Using Centrally Loaded Round Panel).
- y. ASTM C1567 - Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method).
- z. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.
- aa. ASTM C1609 - Standard Test Method for Flexural Performance of Fiber-Reinforced Concrete (Using Beam with Third-Point Loading).
- bb. ASTM C1778 - Standard Guide for Reducing the Risk of Deleterious Alkali-Aggregate Reaction in Concrete.

1.2 QUALITY ASSURANCE

- A. Inform Engineer at least 48 hours in advance of time at which Contractor intends to place concrete.
- B. Contractor shall have reinforcement inspected prior to placement of concrete.
- C. Construct and erect concrete formwork in accordance with ACI 301 and ACI 347R.
- D. Contractor shall submit proposed concrete mix to the Engineer for approval. If off-site mixed concrete is to be delivered on site, pre-approval of mix provide by the concrete supplier is required prior to ordering and Contractor shall provide copies of delivery mix tickets.
- E. Completed Work
 - 1. Completed concrete work which fails to meet 1 or more requirements, but which has been repaired to bring it into compliance, will be accepted without qualification.
 - 2. Completed concrete work which fails to meet 1 or more requirements and which cannot be brought into compliance shall be rejected as provided in these Contract Documents. In this event, modifications shall be required to assure that concrete

work complies with requirements. Modifications, as directed by Engineer, to be made at no additional cost to Owner.

- F. Perform concrete reinforcing and cast-in-place concrete work in accordance with ACI 301.
- G. The maximum deviation of the top surface of curb and gutter shall not exceed 1/8" in 10' nor shall the inside face deviate more than 1/4" in 10' from a straight line. Prior to or during final inspection, curb and gutter shall be water flow tested as directed by the Engineer. All areas with standing water will be rejected.

PART 2 PRODUCTS

2.1 FORM MATERIALS AND ACCESSORIES

- A. Steel Forms: Symons "Steel-Ply", Simplex "Industrial Steel Frame Forms", Universal "Uniform". Forms shall be clean, straight and true, without surface defects.
- B. Plywood Forms: Product standard PS-1, waterproof, resin-bonded exterior type Douglas Fir or Larch. Forms shall be clean, straight and true, without surface defects.
- C. Lumber: Douglas Fir or Larch, straight, uniform width and thickness, clean and free from offsets, holes, dents and other surface defects.
- D. Chamfer Strips: Clean white pine, surface against concrete planed.
- E. Form Release Agent: Colorless mineral oil not capable of staining concrete or impairing natural bonding characteristics of coating intended for use on concrete.

2.2 REINFORCEMENT MATERIALS

- A. Reinforcing Steel: ASTM A615, deformed. Reinforcement bar, size and spacing as indicated on the Drawings.
- B. Welded wire fabric reinforcement shall conform to the requirements of ASTM A1064 and the details shown; provided, that welded wire fabric with longitudinal wire of W4 size wire and smaller shall be either furnished in flat sheets or in rolls with a core diameter of not less than 10 inches; and provided further, that welded wire fabric with longitudinal wires larger than W4 size shall be furnished in flat sheets only.
- C. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for support of reinforcing; plastic tipped or non-corroding for supports in slabs where supports are exposed to weather.
- D. Concrete blocks used to support and position reinforcement steel, shall have the same or higher compressive strength as specified for the concrete in which it is located. Wire ties shall be embedded in concrete block bar supports.
- E. Fabricate concrete reinforcing in accordance with ACI SP-66.

2.3 CONCRETE MATERIALS

- A. Cementitious Materials:
 - 1. Portland Cement: ASTM C150 Type I.
 - 2. Fly Ash: ASTM C618, Class F or C.
 - 3. Slag Cement: ASTM C989, Grade 100 or 120.
 - 4. Silica Fume: ASTM C1240.
 - 5. Metakaolin: ASTM C618, Class N.
- B. Fine and Coarse Aggregates: ASTM C33.
- C. Water: ASTM C1602/C1602M, Clean and not detrimental to concrete.
- D. Chemical Admixtures (when applicable): Compatible with each other and free of intentionally-added chlorides.
 - 1. Air Entraining Admixture: ASTM C260.
 - 2. Water-Reducing Admixture: ASTM C494, Type A.
 - 3. Mid-Range Water-Reducing Admixture: ASTM C494, Type A.
 - 4. High-Range Water-Reducing Admixture: ASTM C494, Type F.
 - 5. Accelerating Admixture: ASTM C494, Type C or E.
 - 6. Retarding Admixture: ASTM C494, Type B or D.
 - 7. Workability-Retaining Admixture: ASTM C 494, Type S.
 - a. Shall retain concrete workability without affecting time of setting or early-age strength development.
 - 8. Alkali-Silica Reaction Inhibiting Admixture: ASTM C494, Type S
 - a. Shall contain a nominal lithium nitrate content of 30 percent.

2.4 CONCRETE MIX

- A. Mix and deliver concrete in accordance with ASTM C94.
- B. Re-tempering of prepared concrete will not be permitted.
- C. Furnish concrete of the following strength:

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.)
Site work concrete such as well pad and valve collars, etc.	3,000	1	5.0	0.50

- D. Proportioning:
 - 1. Proportion ingredients to produce a well-graded mix of high-density maximum workability consistent with approved mix design.
 - 2. Entrained air - all concrete exposed to freeze-thaw cycles under saturated conditions:
 - a. Five (5) percent, plus or minus one (1) percent, for concrete in the forms. Concrete samples for air content tests shall be taken at the end of the

concrete truck chute or the output of the concrete pump, whichever applies. A reduction in air content of pumped concrete should be expected. Contractor shall be responsible to coordinate with the concrete supplier to provide the specified air content of the in-place concrete.

- b. Refer to ACI 301 for further requirements.
3. Fly ash, silica fume, and slag cement:
 - a. Fly ash: The mineral admixture Class F 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 per cent 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. 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.
 - b. Silica fume: 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. Portland cement concrete using silica fume shall follow ASTM C1240 standards.
 - c. Slag cement: 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. Slag cement can consist of Grade 100 or grade 120. Portland cement concrete using slag cement shall follow ASTM C989 standards.
 4. Aggregates supplied under this Specification shall be assumed to be "alkali-silica reactive", ASR. Mitigation measures, such as the use of supplementary cementitious materials or lithium nitrate based admixtures or the combination of both, shall be utilized in the concrete mixtures to mitigate alkali-silica reaction, when the aggregates are known to be alkali-silica reactive. 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. Variance from this position for a particular aggregate source may be authorized by the Engineer. Application for a variance may be made to the Engineer.
 - a. Portland cement concrete design mixes using non alkali-silica reactive aggregates will not be required to be proportioned with Class F fly ash.
- E. Batching and Mixing Equipment: Conform to ACI 304R.
 - F. Slump:
 1. Keep as low as possible consistent with proper handling and thorough compaction.
 2. Shall not exceed 4 inches unless otherwise authorized by Engineer.

2.5 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.
- 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 submittal requirements, 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 ensure that no equipment is overstressed, as well as proper placement tolerances. Equipment Supplier shall have final say on grouting procedures and final tolerances.

PART 3 EXECUTION

3.1 FORMWORK ERECTION

- A. Erect formwork, shoring and bracing to achieve design requirements.
- B. Erect forms substantially and sufficiently tight to prevent leakage of mortar and braced or tied to maintain desired position, shape and alignment before, during, and after concrete placement.
- C. Carefully remove forms only after concrete is able to support all dead and live loads and curing requirements are met. Apply curing compound to all formed surfaces immediately after form removal.
- D. Camber slabs and framing to achieve ACI 301 tolerances.
- E. Provide bracing to ensure stability of formwork.
- F. Clean forms as erection proceeds, to remove foreign matter.

3.2 INSERTS, EMBEDDED COMPONENTS, AND OPENINGS

- A. Provide formed openings where required for work to be embedded in and passing through concrete members.
- B. Coordinate work of other sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts.
- C. Install concrete accessories straight, level, and plumb.
- D. Install water stops continuous without displacing reinforcement.

3.3 REINFORCEMENT PLACEMENT

- A. Place reinforcement, supported and secured against displacement.
- B. Ensure reinforcing is clean, free of loose scale, dirt, or other foreign coatings.

3.4 PLACING CONCRETE

- A. Do not place concrete during rain, sleet, or snow unless adequate protection is provided and Construction Observer approval is obtained. Do not allow rainwater to increase mixing water or damage surface finish.
- B. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent.
- C. Convey concrete from mixer to final position as rapidly as practicable without segregation or loss of material. Limit chute length to less than 20 feet with maximum slope of 1 vertical to 2 horizontal.
- D. Maximum height of concrete free fall is 4 feet.
- E. Place concrete continuously between predetermined expansion, control and construction joints. Do not break or interrupt successive pours creating cold joints.
- F. On large volume pours, 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.
- G. Where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack with non-shrink grout.
- H. Screed slabs-on-grade and concrete base for toppings level.

3.5 FORM REMOVAL

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.
- B. Remove formwork progressively and in accordance with code requirements.

3.6 CURING

- A. Immediately after placement, protect concrete from premature drying.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete, 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.
 - 1. 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.
- C. Use a pre-approved concrete curing method. Acceptable curing methods, as detailed in ACI 308.1, are as follows:
 - 1. Water Curing Methods:
 - a. Ponding/Immersion.
 - b. Fogging/Sprinkler.
 - c. Burlap/Cotton Mats/Absorbent Material.
 - d. Wet Sand Curing.
 - e. Straw/Hay.
 - f. Plastic Film.
 - g. Reinforced Paper.
 - 2. Liquid Membrane-Forming Compounds.
- D. The covering used, if applicable, must be overlapped adequately to ensure 100% coverage, and must not be allowed to become dry at any point during the curing period. Place and anchor covers, mats, and/or sheeting to ensure continuous contact with the concrete surfaces.
- E. When using one of the water curing methods, keep the concrete structures thoroughly and continuously moist and covered during the entire curing period.

3.7 DEFECTIVE CONCRETE

- A. Modify or replace concrete not conforming to required lines, details and elevations, as directed by Engineer.

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.
 - 2. Section 31 23 18 - Rock Removal.

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. Conform to applicable Navajo Nation and State of New Mexico codes 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, Navajo Tribal Utility Authority (NTUA) and other applicable 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.

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
 - 2. Section 31 23 17 - Trenching
 - 3. Section 31 23 18 - Rock Removal
 - 4. Section 31 23 23 - Backfill

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Grading shall be considered incidental to those items which require excavation.

1.3 REFERENCES

- A. Geotechnical Report
 - 1. No geotechnical information is available.

- 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 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 Soils 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 CLOSEOUT SUBMITTALS

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

1.5 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, the Navajo Tribal Utility Authority at 1-800-528-5011 and any other 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, relandscaped, or regraded.
- B. Do not excavate wet subsoil or excavate and process wet material to obtain optimum moisture content.
- C. Remove excess subsoil not intended for reuse, from site.

- D. Benching Slopes: Horizontally bench existing slopes greater than 1: 4 to key placed fill material to slope to provide firm bearing.
- E. Stability: Replace damaged or displaced subsoil as specified for fill.
- F. Notify Owner of any utility damage at once so emergency measures can be taken. The Contractor will pay for any required repairs.
- G. Intercept and divert surface drainage and precipitation away from excavation through use of dikes, curb walls, ditches, pipes, or other means.
- H. 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.
- I. Comply with Navajo Nation and New Mexico state standards and requirements for dewatering to any watercourse, prevention of stream degradation, and erosion and sediment control.
- J. 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 subgrade 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.
- K. 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.
- L. 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, 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.

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. 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 trench.

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
 - 2. Section 31 22 13 - Rough Grading
 - 3. Section 31 23 18 - Rock Removal
 - 4. Section 31 23 23 - Backfill

1.2 REFERENCES

- A. Geotechnical Report:
 - 1. No report available.
- B. New Mexico Standard Specifications for Public Works Construction (NMSSPWC):
 - 1. NMSSPWC Sections 701, 801 & 802 "Trenching, Excavation and Backfill".
- C. 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.
- D. 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 Soils 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 Navajo Tribal Utility Authority (NTUA) and any other applicable utilities.
- 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: Cast in-place concrete, as specified in Section 03 30 00, with minimum compressive strength of 4,000 psi. Concrete for thrust blocking with minimum compressive strength of 3,000 psi.

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 and NTUA 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. When bottom of trench is rocky, over-excavate and fill with suitable backfill.
- B. Excavate trench to minimum depth as indicated on Drawings.
- C. Use trench width required to meet required clearances between pipe and utilities, 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. In developed areas and along traveled roadways, 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. In undeveloped areas outside of roadway rights-of-way and away from any vehicular or pedestrian traffic, open trench shall not be advanced more than 500 feet ahead of installed pipe. 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. The above requirements for backfilling or use of steel plates may be waived in undeveloped areas, such as where the trench is located further than 100 feet from any traveled roadway or occupied structure. In such cases, however, barricades and warning lights, or escape ramps and earthen trench plugs for wildlife, shall be provided and maintained to meet applicable safety requirements. In no case shall more than 150 feet of trench be left open at end of working 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. Comply with all stipulations set forth by the State of New Mexico and the Navajo Nation.
 - b. 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.

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. If requested, perform laboratory material tests in accordance with ASTM D1557.

- D. Refer to compaction testing requirements in Section 31 22 13 - Rough Grading, as applicable and if requested.

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 discovered rock during excavation.
- B. Related Sections:
 - 1. Section 31 22 13 - Rough Grading
 - 2. Section 31 23 17 - Trenching
 - 3. Section 31 23 23 - Backfill

1.2 INCIDENTAL

- A. Site and Trench Rock Removal:
 - 1. Removal of any rock is incidental to respective bid items and no additional payment will be provided.
 - 2. Contractor shall notify Engineer prior to commencement of rock removal work when rock is encountered and specialized equipment will be required and await approval from Engineer before proceeding.

1.3 DEFINITIONS

- A. Rock: Solid mineral material of size that cannot be removed with conventional equipment.
- B. For general excavation, a D-9N Caterpillar tractor with a single shank ripper, or equivalent equipment, is considered conventional equipment, if it can rip at a production rate of at least 300 bank cubic yards per hour.
- C. For trench excavation, a 235C Caterpillar excavator with a medium stick and a rock ripping bucket, or equivalent equipment, is considered conventional equipment, if it can excavate at a production rate of at least 30 bank cubic yards per hour.
- D. If material cannot be excavated by conventional equipment, the Engineer must be immediately notified. The Contractor shall provide performance tests of the specified conventional or equivalent equipment. If the Engineer confirms in writing that the specified conventional equipment cannot perform at the production rates specified, the excavation shall be considered rock excavation.

1.4 SUBMITTALS

- A. Section 01 00 00 - Submittals: Submittal procedures.
- B. Submit type of equipment to be used for rock removal.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Explosives: Not allowed.

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 method only. No blasting allowed.
- B. Cut away rock at bottom of excavation to form level bearing.
- C. 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.
- D. Remove excavated materials from site.

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

SECTION 31 23 23

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 05 00 - Basic Concrete Materials and Methods
 - 2. Section 31 22 13 - Rough Grading
 - 3. Section 31 23 17 - Trenching
 - 4. Section 31 23 18 - Rock Removal

1.2 REFERENCES

- A. Geotechnical Report
 - 1. No report available.

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

- C. 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.

- D. 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/m<sup>3 - 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).</sup>

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 Soils 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.

<u>Sieve Size</u>	<u>Percentage Passing</u>
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.

<u>Sieve Size</u>	<u>Percentage Passing</u>
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:

<u>Sieve Size</u>	<u>Percentage Passing</u>
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:

<u>Sieve Size</u>	<u>Percentage Passing</u>
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:

<u>Sieve Size</u>	<u>Percentage Passing</u>
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:

- 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.
- 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:

<u>Sieve Size</u>	<u>Percentage Passing</u>
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. When using soil cement slurry, refer to Type L (controlled low strength material, above).
- E. If pipe laying operations are interrupted for more than 24 hours, cover pipe laid in the trench with backfill.
- F. 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.
- G. 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.
- H. 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.
- I. 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 to 95%.
 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. If requested, perform laboratory material tests in accordance with ASTM D1557.
- C. If requested, 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. Using a testing allowance, the Owner and Engineer will determine the testing frequency to be used throughout the project.
- 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. Fill Type G or H, 12 inches thick, compacted to 95 percent.
 - 2. Cover with Fill Type G, 2 inches thick, compact uniformly to 95 percent of maximum density.

- 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 for French Drains and Well Points:
 - 1. Fill Type F, to 6 inches below finish grade, compact uniformly to 90 percent of maximum density.

SECTION

SECTION 33 12 13

WATER SERVICE CONNECTIONS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pipe, fittings and accessories for providing domestic water service to existing homes.

- B. Related Sections:
 - 1. Section 03 05 00 - Basic Concrete Materials and Methods
 - 2. Section 31 23 17 - Trenching
 - 3. Section 31 23 18 - Rock Removal
 - 4. Section 31 23 23 - Backfill
 - 5. Section 33 12 19 - Hydrants
 - 6. Section 33 13 00 - Disinfection of Water Utility Distribution
 - 7. Section 33 21 13 - Water Supply Wells

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Water Service Connection
 - 1. Basis of Measurement: By the unit or linear feet shown in the bid form
 - 2. Basis of Payment: Includes pipe and all associated fittings from well to house, including but limited to pressure tank, pressure tank pit/culvert with insulated cover, piping inside the pressure tank pit, tank tee, pressure gauges, pressure switch, pressure relief valve, tank drain, tank base, gravel, ladder, curb stop assembly, yard hydrant, tee posts, concrete, rebar, connection of service line to existing house water line/cistern tank (or as otherwise indicated on the drawings), excavation, rock excavation, bedding, backfill, disinfection and any other items/accessories not specifically listed but shown on the plans. Electrical components are covered under separate specifications and bid items.

1.3 REFERENCES

- A. New Mexico Standard Specification for Public Works Construction (NMSSPWC), 1987 edition.
 - 1. NMSSPWC - Section 802 - Installation of Water Service Lines.

- B. 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.

- C. American Society of Mechanical Engineers (ASME):
 - 1. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
 - 2. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

- D. American Society of Sanitary Engineering (AMSE):
 - 1. ASSE 1012 - Backflow Preventer with Intermediate Atmospheric Vent.
 - 2. ASSE 1013 - Reduced Pressure Principle Backflow Preventers.
- E. American Society for Testing and Materials International (ASTM):
 - 1. ASTM A48/A48M - Standard Specification for Gray Iron Castings.
 - 2. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.
 - 3. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m<sup>3 - 4. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft³ (2,700 kN-m/m<sup>3 - 5. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 - 6. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).</sup></sup>
- F. American Welding Society (AWS):
 - 1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
- G. American Water Works Association (AWWA):
 - 1. AWWA C800 - Underground Service Line Valves and Fittings.
 - 2. AWWA C906 - Cross-Linked Polyethylene (PEX) Pressure Pipe.

1.4 SUBMITTALS

- A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data on materials and accessories.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 00 00 - Execution Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of wells, piping, pressure tank pit, curb stops, yard hydrants, utilities crossed, and final connections, including depths. Swing ties to locations are to be noted in the charts provided in the plans.
- C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with New Mexico Standard Specifications for Public Works Construction.
- B. All piping, fittings, valves, and any other service connection 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. During loading, transporting, and unloading of materials and products, exercise care to prevent any damage.
- C. Store products and materials off ground and under protective coverings and custody, away from walls and in manner to keep these clean and in good condition until used.

1.8 MAINTENANCE MATERIALS

- A. Furnish a spare pressure switch to each homeowner.

PART 2 PRODUCTS

2.1 PEX WATER PIPING, VALVES AND FITTINGS

- A. Cross-Linked Polyethylene (PEX) Pressure Pipe: AWWA C904-06, for Pressure Pipe and Tubing ½” through 3”;
 - 1. PEX Tubing:
 - a. 1-inch diameter
 - b. 160 psi minimum pressure rating
 - 2. PEX Fittings:
 - a. heavy-duty stainless steel or approved equal if unavailable
 - 3. PEX Valves:
 - a. heavy-duty stainless steel or approved equal if unavailable

2.2 PRESSURE TANK PIT CAN and INSULATED LID

- A. Corrugated Steel Culvert Pipe: ASTM A929/A929M
 - 1. Circular with nominal diameter of 6-feet and a height of 8-feet
 - 2. Galvanized
 - 3. Wall thickness: 12 to 18 gage
 - 4. Helical lock seam
- B. Steel Lid
 - 1. Circular with nominal diameter of 6-feet and 3-inch thick lip
 - 2. U-shaped ½-inch sold handle welded to cover
 - 3. Hinged at middle to allow lid to be opened
 - 4. Primed and epoxy painted on all surfaces
 - 5. 2-inch thick ridge foam insulation with pressure treated ½” plywood bolted to cover

2.3 PRESSURE TANK

- A. Manufacturers:
 - 1. AMTROL
 - a. WX-302 86 GAL
 - 2. Or approved equal

2.4 PRESSURE TANK ACCESSORIES

- A. Tank Tee
 - 1. 1" X 13" STAINLESS STEEL O-RING UNION
- B. Pressure Gauges
 - 1. 2 ½" diameter
 - 2. Stainless steel
 - 3. 0-100 psi range
- C. Pressure Switch (refer to electrical specifications)
 - 1. Double pole
 - 2. 60/40 psi settings
- D. Hose Bib
 - 1. ¾" diameter
 - 2. Stainless steel or approved equal if unavailable
 - 3. Vacuum breaker
- E. Pressure Relief Valve
 - 1. ¾"
 - 2. 100 psi max, set to 80 psi
 - 3. Stainless steel or approved equal if unavailable
- F. Ladder
 - 1. Manufacturers:
 - a. Cotterman
 - 1) Model Number: F8S C1
 - 2) Item Number: 3570208
 - b. Or approved equal
 - 2. 8 Rung
 - 3. 87 inch length/height
 - 4. Standoff brackets bolted to pit wall
 - 5. Steel
 - 6. Or approved equal
- G. Pipe Penetration Seal
 - 1. Manufacturers:
 - a. Link-Seal Modular Seals
 - 1) Century-Line® Sleeve
 - 2) Model Number: CS
 - b. Or approved equal

2. 1-inch diameter water pipe and 1-1/4-inch electrical conduit penetrations
- H. Concrete Block Tank Base
1. Solid or approved equal
- I. Gravel
1. 3/4" to 1" diameter crushed rock with no fines

2.5 CURB STOP ASSEMBLY

- A. Manufacturers (acceptable model numbers as indicated on Drawings):
1. Mueller Company.
 2. Ford Company.
 3. A.Y. McDonald Manufacturing Co.
 4. Or approved equal
 5. Substitutions: Section 01 00 00 - Product Requirements.
- B. Curb Stops:
1. Brass or red brass alloy body conforming to ASTM B62.
 2. Plug type valve.
 3. Positive pressure sealing.
- C. Curb Boxes and Covers:
1. Cast iron body, Extension Type or Buffalo Type.
 2. Minneapolis or Arch Pattern Base.
 3. Lid with inscription WATER, with Pentagon Plug.

2.6

2.7 BEDDING AND COVER MATERIALS

- A. Excavate culvert trench to design drawings specified height, in accordance with Section 31 23 17 for work of this Section.
- B. Place bedding material at trench bottom per design drawings, level fill materials in one continuous layer not exceeding 6 inches compacted depth, compact to 95 percent.
- C. Maintain optimum moisture content of bedding material to attain required compaction density.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 00 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify building service connection size, location, and invert elevation.

- C. Water service assemblies shall be installed at the locations indicated in the drawings and approved by the Owner's Representative. The Owner's Representative will identify location of existing system components and assist the Contractor with location and verification of the existing system in the field.

3.2 PREPARATION

- A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.

3.3 BEDDING

- A. Excavate pipe trench in accordance with Section 31 23 17 for Work of this Section.
- B. Place bedding material at trench bottom, level fill materials in one continuous layer not exceeding 8 inches compacted depth; compact to 95 percent.
- C. Backfill around sides and to top of pipe with cover fill, tamp in place and compact to 95 percent.

3.4 INSTALLATION - PIPE AND FITTINGS

- A. Maintain separation of water lines from sewer piping in accordance with New Mexico Public Work Standards.
- B. Group piping with other site piping work whenever practical.
- C. Route pipe in straight line, as much as possible. Do not crimp PEX pipe during installation or at any other time.
- D. Metal tubing shall be bent with approved tube benders without any kinks or sharp bends. Cutting of tubing will be performed with cutters designed for that purpose.
- E. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- F. Install access fittings to permit disinfection of water system performed under Section 33 13 00.
- G. Establish elevations of buried piping with not less than 4 ft of cover. Install plastic warning tape at least 12 inches above buried piping and at least 18 inches below finished grade.
- H. Backfill trench in accordance with Section 31 23 23.

3.5 INSTALLATION - CURB STOP ASSEMBLY

- A. Set curb stops on solid bearing.
- B. Center and plumb curb box over curb stops. Set box cover flush with finished grade.

3.6 SERVICE CONNECTIONS

- A. Connect water line to existing service line from each home or as otherwise indicated on the Drawings.
- B. Install Work in accordance with the most recent edition of New Mexico Standard Specifications for Public Works Construction, with latest revisions.

3.7 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Flush and disinfect system in accordance with Section 33 13 00.

3.8 FIELD QUALITY CONTROL

- A. Section 01 00 00 - Execution Requirements: Field inspecting, testing, adjusting, and balancing.
- B. During testing of the materials at the above ambient temperatures, no visual cracking, checking, blistering, surface pitting or deformation shall be noted.
- C. Perform pressure test on water piping in accordance with AWWA C600. Compaction Testing for Bedding: In accordance with ASTM D1557.
- 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. If desired, the Owner and Engineer will determine the testing frequency to be used throughout the project, using testing allowance.

END OF SECTION

SECTION 33 12 19

HYDRANTS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Yard hydrants.
- B. Related Sections:
 - 1. Section 03 05 00 - Basic Concrete Materials and Methods.
 - 2. Section 31 22 13 - Rough Grading.
 - 3. Section 31 23 23 - Backfill.
 - 4. Section 33 12 13 - Water Service Connections.
 - 5. Section 33 13 00 - Disinfection of Water Utility Distribution.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Yard Hydrants:
 - 1. Basis of Measurement: Each.
 - 2. Basis of Payment: Includes yard hydrant, excavation and backfill, concrete block, concrete collar with rebar, teepest markers, vacuum breaker fitting, and all other fittings and accessories necessary for a complete installation. Does not include piping between waterline and hydrant.

1.3 REFERENCES

- A. American Water Works Association (AWWA):
 - 1. AWWA C500 - Metal-Seated Gate Valves for Water Supply Service.
- B. National Sanitation Foundation (NSF):
 - 1. NSF/ANSI Standard 61 - Drinking Water Components - Health Effects.

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, hydrants, and accessories provided meet or exceed AWWA Standards and specification requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of yard hydrants.

- B. Provide Operation and Maintenance Data for yard hydrants.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Prepare valves, hydrants and accessories for shipment according to AWWA Standards and seal valve, hydrant and ends to prevent entry of foreign matter into product body.
- B. 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.

1.7 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.

1.8 COORDINATION

- A. Coordinate work with the Engineer and the Owner.

PART 2 PRODUCTS

2.1 YARD HYDRANTS

- A. Brass frost proof type equipped with a brass vacuum breaker. The valve stem and plunger assembly shall be removable for inspection and repair without the need for digging up of the hydrant. The piping between the main waterline and the yard hydrant assembly shall be of the same material as the main waterline with the same pressure rating.
- B. Manufacturers:
 - 1. Woodford
 - a. Model: S3
 - 2. Or approved equal
 - 3. Substitutions: Permitted.
 - 4.
- C. Freezeless Self-Draining Dry-barrel.
 - 1. 1 inch brass hydrant barrel.
 - 2. Bury Depth: 4' bury.
 - 3. Inlet Connection: 1 inch NPT in brass casting.
 - 4. Valve Opening: 3/4 inch NPT heavy-duty male house thread.
 - 5. Min pressure: 20 psi and Max pressure: 100 psi
 - 6. Back flow preventor

2.2 ACCESSORIES

- A. Solid Concrete Block

- B. Teepost
- C. Single Check Vacuum Breaker
 - 1. NIDEL® Model 34HF

2.3 EXAMINATION

- A. Determine exact location of valves and hydrants from Drawings; obtain clarification and directions from Engineer prior to execution of work.
- B. Verify invert elevations prior to excavation and installation of valves and hydrants.

2.4 PREPARATION

- A. Identify required lines, levels, contours and datum locations.
- B. Locate, identify, and protect utilities to remain from damage.
- C. Perform trench excavation, backfilling and compaction in accordance with Sections 31 23 17 and 31 23 23.

2.5 INSTALLATION

- A. Install hydrants in accordance with Drawings, manufacturer's instructions, and the following sections of NNMSSPWC, in total or in part, except where amended by these Technical Specifications:
 - 1. Section 802 - Installation of Water Service Lines.
- B. Yard Hydrants:
 - 1. Thoroughly flush waterline prior to installation.
 - 2. Install hydrants; provide support blocking.

2.6 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Flush and disinfect system in accordance with Section 33 13 00.

2.7 FIELD QUALITY CONTROL

- A. Section 01 00 00 - Execution Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Perform pressure test on domestic site water distribution system in accordance with AWWA C605.

END OF SECTION

SECTION 33 13 00

DISINFECTION OF WATER UTILITY DISTRIBUTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes disinfection of potable water distribution and transmission system; and testing and reporting results.
- B. Related Sections:
 - 1. Section 33 12 13 - Water Service Connections.
 - 2. Section 33 12 19 - Hydrants
 - 3. Section 33 21 13 - Water Supply Wells

1.2 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 Appurtenances.
 - 6. AWWA C651 - Disinfecting Water Mains.
- B. National Sanitation Foundation (NSF):
 - 1. NSF-60 - Drinking Water Treatment Chemicals - Health Effects.
- C. 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.

1.3 SUBMITTALS

- A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit procedures, proposed chemicals, and treatment levels for review.
- C. Testing Plan: Contractor must submit proposed testing procedures specific to the project including laboratory name and contact information, testing/sampling locations, method for disposal of chlorinated water and equipment to be employed for disinfection for approval by Engineer.
- D. Test Reports: Indicate results comparative to specified requirements.

1.4 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.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with AWWA C651

1.6 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. All products added directly to water for purposes of disinfection shall conform to NSF/ANSI Standard 60.

- B. 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. 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.
- B. Provide and attach required equipment to perform the Work of this section.
- C. Introduce treatment into piping system and perform disinfection in accordance with AWWA C651.
- D. Maintain disinfectant in system for 24 hours, or 48 hours if the temperature is less than 41 degrees Fahrenheit.
- E. Flush, circulate, and clean using domestic water.
 - 1. Contractor shall coordinate with Owner Representative prior to using domestic water to avoid interruption of service to existing connections. Contractor shall not exceed maximum allowable instantaneous flow (gpm) or daily flow (gpd), as specified by the Engineer.
- F. 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 generally prevailing in existing system or is acceptable for domestic use.
 - 3. Legally dispose of chlorinated water. When chlorinated discharge may cause damage to environment, apply neutralizing chemical to chlorinated water to neutralize chlorine residual remaining in water.
 - 4. 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. Per AWWA C651 Sec. 5.1, two samples taken are required at each sampling location. See C651 for details.
- b. One set of samples shall be collected at the end of each service line.

5. Contractor shall be reimbursed for the cost of passing laboratory tests upon submittal of invoice(s). The laboratory results of all tests shall be submitted directly to the Engineer. Contractor shall pay for all failed tests.
6. 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
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 up to seven domestic water supply wells, to be located within the Lake Valley Chapter, Navajo Nation, San Juan County, New Mexico for the Navajo Nation (herein referred to as Owner).
- B. 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.
- C. All equipment and materials that contact potable water must comply with NSF/ANSI Standard 61 as available. All drinking water treatment chemicals shall comply with NSF/ANSI Standard 60 as available.

1.2 SYSTEM DESCRIPTION

- A. Work required for construction of each domestic water supply well includes, but is not limited to, the following:
 - 1. Inspect access routes to well sites. Notify Owner of any grading or other improvements to access routes proposed to be completed by Contractor.
 - 2. Mobilize equipment and materials on-site and rig up.
 - 3. Maintain drilling-time and daily drilling reports.
 - 4. Collect drill cuttings at 10-foot intervals, or as directed by the Engineer.
 - 5. Drill 20-inch hole to accommodate a nominal 12-inch steel conductor casing to 80 feet, or other depth, as directed by Engineer, considering evaluation of cuttings, records of other wells completed in the area, and consultation with Driller.
 - 6. Install an estimated 80 feet of 12-inch surface conductor casing and grout in place. Allow for pitless adapter in cementing.

7. Drill 9 7/8-inch borehole from bottom of surface casing to an estimated depth of 500 feet, or as directed by Engineer. Final well depth is to be determined by the Engineer with consultation with the Contractor based upon drilling conditions encountered.
8. Complete geophysical logging of borehole, if determined advantageous by the Engineer. This work shall be conducted by a sub-contractor.
9. Plug and abandon partial or full depth of borehole, per Navajo Nation requirements, if directed by the Engineer following review of drill logs, cuttings, and/or geophysics data.
10. After reviewing geophysics data, Engineer or Engineer's representative onsite must approve final design of casing, screen and casing set depths prior to Contractor commencing installation of production casing.
11. Install approximately 400 feet (plus minimum of 2 feet stick up) of 5-inch SCH80 PVC production casing, 100 feet of SCH80 PVC well screen, and end cap, as shown on the Design Drawings or as directed by the Engineer.
 - a. Install casing centralizers every 100 feet.
12. Install filter pack in the annulus from total depth to 15 to 25 feet above screen, as shown in the Design Drawings, or as directed by the Engineer. Swab in filter pack and ensure adequate final settled depth before installing bentonite seal.
13. Install 20-foot (minimum) thick bentonite seal above the screen, as shown in the Design Drawings or as directed by the Engineer.
14. Install pea gravel from top of bentonite seal to 55 feet below ground surface.
15. Install high solids bentonite grout from 55 feet to 5 feet below ground surface.
16. Develop the well by swabbing, air-lift pumping and bailing.
17. Supply and install test pump and transducer line if directed by Engineer.
18. Develop the well by pumping.
19. Conduct pumping test (including required recovery periods), monitor equipment during tests, and record results as specified. Pumping tests may be completed for no wells, one well or more than one well, as determined by the Engineer.
20. Assist Engineer with water quality constituent analysis sample collection and collect initial bacteriological test sample to ensure adequate disinfection.
21. Bail accumulated sediments from well.
22. Install cap to protect well from contamination.
23. If directed by Owner, construct surface completion including installation of pitless adapter, specified well cap, and concrete well pad.
 - a. Coordinate installation of pad around well and final height of surface completion with site electrical and plumbing work.

24. If directed by Owner, install production pump, drop pipe, check valves, wire, and other downhole appurtenances. Disinfect the well, including all installed downhole equipment as specified.
25. Demobilize equipment, clean-up and restore well site.
26. Collect final sample for bacteriological testing to ensure adequate disinfection.

1.3 LOCATION AND GENERAL DESCRIPTION

- A. The seven well sites are located at homesites of Lake Valley Navajo Chapter residents. The project area is north of Chaco Wash and east of Highway NM 371, approximately 35 miles North of I-40/Crownpoint, NM.
- B. The sequencing and total number of wells to be drilled will be determined by the Owner, with technical input from the Engineer, and may change pending geology and water production and quality encountered at each well constructed, available budget, and other factors. Requests from the Contractor to adjust sequencing of drilling at different well sites can be considered and may be approved at the Owner's discretion.
 1. The Owner's intent is to begin drilling at Well Site #1 and #2, given the anticipated shallower depth of these two wells as described in Geology and Anticipated Conditions.
- C. The Contractor shall drill the wells by the air-rotary method. The wells 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.
- D. Acceptable minimum production for these domestic wells may be as low as a quarter gallons per minute (1/4 GPM), as determined by the Engineer. The maximum rate for which production pumps will be sized is anticipated to be ten (10) GPM.

1.4 GEOLOGY AND ANTICIPATED CONDITIONS

- A. Supplemental Hydrogeological Information, which, in part was used to develop the project geologic summary and anticipated conditions below is provided for the Contractor's reference as an Exhibit to the Bid Documents.
- B. Formations underlying the project include Eolian sand (Qes, 0-5 feet thick), underlain by (from higher to lower) Pictured Cliffs Sandstone (Kpc, approx. 50 feet thick), Lewis Shale (Kl, approx. 80 feet thick), the Upper Bed of the Cliff House Sandstone (Kchu, up to 35 feet thick), Unnamed Tongue of Menefee Formation (Kmf, up to 20 feet thick), Main Body of the Cliff House Formation (Kch, approx. 160 feet thick) and the Main Body of the Menefee Formation

(Kmf) which extends to a depth greater than 1,300 feet. The Pictured Cliffs Sandstone and Lewis Shale are not present in the western portion of the project area.

- C. The upper Menefee Formation appears to be able to provide adequate water for domestic supply wells in the area. The upper Menefee may contain thin coal beds, which have the potential to supply poor quality water. Care should be taken to ensure coal beds are not included in the screened intervals of wells.
- D. Nearby wells (19R-307, 15T-6, 15B-24) indicate well total depths between 450 and 1,400 feet, with historic static water level varying between 280 and 375 feet below ground surface. The current water level may be deeper due to drawdown from use between installation and present day. No production data was obtained for these wells.
- E. The project area is bisected by Tsaya Canyon, which is incised into the bedrock described above. The canyon floor is underlain by Naha or Tsegi Alluvium (Qnt). The well record for well 15T-565, along the Chaco Wash, indicates the alluvium is at least 68 feet thick, with depth to water of approximately 8 feet. Nearby La Vida Mission Well SJ-3805 records indicate production of at least 10 GPM.
- F. For Well Sites #1 and #2, located within Tsaya Canyon, the Contractor will first attempt to construct alluvial supply wells with borings up to an estimated 100 feet below ground surface, and construct wells with an estimated 40 feet of screen. If the alluvial material does not contain adequate saturated thickness to support alluvial supply wells, the Contractor will bore deeper as described below for bedrock supply wells.
- G. SMA recommends advancing borings for bedrock supply wells at all remaining sites to estimated depths of 500 to 800 feet maximum below ground surface, targeting the upper Menefee Formation, and constructing wells with up to 100 feet of screen.
- H. Although not anticipated, 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's costs associated with this control of flow shall be reimbursed by the Owner at the customary rates for time and materials.

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. The Contractor shall access all sites via existing roads and driveways, new temporary access roads shall not be constructed.

- B. The Contractor shall note that some access roads have sandy or muddy areas, depending on weather and other factors, that may be difficult for equipment to traverse. Also see Section 01 00 00 for additional details pertaining to site access.
- C. The Contractor shall be solely responsible for locating all existing underground installations in advance of any drilling, 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 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 5-inch PVC 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 total depth of hole shall not deviate from vertical more than two thirds of the inside diameter of the casing per 100 feet of depth.
 - 1. Should deviation exceed the allowed deviation specified above, the Contractor shall plug and abandon the borehole with grout per applicable

local regulations and redrill surface casing and borehole at a location approved by the Engineer and Owner at no cost to the Owner.

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. Maximum circulation rate capability
 7. 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. Equipment for collection of representative cuttings samples
- 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 Contractor, 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 production borehole and perform all reaming (if necessary) by the air-rotary method, unless otherwise approved by Engineer. Drilling fluid shall consist of air. Any additional fluids utilized, such as water mist or foam to aid in the removal of cuttings from the borehole, must be NSF 60 or NSF 61 certified and approved by the Engineer prior to use.
- B. The Contractor shall, within 5 (five) working 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 casing and conductor pipe prior to the drilling of the borehole below the bottom of surface casing. The Contractor will be paid for surface and conductor casing if, after logging the hole, the Owner decides to abandon the project.

1.9 DRILLING WATER SUPPLY

- A. The Contractor shall be responsible for purchasing and hauling any water needed for the drilling work. All costs associated with the 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 and shall be incidental to drilling. All water should be carefully conserved.

1.10 WELDING

- A. All welding shall be done by competent and experienced workmen with adequate equipment, using the metal arc welding process. Welders employed for field assembly of all casing shall be qualified in accordance with the latest revision of the section title "Welding Procedure" of the ASME Boiler Construction Code, or by the AWS Standard Qualification Procedures.

1.11 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. Air compressor/pump pressure.
 5. String weight and weight on bit.
 6. Description of formation drilled and depth at each change.
 7. Rate of drilling, and changes in that rate, as calculated based on time between drill pipe joint connections, or other Engineer-approved method.
 8. Observable water produced (if applicable) during drilling of the borehole and corresponding depths.
 9. Total Depth (TD) of borehole.
 10. Lengths, diameters, and types of casing and perforated casing run.
 11. As-built depths of screens and production casing.
 12. Volumes of filter pack, gravel, bentonite, and grout placed.
 13. The depth of the filter pack, bentonite seal, and surface seal.
 14. Time devoted to each stage of development and characteristics of fluid produced.
 15. Depths of pumping and water level measurement equipment deployed within well during each phase of development and testing.
 16. The depth to the static water level (SWL) and observable changes in SWL and pumping water level (PWL).
 17. If applicable, 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. 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, as directed by Engineer.

1.12 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 (including all equipment necessary to construct and equip the well), coordination, protection of the well throughout project, driller's logs, as-builts, and site restoration.

- B. Surface casing:
 - 1. Basis of Measurement: By vertical foot of casing installed
 - 2. Basis of Payment: Includes drilling of specified diameter borehole, casing installation, and grouting with all materials, equipment, and 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 and pumping, step and constant-rate discharge tests, and any requested standby time. Includes any labor, materials and equipment needed that are not separately listed on bid form.
 - 3. The following items are considered incidental to the work and are not eligible for standby time or other payment at an hourly rate:
 - a. Time and materials required to support geophysical logging.
 - b. Initial required swabbing to settle and confirm final depth of filter pack prior to placement of bentonite seal.
 - c. Development equipment startup, troubleshooting and repairs.
 - d. Initial trip in of airlifting assembly to sufficient depth to 'unload or blow off the hole' until formation water is produced, as well as

- tripping out air-lifting assembly after airlifting development is complete.
 - e. Tripping in and tripping out pump and pumping appurtenances to complete work as specified.
 - f. Required recovery periods after pumping.
- F. Annular materials:
- 1. Basis of Measurement: By cubic foot.
 - 2. Basis of Payment: Includes materials, disinfection and placement of grout, filter pack material, bentonite seals, and pea gravel.
- G. Disinfect Well and Perform Bacteriological Testing:
- 1. Basis of Measurement: By each.
 - 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. Does not include laboratory costs for passing tests, which are covered under testing allowance.
- H. Surface Completion:
- 1. Basis of Measurement: By each.
 - 2. Basis of Payment: Includes pipe fittings, pitless adapter, well cap, plumbing stub outs, concrete pad, accessories, and installation. Includes coordination of surface completion installation with site plumbing and electrical work.
- I. Pump:
- 1. Basis of Measurement: By each.
 - 2. Basis of Payment: Includes pump, motor, centering bolts, fittings, sensor, and accessories. Excludes pump starter to be provided and installed as a separate bid item.
- J. Drop Pipe, Air Line, and Pump Wire
- 1. Basis of Measurement: By linear foot
 - 2. Basis of Payment: Includes furnishing of pipe, wire, tubing, pipe couplings, pipe fittings, centralizers, fasteners, connections, and terminations for drop pipe, air line, and pump wire as specified.
- K. Check Valve:
- 1. Basis of Measurement: By each
 - 2. Basis of Payment: Includes furnishing of check valve and any associated fittings or accessories.
- L. Install Pump and Downhole Appurtenances

1. Basis of Measurement: By each.
2. Basis of Payment: Includes installation, testing, and startup of production pump, motor, drop pipe, check valves, air line, pump wire and appurtenances. Includes equipment and materials needed to perform start-up testing of installed pump. Excludes furnishing of materials separately listed.

M. Other Items:

1. Basis of Measurement: As indicated in the Bid Schedule.

1.13 REFERENCES

A. API (American Petroleum Institute):

1. API 10A - Specification for Cements and Materials for Well Cementing.

B. 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 D1784 – Standard Specification for Rigid PVC and CPVC Compounds
4. ASTM F480 – Standard Specification for Thermoplastic Well Casing Pipe and Couplings Made in SDR, SCH40 and SCH80.
5. ASTM F477 – Standard Specification for Elastometric Seals (Gaskets) for Joining Plastic Pipe

C. American Water Works Association:

1. AWWA A100 - Standard for Water Wells.
2. AWWA C654 - Disinfection of Wells.

D. NSF/ANSI:

1. NSF/ANSI Standard 60: Drinking Water Treatment Chemicals – Health Effects
2. NSF/ANSI Standard 61: Drinking Water System Components – Health Effects

1.14 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.

1.15 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 this Section.
- 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 Conductor Casing:
 - 1. Any permanently installed conductor casing shall be new, Standard (STD) wall thickness, low-carbon steel well casing manufactured in accordance with ASTM Specification A53, Grade B or ASTM A139, Grade B.
 - 2. Materials used for any temporary surface conductor casings may be selected at the Contractor's discretion.
- B. Blank Production Casing:
 - 1. Production casing shall be manufactured by Certa-lok, or approved equal
 - a. 5-inch nominal diameter
 - b. Schedule 80 PVC
 - c. Bell and spigot joints with spline connections.
 - 1) Certa-lok CLIK, Certa-lok CLIB, or approved equal.

- 2) NBR gaskets meeting ASTM F477.
 - 3) Solvent-weld joints not permitted.
 2. Factory assembled in not less than 20-foot sections, unless otherwise directed by Engineer.
 3. Continuous and watertight from top to bottom, except for well screens.
 4. New and free of cracks, pits, or other defects.
 5. Manufactured in accordance with ASTM F480, with materials conforming to ASTM D1784.
 6. Substitutions: Section 01 00 00 – Product Requirements.
- C. Perforations:
 1. Well screens shall be manufactured by Certa-lok, or approved equal
 - a. 5-inch nominal diameter
 - b. SCH80 PVC
 - c. 0.25-inch slot spacing and 0.040-inch slot size.
 - d. Bell and spigot joints with spline connections.
 - 1) Certa-lok CLIK, Certa-lok CLIB, or approved equal.
 - 2) NBR gaskets meeting ASTM F477.
 - 3) Solvent-weld joints not permitted.
 2. The final screen lengths and position will be determined by the Engineer after reviewing the lithological logs, geophysical logs, and previously obtained pilot well results, if applicable.
 3. 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.
 4. Manufactured in accordance with ASTM F480, with materials conforming to ASTM D1784.
 5. Substitutions: Section 01 00 00 – Product Requirements.
- D. Casing Centralizers
 1. All stainless steel construction.
 2. Mechanically fastened to casing with worm-drive clamps at top and bottom.
 3. Each casing centralizer shall include a minimum of three bowspring guides, equally spaced.
 4. Guide dimensions:
 - a. Minimum standoff from casing: 2-inches, unless otherwise approved by Engineer.
 - b. For centralizers on screened intervals: Size appropriately for affixing across the joint without securing on screen itself.
 - 1) Should contractor propose to secure any centralizers directly to the well screen, submit manufacturer or supplier written confirmation that the centralizers submitted are appropriate for directly securing to the specified screen.

- E. Filter Pack:
1. The filter pack shall be composed of sound, durable, well-rounded particles, free from organic matter, silt, 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.
 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 8-12 Colorado silica sand. 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.
- F. Pea Gravel:
1. The pea gravel shall be composed of sound, durable, semi- to well-rounded particles, free from organic matter, silt, clay, or other deleterious materials. Under no circumstances shall crushed rock or any material with an excess of flat faces be installed in the well.
- G. Neat Cement Grout:
1. Grout shall consist of a mixture of Portland cement meeting the requirements of ASTM C150 Type II, 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/ft³).
 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.
- H. Sand Cement Grout:
1. Grout shall consist of a mixture of Portland cement meeting the requirements of ASTM C150 Type II, 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.
- I. High Solids Bentonite Grout:
1. Manufacturer:
 - a. WYO-BEN Grout-Well DF, or approved equal.
 - b. Substitutions: Section 01 00 00 – Product Requirements.
 2. 20% solids bentonite product.
 3. Slurry density: 9.4-9.5 lbs/gal
 4. Dry bulk density: 55-60 lbs/cu. Ft.
 5. NSF-60 certified.
- J. Air line
1. Manufacturers:

- a. Baski, or approved equal
 - b. Substitutions: Section 01 00 00 – Product Requirements.
 2. 1/4” outside diameter, 0.035” wall, type 316/L stainless steel tubing.
 3. Provide with stainless steel, 1/4” diameter female NPT connection with cap at termination of air line under well cap, appropriate for connection to pressure gauge and air compressor manifold.
- K. Pump wire
 1. #6 wire, jacketed.
 2. Includes three (3) conductors and one (1) ground.
 3. Sufficient length for the downhole depth to pump with 10 extra feet to be left coiled at the well head
 4. Final wire size to be determined by Engineer after final selection of pump and motor.
- L. Drop pipe for pump:
 1. 1” diameter Boreline Flexible Drop Pipe, FlexiRiser Model, or approved equal:
 - a. Operating pressure rating: 500 psi
 - b. Theoretical short length burst pressure: 980 psi
 - c. Theoretical tensile strength: 3,000 lbs
 - d. Maximum depth setting: 1,200 ft
 - e. Maximum extension: 3%
 - f. Maximum diameter swell: 10%.
 - g. Material: high-tenacity, polyester yarns, circular woven and totally encapsulated to form an integrated cover and lining of a high performance polyurethane elastomer, suitable for operating in water with a pH from 3 to 10.
 - h. A rib must be incorporated along the length of the outer cover to facilitate the attachment of cable straps for the electric cable.
 - i. 50 Year warranty against materials and manufacturing defects.
 2. 304 Stainless Steel Boreline Couplings, or approved equal.
 - a. Fully re-usable fittings, each comprising of a body and two outer fastening clamps. The body of the fitting must contain two ribs over which the hose fits and the clamps are tightened. The two fastening clamps must each be split into three equal parts.
 - b. NPT male thread for attachment to the pump at one end and the head works at the surface.
 3. WellHose Centralizer Kit, or approved equal.
 - a. 304 SS Nipple and coupler.
 - b. Rubber spider centralizer.
 4. Boreline re-usable Cable straps, or approved equal.
 - a. Shall be spaced per manufacturer’s recommendations.
 5. Substitutions: Section 01 00 00 – Product Requirements.

- M. Check valves:
 - 1. Manufacturers:
 - a. Flomatic Model 100MSSVFD, or approved equal.
 - 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 and well cap:
 - 1. Manufacturers:
 - a. Baker Manufacturing Co.
 - 1) Stainless Steel Slide-Type Pitless Adapter: Model 125BTSS, OAE.
 - 2) Cast iron watertight cap with solvent weld PVC connection to casing: Model 5WE1P, OAE.
 - 3) Substitutions: Section 01 00 00 - Product Requirements.
 - 2. Pitless adapter
 - a. Stainless Steel, slide type.
 - b. Drop pipe and discharge connections: 1 ¼” NPT.
 - 1) See drawings, bushing adapter shall be provided and installed by Contractor for connection to 1” drop pipe.
 - 2) Provide galvanized iron pull out pipe of appropriate length.
 - 3. Well Cap
 - a. Cast iron construction, with PVC lower flange to be solvent welded to PVC casing.
 - b. 1” diameter conduit outlet.

- P. Pump and motor:
 - 1. Manufacturers:
 - a. Grundfos Model 10S20-27 pump with MS4000 motor, OAE.
 - b. Substitutions: Section 01 00 00 - Product Requirements.
 - 2. Single-Phase, 230V, 2 HP pump and motor.
 - 3. 4” nominal diameter.
 - 4. Stainless steel construction.
 - 5. 1 ¼” diameter discharge outlet.
 - a. Contractor shall provide and install reducer per plans to connect with 1” drop pipe.
 - 6. Pumps shall be equipped with integral check valve.
 - 7. This pump and motor selection is preliminary for the purpose of providing a basis of bid. Pump selection shall be finalized by Engineer after well construction and pump testing, and selection may vary between wells.

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.

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, 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.
- 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 CONDUCTOR CASING

- A. The Contractor shall drill and ream the pilot hole to the depth and diameter indicated on the plans for the surface casing, or as directed by Engineer considering conditions encountered and consultation with the well driller. The Contractor shall set and cement the conductor casing prior to the drilling of the borehole below the surface casing. 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 12-inch diameter conductor casing and the 20-inch diameter boring shall 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 conductor casing and the fluid within the casing must not be greater than 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 conductor 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 BORE HOLE

- A. The bore 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, and to an adequate diameter, plumbness, and alignment so as allow installation of screens, casing, annular materials, and development and pumping equipment as per this specification.

Plumbness and alignment of the bore hole may be evaluated, at the Engineer's discretion during geophysical logging, and, if found to exceed specifications, corrected by the Contractor before proceeding.

- B. The bore hole shall be a minimum of 10 inches in diameter (9 7/8" or larger bit). It shall be drilled from ground surface 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 adequate facilities for the collection of representative cuttings samples.
 4. Monitor and record drilling rate, either through logged times for drill pipe connections or use of a drilling-rate recorder.
 5. 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 ensure that the bore 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 adjust as necessary to correct the level.

3.7 DRILLING FLUID

- A. Borehole shall be drilled by the air-rotary method, with air as the drilling fluid. Fluids other than air and water proposed to be introduced to facilitate cuttings removal must be submitted for Engineer's review.
- B. All equipment, materials, and chemicals that comes in contact with either potable water or products that support the production of potable water must comply with NSF/ANSI Standard 60 and 61 as available.

3.8 DEVIATION SURVEYS

- A. Deviation surveys during drilling are not required, however, the Contractor may choose to make deviation surveys during drilling to ensure the borehole's deviation is within the tolerances of the specification below and that the borehole is adequate for installation of casing, pump and appurtenances.
 1. At the Engineer's discretion, deviation may be measured during geophysical logging of the borehole to confirm conformance with the specification.
- B. 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).

3.9 DRILL CUTTING DISPOSAL

- A. The Contractor shall dispose of cuttings in an area on-site approved by the Engineer and homeowner.

3.10 GEOPHYSICAL LOGS

- A. Upon completion of the borehole, 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

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.

1. An allowance is included in the Bid Schedule to cover the cost of the possible geophysical logging of the drill hole. 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.
2. Additionally, a "by Each" bid item has been included in the Bid Schedule for the Contractor's time and materials to facilitate the geophysical survey at each well, where completed at the Engineer's request. The Contractor shall provide up to eight (8) hours from time of receipt of final, processed, logs for the Engineer and Owner to evaluate the geophysical logs and select final screen and casing settings and lengths before commencing installation of casing. This time shall be incidental to this bid item.
3. No other standby time, materials or additional mobilization/demobilization charges will be allowed for the time required to collect, process, and review the geophysical logging results.

3.11 WELL INSTALLATION AND COMPLETION

- A. The final depths and quantities to be installed of screen, blank casing and appurtenances shall be determined by the Engineer for each well after reviewing the drill cuttings, observations during drilling regarding potential water bearing zones, geophysics (if completed), and the sieve analysis (if completed) of the cuttings.
- B. Final depths and quantities may vary from the depths and quantities purchased and on hand for the well. The Contractor may be eligible for payment of casing and screen materials not used in well construction, provided that any unused casing and screen material at the end of the project is provided to the Owner for use and that submittals and quantities for the materials purchased were previously

reviewed and accepted and agreed upon with the Engineer. Payment of extra materials to be based upon material invoices

3.12 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. 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 ensure 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 spline connection prior to joining.
- E. Blank Production Casing
 1. Blank production casing shall be installed utilizing PVC bell and spigot spline joint connectors as per manufacturer's recommendations.
 2. Install casing centralizers as per this section.
- F. Perforations
 1. Exact depths and lengths for the screen shall be determined based on observations of water producing zones encountered during drilling, lithological logs, and geophysical logs as directed by the Engineer.
 2. Screened casing shall be installed utilizing PVC spline joint connectors as per manufacturer's recommendations.
 3. Install casing centralizers as per this section.
 4. The final screen length and slot size will be determined by the Engineer.
 5. A 0.5-inch bull nose end cap of the same material will be attached to the end of the casing, below the screened interval.
- G. Centralizers
 1. Mechanically fasten centralizers to casing as per manufacturer's instructions.
 2. Install centralizer guides spaced evenly around the casing with 2-inch minimum standoff from casing, unless otherwise approved by Engineer.

3. Centralizers shall be installed throughout the perforated section of the casing by the Contractor, at no more than 100-foot intervals, including centralizers at the top and bottom of the perforated section.
 - a. Centralizers within screened intervals shall be placed across the joint of the two sections and never on the screen itself.
 4. Centralizers 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 securely landed on the conductor casing with a landing clamp prior to placement of any annular fill.

3.13 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 40 feet of the bottom of the borehole. During filter pack installation, the tremie pipe shall be no more than 20 feet above the top of the gravel 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 the gravel is placed. Calcium hypochlorite will not be allowed. The tremie line shall be gradually withdrawn as the gravel 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.
 1. Swabbing hours necessary to settle filter pack shall be incidental to the placement of filter pack and are not eligible for payment of hourly development time.

3.14 ANNULAR SEAL

- A. A bentonite seal shall be placed above the screened interval to prevent commingling of waters, at the position and thickness indicated on the Design Drawings.

3.15 ANNULAR FILL BETWEEN ANNULAR SEAL AND CEMENT SEAL

- A. Pea gravel shall be placed in the annulus between the annular seal and cement seal. The pea gravel shall be placed through a tremie pipe, which shall be set no greater than 40 feet above the top of the area to be filled. The pea gravel shall be placed to ensure continuity without bridging, voids, or segregation.

3.16 SANITARY GROUT SEAL

- A. The sanitary grout seal shall be placed in the annulus from 55 feet below ground surface to within 5 feet of ground surface. The grout shall be placed using a sufficient number of stages such that casing will not be damaged. Each stage of cement grouting, if applicable, shall be allowed to set for 12 hours prior to placing the overlying stage.
- B. The grout seal shall be placed through a tremie pipe, which shall be set no greater than 20 feet above the top of the area to be sealed.

3.17 ANNULAR-CAP PLATE

- A. If a permanent surface casing has been installed, the Contractor shall supply and install by continuous welds or other mechanical sealing methods approved by the Engineer, an annular-cap plate to cover the space between the 5-inch production casing and the 12-inch conductor casing.

3.18 PROTECTIVE CAP FOR CASING

- A. The top of the production casing shall be provided with a locking cap bolted to the production casing to cover and protect the well until the permanent pump installation has begun. The cap should be locked 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.

3.19 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 and approved by homeowner. 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, and cuttings will be incidental to well drilling and be borne by the Contractor.

3.20 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.

3.21 WELL DEVELOPMENT BY SWABBING AND AIR-LIFT PUMPING

- A. After installation of all annular material in the well as per this section, the perforated portion of the well shall first be swabbed in contiguous 20-foot sections, from the top of the perforated casing to the bottom, followed by a subsequent swabbing pass from the bottom to the top of the perforations. Each pass shall include 20 minutes of swabbing on each 20 foot section of perforations, for a total of 40 minutes of swabbing on each 20 foot section, unless otherwise approved or directed by the Engineer.
 - 1. Unless otherwise approved by the Engineer, the swabbing equipment include a swab tool with 5-inch double-disc rubber washers, which fit tightly to the inside of the perforated casing, run into the well and operated using a wire line. 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.
- B. Following swabbing, the well shall be developed by air-lift pumping and bailing. The airline shall be of adequate length to reach total depth of the constructed well casing. Air line diameter and air compressor capacity shall be selected provide for air lifting within the 5" nominal diameter well casing at up to 10gpm of water assuming a pumping water level at the top of the constructed perforated casing.
 - 1. Prior to commencing air-lifting, the Contractor shall submit the proposed air-lifting equipment and capacity calculations for the Engineer's review.
- C. The air line shall be progressively tripped into the well, unloading the water level from static until either the airline reaches total depth of the well, or maximum airlifting pumping rate is achieved, whichever occurs first, unless otherwise directed or approved by the Engineer.
- D. Payment for hours of airlifting shall commence once airlifting equipment is operating at maximum feasible depth or flowrate.
- E. The general procedure to be used during air-lift pumping development for each well shall be:

1. Begin air-lift pumping, measuring average flow and noting color and sand content of the water.
 2. The minimum amount of time devoted to each well is estimated at 8 hours, including water column recovery periods if directed by the Engineer.
 3. Variation of the procedure, considering water clarity, sand content and approximate specific capacity considering water level recovery and flowrate, shall be as directed by the Engineer. Additional development time, if any, shall be paid for at the unit bid price.
- F. 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, the depth of the airline, the approximate pumping rate, and water level measurements as described below. Produced water in the tank will be discharged to a location approved by the homeowner and Engineer prior to well development. Water level in the well shall be measured by sounder and recorded, at the following times, at a minimum:
1. Initial static water level before introduction of the airline into the well.
 2. Water level at the start of each recovery period.
 3. Water level at the end of each recovery period.
 4. Water level after the completion of airlifting for the well after removing the airline from the well.
- G. 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 or less of the bottom of the casing before commencement development by submersible pump.

3.22 DISINFECTION AFTER AIR-LIFT PUMPING

- A. All drinking water treatment chemicals comply with NSF/ANSI Standard 60 as available.
- B. Immediately after well development by swabbing and air-lift pumping 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, most recent editions. 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 it 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.
- C. 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.

- D. 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.
- E. During the time interval between disinfection, as described above and installation of the test pump, the well shall be capped with a PVC cap securely glued or mechanically fastened with lock to the casing.

3.23 DEVELOPMENT BY PUMPING

- A. The Contractor shall furnish, disinfect, install, operate, and remove a deep-well submersible pump for developing the well. The pump and drop pipe shall be thoroughly disinfected pursuant to AWWA 100 Section 4.9 and AWWA C-654, most recent editions, 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.
 - 1. The pump and prime mover shall have a pumping range of 2 gpm to 20 gpm at a pumping level equal to the top of the perforated casing in the constructed well.
- B. The Contractor shall measure water depth using an electric well sounder or transducer accurate to 0.1 foot.
- 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 20 gpm. The Contractor shall be responsible for providing a flow meter, suitable to measure the rate of water discharge. Flow meter and other sampling equipment shall be provided and installed as required in the Well Testing subpart of this Section that follows.
- D. Pumping and recovery 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 2 hours of continuous pumping.

- E. The Contractor shall continue development until the following conditions have been met:
 - 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 2 hours, and the specific capacity is the same for all of the different flow-rate steps after equal amounts of time.
- F. 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), or another method approved by the Engineer. The Contractor shall keep independent records of pumping time, flow rate, pumping level, sand production, and other discharge characteristics.

3.24 WELL TESTING

- A. At the discretion of the Engineer, the combined step test and constant rate 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.
- B. The Contractor shall furnish all necessary equipment and materials and make a complete pumping test of the well following development work.
 - 1. Test pumping shall consist of a 300-minute step-drawdown test (three 100-minute steps), transitioning to a 12-hour constant-rate test, and associated recovery test. The number of steps and duration of steps and constant rate test may be adjusted at the discretion of the Engineer.
 - 2. The Contractor shall supply and install an in-line flow meter with discharge plumbing appurtenances appropriate for measure flows between 2 and 20gpm. Manual valves of appropriate diameter to adjust backpressure and flowrate shall be incorporated upstream and downstream of the flow meter. The sand sampler and in-line water quality sampling valve shall be placed downstream of the flow meter but upstream of the second valve.
 - 3. The Contractor will be responsible for providing equipment and collecting all flow and water-level measurements during the testing.
 - 4. The Contractor shall submit proposed procedures, equipment, and assembly sketch for the pump testing equipment for the Engineer's review prior to commencing the test.
- C. Upon completion of the pumping test, the well shall be allowed to recover and remain shut off for 24 hours, during which time the Contractor shall continue gathering and recording well recovery data. The pumping and other downhole

equipment shall not be raised or removed from the well until the required recovery period and data collection is complete.

- D. 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.

3.25 BAILING

- A. After development by pumping, pump test, and recovery periods are complete, the test pump and appurtenances shall be withdrawn from the well. The well shall be sounded, and accumulated fill shall be bailed from the well to within 5 feet or less of the bottom of the casing.

3.26 WATER QUALITY TESTING

A. Bacteriological Testing

1. To determine if the well contains unacceptable numbers of bacteria, the Contractor shall collect and properly preserve water samples obtained from the house or yard hydrant being served, as directed by the Engineer, for bacteriological testing. No residual chlorine may be detected at the time of sampling.
2. Bacteriological tests shall include total coliforms (presence or absence method). The water shall be deemed unacceptable if coliform bacteria are “present” in 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.
5. The final bacteriological test must be performed after Contractor has finished installing all downhole materials and equipment within well.

B. Constituent Sampling and Testing:

1. The Contractor and Engineer will coordinate and collaborate to collect the water sample for constituent analysis at the end of the constant-rate pumping test as follows.
 - a. The Engineer will determine the analyses to be completed, order sample bottle kit and deliver sample bottles to the site.

- b. The Contractor and Engineer will coordinate the time of sampling, including evaluation of the duration of pumping, flowrate, and observations of apparent field water quality characteristics to ensure a representative sample is collected.
- c. If requested, the Contractor shall assist the Engineer with collection and labeling of the samples.
- d. The Engineer will deliver the collected samples to the laboratory for analysis unless otherwise agreed.
- e. The Contractor will pay the laboratory invoice for constituent analysis, the cost of which is reimbursable, plus a 10% markup, from the allowance on the bid form.

3.27 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 (if a permanent surface casing is installed) to the appropriate depth for pitless installation;
 2. Installation of the pitless adaptor with 2-foot casing stickup above top of concrete and cast or forged, bolted, locking, watertight cap;
 - a. Contractor coordinate with Engineer to ensure the pitless adaptor and appurtenances are placed at the correct elevation relative to finished grade;
 3. Installation of discharge line stub-outs (capped and marked), aligned as per site design as directed by Engineer;
 4. Coordination of installation of electrical conduit and discharge line stub-outs with Electrician, if applicable;
 5. 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. One (1) pump centralizer as specified herein; located as indicated on drawings.
 2. Drop pipe and two (2) check valves, located as indicated on drawings.
 3. Pump wire sufficient for the pump with 10 extra feet to be left coiled at the well head.
 4. Air line, as called for on the drawings and specified herein.

- D. The Contractor shall complete start-up tests of the pump, motor and air-line 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 tests are incidental to the work.

3.28 RESTORATION OF DISTURBED AREAS

- A. After the work is completed, the Contractor shall fill any excavations, if applicable, with cuttings, and dispose of or spread remaining cuttings onsite in a location approved by Engineer and homeowner. 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.
- 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 work site restoration will be incidental to the Contractor.

3.29 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 mechanically attached locking cap or a PVC cap solvent welded to the casing, provided that additional stickup is accounted for to allow cutting the solvent welded cap for installation of the permanent cap. Between disinfection and well development activities a padlock should be placed on the cap to prevent unauthorized access to the well. 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. Any well vent and all other openings will be screened (24 mesh or smaller).

3.30 BOREHOLE ABANDONMENT

- A. If the results indicate that completion of the production well is not justified, then the Contractor shall abandon the borehole if requested by the Owner. The Contractor shall complete the borehole abandonment, on a time and materials basis, in a method consistent with the requirements of the Navajo Nation Primary Drinking Water Regulations, Minimum Design Regulations, subpart 1506.

END OF SECTION

SECTION 26 01 00

GENERAL PROVISIONS

PART 1: GENERAL

1.1 SUMMARY

- A. The general provisions of the Contract, including General Conditions, Supplementary General Conditions (if any) and General Requirements apply to the work specified in this section.

1.2 ELECTRICAL DIVISION INDEX

26 01 00	General Provisions
26 11 00	Raceways
26 12 00	Wires and Cables
26 13 00	Outlet Boxes
26 13 30	Cabinets
26 14 00	Wiring Devices
26 15 00	Motors
26 16 00	Panelboards
26 19 00	Relays and Contactors
26 45 00	Grounding

1.3 REQUIREMENTS

- A. Furnish all labor, materials, service, equipment and appliances required to complete the installation of the complete Electrical System in accordance with the Specifications and Contract Drawings.

1.4 REQUIREMENTS OF REGULATORY AGENCIES AND STANDARDS

- A. Regulatory Agencies: Installation, materials, equipment and workmanship shall conform to the applicable provisions of the National Electrical Code (NEC), the National Electrical Safety Code (NESC) and the terms and conditions of the Electrical Utility and other authorities having lawful jurisdiction pertaining to the work required. All modifications required by these codes, rules, regulations and authorities shall be made by the Contractor without additional charge.
- B. Underwriters Laboratories (UL) or Factory Mutual (FM): All materials, appliances, equipment or devices shall conform to the applicable standards of Underwriters Laboratories, Inc. or Factory Mutual, Inc. The label of, or listing by, UL or FM is required.
- C. Standards: Where referenced in these Specifications or on the Drawings, the publications and standards of the following organizations shall apply: American Society of Testing and Materials (ASTM), Insulated Power Cable Engineers Association (IPCEA), National

Fire Protection Association (NFPA), American National Standards Institute (ANSI), and National Electrical Manufacturers Association (NEMA).

- D. Conflicting code requirements shall be brought to the attention of the Engineer. Where two or more codes apply, the most stringent of the codes shall govern.

1.5 SUBMITTALS AND SUBSTITUTIONS

- A. Material List: Within 30 days of Contract Award or Notice to Proceed and before material is ordered, the Contractor shall submit for approval a list of all proposed material and equipment, indicating manufacturer's name and general description.
- B. Shop Drawings: Submit for approval a minimum of six copies of all shop drawings no later than 30 days after the material list has been approved and prior to ordering any material. Show complete outlines, dimensions, electrical services, control diagrams, electrical characteristics of special nature or critical to the installation and pertinent data required for installation. Indicate in the transmittal that submittal has been reviewed and accepted and all Contract deviations identified. In addition to specific references or requests; submit shop drawings for the following applicable items: panelboards, transformers, primary cable and gear, alarm systems and all special equipment.
- C. Substitutions may be requested in accordance with the specification.

PART 2: PRODUCTS

2.1 EQUIPMENT REQUIREMENTS

- A. The Electrical requirements for equipment specified or indicated on the Drawings are based on information available at the time of design. If equipment furnished for installation has Electrical requirements other than indicated on the Electrical Drawings, the Contractor shall make all adjustments to wire and conduit size, controls, overcurrent protection and installation as required to accommodate the equipment supplied, without additional charge to the Owner. All adjustments to the Drawings reflecting the Electrical System shall be delineated in a submittal to the Owners Representative immediately upon knowledge of the required adjustments. The complete responsibility and costs for such adjustments shall be assigned to the respective section of these Specifications in which the equipment is furnished.

2.2 MATERIALS

- A. All similar materials and equipment shall be the product of the same manufacturer.
- B. Where no specific material, apparatus or appliance is mentioned, any first-class product made by a reputable manufacturer may be used, providing it conforms to the Contract requirements and meets the approval of the Owners Representative.
- C. Materials and equipment shall be the standard products of manufacturers regularly engaged in the production of such material and shall be the manufacturer's current and standard design.
- D. All equipment and material that is provided shall meet the Buy American Act.

2.3 ALTITUDE

- A. Equipment affected by altitude shall perform satisfactorily the function intended at the altitude of the project site.

PART 3: EXECUTION

3.1 GENERAL

- A. Fabrication, erection and installation of the complete Electrical System shall be done in a first class workmanlike manner by qualified personnel experienced in such work and shall proceed in an orderly manner so as not to hold up the progress of the project. The Contractor shall check all areas and surface where Electrical equipment or material is to be installed, removed or relocated and report any unsatisfactory conditions before starting work. Commencement of work signifies this Contractor's acceptance of the prevailing conditions.

3.2 TEMPORARY POWER AND LIGHTING

- A. Furnish and install all temporary Electrical facilities required for construction and safety operation. No part of the permanent Electrical Systems or the existing Electrical System may be used for temporary service unless approved by the Owners Representative.

3.3 UTILITIES

- A. GENERAL: The Drawings reflect requirements of the serving utilities based on information derived from representatives of the utilities.

3.4 EXCAVATION

- A. Comply with Earthwork section.

3.5 PERFORMANCE TESTS

- A. Thoroughly test all fixtures, services and all circuits for proper operating conditions and freedom from grounds and short circuits before acceptance is requested. All equipment appliances and devices shall be operated under load conditions.
- B. After the interior-wiring system installation is complete and at such time as the Owners Representative may direct, conduct operating tests for approval. When requested, test all the wire, cable, devices and equipment after installation to assure that all material continues to possess all the original characteristics as required by the governing codes and standards as listed in these Specifications.
- C. After substantial completion and after power loads have been established, make voltage readings at all panelboards. Based on these readings make final adjustments of taps on all transformers in the building as directed. Submit to Engineer correspondence and/or drawing delineating readings.

- D. Perform such other tests as required by other sections of these Specifications or as requested by the owner to prove acceptability.
- E. Furnish all instruments and labor for testing.

3.6 OPERATING INSTRUCTIONS AND MANUALS

- A. Instructions: Without additional charge to the Owner, the Contractor shall provide an experienced and competent representative to instruct the Owner or his representative fully in the concept, theory, operations, adjustment and maintenance of all equipment furnished for the Electrical System. Contractor shall provide at least two (2) weeks notice to the Engineer in advance of this period.
- B. Manuals: Upon completion of the work, prepare and deliver to the Owner two (2) sets of complete operating and maintenance manuals for the systems and major equipment installed. Include catalog data, shop drawings, wiring diagrams, performance curves and rating data, spare parts lists and manufacturer's operating and maintenance data. Operating and maintenance manuals as required herein shall be submitted to the Owners Representative for review and distribution to the Owner not less than two (2) weeks prior to the scheduled final acceptance of the Project.
- C. Other: The above requirements are in addition to specific instruction and manuals specified for individual systems or equipment.

3.7 DRAWINGS

- A. General: The Electrical Drawings show the general arrangement of all conduit, equipment, etc. and shall be followed as closely as actual building construction and the work of other trades will permit. The Civil Structural Drawings shall be considered as a part of the work insofar as these Drawings furnish the Contractor with information relating to the design and construction of the building. Civil Drawings shall take precedence over Electrical Drawings. The Contractor shall investigate the civil and finish conditions affecting the work and shall arrange his work accordingly, providing such fittings, elbows, pullboxes and accessories as may be required to meet such conditions.
- B. Field Measurements: The Contractor shall verify the dimensions governing the Electrical work at the building. No extra compensation shall be claimed or allowed on account of differences between actual dimensions and those indicated on the Drawings.

3.8 LOCATION OF EQUIPMENT AND OUTLETS

- A. The approximate locations of cabinets, panelboards, wiring gutters, switches, light outlets, power outlets, etc., are indicated on the Drawings; however, the exact location shall be determined after thoroughly examining the general building plans and by actual measurements during construction to avoid conflicts with any or other trades with all locations subject to the approval of the Engineer.
- B. Verify all locations of conduit, boxes, etc., stubbed in the floor prior to installation.

3.9 IDENTIFICATION AND SIGNS

- A. Mark each individual motor controller, disconnect switch and remote control device to identify each item with its respective service using engraved nameplates.
- B. Provide nameplates with engraved lettering not less than 3/8" high where specified or noted. In general, use white core laminated plastic, attached with screws. Embossed plastic adhesive tape is not acceptable. Flush mounted devices may have identification engraved in the device plate.
- C. Identify panelboards, transformers and cabinets by engraved nameplates with descriptions indicated on the Drawings together with indication of the location of the feeder overcurrent protection. Install on inside of hinged doors or panelboards and cabinets.

Example: Panel 2P
120/240V, 1-phase, 3-wire
Fed from Panel MDP/ckt. #4

- D. Provide warning signs on all equipment or devices operating at 300 volts or more, reading "DANGER-480 VOLTS", etc. with white letters on red background of standard code size. Signs shall be decals.
- E. All underground utilities indicated on the Drawings shall have a 6" wide plastic marker installed continuously in the trench at 12" below grade. The marker shall have continuous markings embossed in the tape identifying the system installed, i.e., communications, telephone, power, and secured computer.
- F. Identify all exposed conduits, junction and pullboxes at maximum intervals of twenty feet and as indicated below. Identify exposed conduits according to the system carried by means of Brady #B-350 permacode thin film pipe markers or approved equal by the Owner. Identify junction and pullboxes by painted on stencils or approved labels. Identification shall be placed at necessary intervals on straight conduit runs, close to all terminations, adjacent to all changes in directions and where conduits pass through walls or floors. Stencils to be painted on with legible contrasting colors without abbreviations. Painting shall be in accordance with DIVISION - FINISHES.

1. Approved Electrical Conduit Color Codes:

120/240 Volt	Black
Grounding	Green
110 Volt Control	Black/White

- G. Identify all receptacle and switch devices with the circuit and overcurrent protection device. Identification may be by waterproof, permanent marker on the rear of the device cover plate or as approved by the Owners Representative and Owner.

3.10 WARRANTY

- A. Deliver originals of all guarantees and warranties on this portion of the work to the Owner's Representative. Warrant all equipment, materials and workmanship for one year in accordance with the terms of the Contract.

3.11 PRODUCT HANDLING

- A. Use all means necessary to protect Electrical materials and equipment before, during and after installation and to protect the installed work of other trades.

3.12 RECORD DRAWINGS

- A. As part of this Contract, the Contractor shall provide a complete marked-up set of Contract Documents indicating all changes to the documents during the project construction phase to the Owner's Representative. Changes to the Electrical System shall be documented on a set of "Record Drawings" on a daily basis.

END OF SECTION

SECTION 26 11 00

RACEWAYS

PART 1: GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

- A. The general provisions of the Contract, including General Conditions, Supplementary General Conditions (if any) and General Requirements apply to the work specified in this section.
- B. General Provisions: Section 26 01 00.
- C. Grounding: Section 26 45 00.

PART 2: PRODUCTS

2.1 CONDUITS

- A. Rigid Steel Conduit: Rigid, threaded, thick-wall with zinc-coated on the inside and either zinc-coated or coated with an approved corrosion-resistant coating on the outside.
- B. Rigid Aluminum Conduit: Rigid, threaded, thick-wall type, approved for the application.
- C. Intermediate Metal Conduit (IMC): Rigid, threaded, lightweight steel, zinc-coated or coated on the outside and either zinc-coated or coated with an approved corrosion-resistant coating on the inside.
- D. Rigid Non-Metallic Conduit: Schedule 80, high impact PVC with 7,000 psi tensile strength at 73.4 degrees fahrenheit, 11,000 psi flexural strength, 8,600 psi compression strength, approved 90 degree conductors. Carlon, Triangle or approved equal.
- E. Electrical Metallic Tubing (EMT): Mild steel, zinc-coated on the outside and either zinc-coated or coated with an approved corrosion-resistant coating on the inside.
- F. Flexible Conduit: Commercial Greenfield, galvanized steel, with a separate grounding bond wire installed in the conduit in addition to other wires.
- G. Liquid-Tight Flexible Conduit: Flexible galvanized steel tubing with extruded liquid-tight PVC outer jacket and a separate grounding conductor installed in the conduit.
- H. Conduit Size: Minimum conduit size 1/2" except where specifically approved for equipment connections. Sizes not noted on the Drawings shall be as required by the NEC.

2.2 CONDUIT FITTINGS

- A. Rigid Steel Conduit, IMC and EMT Fittings: Iron, steel, or die-cast only.
- B. Rigid Aluminum Conduit Fittings: Malleable iron, steel or aluminum alloy. Ferrous fittings zinc-coated or cadmium plated. Aluminum alloy fittings shall conform to the

characteristics defined by UL for rigid aluminum metallic conduit and shall not contain more than 0.04 percent copper.

- C. Rigid Non-metallic Conduit Fittings: Approved for the purpose and as recommended by the manufacturer.
- D. Flexible Conduit Fittings (Commercial Greenfield): Either die-cast, steel, or malleable iron only with insulated throats and shall be of one of the following types:
 - 1. Squeeze or clamp type with bearing surface contoured to wrap around the conduit and clamped by one or more screws.
 - 2. Steel, multiple point type, for threading into internal wall of the conduit convolutions.
 - 3. Wedge and screw type with angular in-edge fitting between the convolutions of the conduit.
- E. Liquid-tight Flexible Conduit Fittings: With threaded grounding cone, a steel, nylon, or equal plastic compression ring and a gland for tightening. Either steel or malleable iron only with insulated throats and male thread and locknut or male bushing with or without "O" ring seal.
- F. Connectors and Couplings: Compression type threadless fittings for rigid steel conduit or IMC not permitted. Set-screw type fittings for rigid aluminum conduit not permitted. EMT couplings and connectors either die-cast, steel, or malleable iron only, "Concrete-tight" or "Raintight", and either the gland and ring compression type or the stainless steel multiple point locking type. Connectors to have insulated throats. EMT fittings using set-screws or indentations as a means of attachment are not permitted.
- G. Bushings: Insulated type, designed to prevent abrasion of the wires without impairing the continuity of the conduit grounding system, for rigid steel conduit, IMC, and rigid aluminum conduit.
- H. Expansion Fittings: Each conduit that is buried in or rigidly secured to the building construction on opposite sides of a building expansion joint and each run of 100 feet of exposed conduit shall be provided with an expansion fitting. Expansion fittings shall be hot dipped galvanized malleable iron with factory-installed packing and a grounding ring.
- I. Sealing Fittings: Threaded, zinc or cadmium coated, cast or malleable iron type for steel conduits and threaded cast aluminum type for aluminum conduits. Fittings used to prevent passage of water vapor shall be of the continuous drain type.

PART 3: EXECUTION

3.1 CONDUIT INSTALLATION

- A. Conduit Systems: Rigid steel conduit, IMC, rigid non-metallic conduit or EMT unless otherwise specified.
- B. Aluminum Conduit: Aluminum conduit may be used only in dry locations above ground in sizes two inch or larger for Power and Communications Systems.

- C. Rigid Non-metallic Conduit: Install in accordance with manufacturer's recommendations. Joints shall be solvent welded. Field bends shall utilize approved bending equipment. Provide rigid steel elbows and rigid steel conduit risers on underground runs or runs in concrete. Provide a suitable bond wire in each run except low voltage communications runs. Underground runs under concrete slabs may be direct buried without concrete encasement if of approved type. Rigid non-metallic conduit may be installed outside the perimeter of the building. Rigid non-metallic conduit is not permitted to be surface mounted in ducts, plenums or other air handling spaces. All 90 degree bends shall be rigid steel conduit. For encased conduits carrying 600 volts or more, the concrete shall be colored red using a permanent dye.
- D. EMT: Not permitted underground or embedded in concrete.
- E. Flexible Conduits: Use flexible conduit only for motor or equipment connections and then only to the extent of minimum lengths required for connections. Length shall not exceed 5 feet without approval from the Owners Representative and Owner. Install flexible conduit connections at all resilient-mounted equipment. Provide liquid-tight flexible conduit in exterior, wet or damp locations and for connections to wet pipe mechanical systems.
- F. Conduit in Concrete: Rigid steel conduit or rigid non-metallic conduit may not be embedded in concrete that is in direct contact with the earth. When embedded, the outside diameter shall not exceed one-third the thickness of the concrete slab, wall or beam, shall be located entirely within the center third of the member, and the lateral spacing of conduits shall not be less than three diameter unless otherwise prohibited by Owners Representative.
- G. Steel Conduit in Ground: Rigid steel conduit that is not completely encased in concrete but is in contact with ground or on a vapor barrier shall be wrapped with Scotchwrap 51 half-lapped, or shall have an additional outside factory coating of polyvinyl chloride with a minimum coat thickness of 20 mils. Other PVC or Phenolic-resin epoxy coating material which is equally flexible and chemically resistant may be used providing approval by the Owners Representative is obtained prior to the installation.
- H. Exposed Conduits: Install exposed conduit systems parallel to or at right angles to the lines of the building. Right angle bends in exposed runs shall be made with standard elbows, screw jointed conduit fittings or conduit bent to radii not less than those of standard elbows.
- I. Concealed Conduits: Install conduit systems concealed unless otherwise noted. Conduit systems may be exposed in unfinished utility areas, ceiling cavities, and where specifically approved by the Owners Representative. Install concealed conduit systems in as direct lines as possible.
- J. Conduit Openings: Protect all vertical runs of conduits or EMT terminating in the bottoms of boxes or cabinets, etc., from the entrance of foreign material prior to installation of conductors.
- K. Sealing Fittings: Install where required by the NEC, where conduits pass from warm to cold locations and where otherwise indicated.

- L. Sleeves for Conduit: Install sleeves for conduit where shown or as required. Conduit sleeves not used shall be plugged with recessed type plugs. Sleeve all conduit passing through walls. Sleeves that are used shall be sealed tight with rated fire and smokeproofing compounds.

3.2 CONDUIT SUPPORTS

- A. Supports: Provide supports for horizontal steel conduits and EMT not more than eight feet apart with one support near each elbow or bend and one support within one foot of each coupling, including runs above suspended ceilings.
- B. Straps: Install one-hole pipe straps on conduits 1-1/2" or smaller. Install individual pipe hangers for conduits larger than 1-1/2". Spring steel fasteners with hanger rods may be used in dry locations in lieu of pipe straps.
- C. Hanger Rods: Install 1/4" diameter or larger steel rods for trapezes, spring steel fasteners, clips and clamps. Wire or perforated strapping shall not be used for the support of any conduit or EMT.
- D. Fastening: Fasten pipe straps and hanger rods to concrete by means of inserts or expansion bolts, to brickwork by means of expansion bolts, and to hollow masonry by means of toggle bolts. Wooden plugs and shields shall not be used. Power-driven fasteners may be used to attach pipe straps and hanger rods to concrete where approved by the Owners Representative. All conduits not embedded in concrete shall be firmly secured by means of pipe clamps, hangers, etc., equal to Caddy Fasteners of ERICO Products, Inc., or approved equal. Wire wrapped around conduits and supporting members will not be accepted. Conduit fastened to the wall above the ceiling is not acceptable.

3.3 IDENTIFICATION

- A. Identify per Section 260105, Paragraph 3.09F.

3.4 CLOSING OF OPENING

- A. Wherever slots, sleeves or other openings are provided in floors or walls for the passage of conduits or other forms of raceway, including bus ducts, such openings, if unused, or the spaces left in such openings, shall be closed. All closure material along with installation methods shall retain the fire rating integrity of the surface being penetrated. All openings in walls or floors remaining after removal of existing conduits, raceways, or bus ducts shall be closed in a like, approved manner.

END OF SECTION

SECTION 26 12 00

WIRES AND CABLES

PART 1: GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

- A. The general provisions of the Contract, including General Conditions, Supplementary General Conditions (if any) and General Requirements apply to the work specified in this section.
- B. General Provisions: Section 26 01 00.
- C. Grounding: Section 26 45 00.

PART 2: PRODUCTS

2.1 WIRES AND CABLES (600 VOLTS)

- A. Type:
 - 1. Conform to the applicable UL and IPCEA Standards for the use intended. Copper conductors with 600 volt insulation unless otherwise specified or noted on the Drawings. Stranded conductors for No. 6 and larger and where elsewhere specified or noted on the Drawings.
 - 2. All conductors shall be copper. Aluminum conductors will be permitted only on 600 volt and above systems.
- B. Insulations: Type THWN insulation unless otherwise specified or noted on the Drawings. Type THWN minimum or type XHHW filled cross-linked polyethylene 90 degree C. thermosetting insulation for conductors larger than No. 6 and elsewhere as required by NEC.
- C. Size: No. 12 minimum unless otherwise specified or noted on the Drawings. Not less than NEC requirements for the system to be installed.
- D. Color Coding: Phase, neutral and ground conductors color-coded in accordance with NEC. Connect all conductors of the same color to the same phase conductors.

	<u>Phase A</u>	<u>Phase B</u>	<u>Phase C</u>	<u>Neutral</u>
120/240V/1 Phase	Black	Red	----	White
208Y/120V/3 Phase	Black	Red	Blue	White

Ground shall be Green for all systems.

- E. Conductors No. 12 and 10 shall be solid color compounded for the entire length and each like color shall be connected only to the particular phase throughout the project. Conductor sizes larger than No. 10 may be color-coded at each termination and in each box or enclosure with six inches of half-lapped 3/4" pressure sensitive, plastic tape of respective colors in lieu of solid color compound.

2.2 VERTICAL CABLE SUPPORTS

- A. Split wedge type supports which clamp each individual conductor and tightens due to weight of the cable shall be used without metallic sheath.

2.3 CONNECTORS AND LUGS

- A. For copper conductors No. 6 and smaller: 3M Scotch-Lok or T & B Sta-Kin, or equal compression or indent type connectors with integral or separate insulating caps.
- B. For copper conductors larger than No. 6: Solderless, indent, hex screw, or bolt-type pressure connectors, properly taped or insulated.

2.4 TAPE

- A. Plastic tape, 8.5 mils minimum thickness, 1,000,000 megohms minimum insulation resistance, oil resistant vinyl backing, oil resistant acrylic adhesive, incapable of supporting combustion per ASTM D-1000. Equal to 3-M Super 88 Tape.

2.5 FEEDER CIRCUITS

- A. Single conductor feeder cables shall be of the size and type as indicated on the Drawings. Sizes shown are for copper conductors unless otherwise noted on Drawings.

2.6 BRANCH CIRCUITS

- A. Branch circuits shall be No. 12 AWG copper minimum and shall be larger AWG size where indicated on Drawings. Where branch circuits exceed 70 ft. in length, the AWG size shall be increased to accommodate voltage drop.
- B. Branch circuits to all equipment, fixtures and outlets shall include a white neutral and green wire equipment ground.

2.7 TERMINATIONS

- A. Cold shrink stress-relief cones shall be installed at all terminations where shielded cable is used and shall be installed in strict accordance with the recommendations of Electro-Products Division/3M.

PART 3: EXECUTION

3.1 WIRE AND CABLE TESTS (600 VOLTS)

- A. Measure the insulating resistance of service entrance conductors, feeder circuit conductors and service ground. Measurements shall be taken between conductors and between conductors and ground. Resistance shall be 1,000,000 ohms or more when tested at 500 volts by megger without branch circuit loads. Tests and procedures shall meet the approval of the Owners Representative, and shall be in accordance with the applicable IPCEA standards for the wires and cables to be installed. Furnish all instruments, equipment and personnel required for testing, and conduct tests in the presence of the

Owner's Representative. Submit written reports of the tests and results when requested by the Engineer.

3.2 SPLICES (480 VOLTS AND UNDER)

- A. Permitted only at outlets or accessible enclosures. Conductor lengths shall be continuous from termination to termination without splices unless approved by the Engineer.

3.3 PULL WIRES

- A. In each empty conduit, except underground conduits, install a plastic line having tensile strength of not less than 200 pounds. In each empty underground conduit, install a No. 10 AWG bare, hard-drawn copper pull wire or a plastic line having a tensile strength of not less than 200 pounds.

3.4 RACEWAYS

- A. Install in rigid conduit, EMT, or flexible metallic conduit, unless otherwise specified or noted on the Drawings.

3.5 CABLE BENDS

- A. Radius or bends not less than ten times the outer diameter of the cable.

3.6 CONDUCTOR PULL

- A. Conductors shall not be pulled into conduits until after all plastering or concrete work is completed and all conduits in which moisture collected have been swabbed out.

3.7 FEEDER IDENTIFICATION

- A. Tag feeder circuits in each enclosure with wrap-around circuit designation labels.

3.8 CONNECTORS AND LUGS

- A. Install with manufacturer's recommended tools and with the type and quantity of deformations recommended by manufacturer.

3.9 BUNDLING

- A. Conductors No. 10 and smaller shall be neatly and securely bundled and conductors larger than No. 10 shall be neatly and securely cabled in individual circuits, utilizing marlin twine, two-ply lacing or nylon straps.

END OF SECTION

SECTION 26 13 00

OUTLET BOXES

PART 1: GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

- A. The general provisions of the Contract, including General Conditions, Supplementary General Conditions (if any) and General Requirements apply to the work specified in this section.
- B. General Provisions: Section 26 01 00.
- C. Grounding: Section 26 45 00.

PART 2: PRODUCTS

2.1 OUTLET BOXES

- A. Construction: Zinc-coated or cadmium plated sheet steel boxes of a class to satisfy the conditions at each outlet except where unilet or conduit bodies are required. Knockout type with knockouts removed are required. Knockout type with knockouts removed only where necessary to accommodate the conduit entering. Square cornered, straight sided gang boxes, 4" octagon concrete rings and 4" octagon hung ceiling boxes with bars may be folded type; one-piece deep-drawn for all other boxes.
- B. Size: To accommodate the required number and sizes of conduits, wires and splices in accordance with NEC requirements, but not smaller than size shown or specified. Standard concrete type boxes not to exceed six inches deep except where necessary to permit entrance of conduits into sides of boxes without interference with reinforcing bars. Special purpose boxes shall be sized for the device or application indicated.
- C. Exposed: Screw-joint type with gasketed weatherproof covers in locations exposed to the weather.
- D. Wall-Mounted Switch, Receptacle and Signal Boxes: Unless otherwise noted or specified not less 4" square by 1-1/2" deep for 2 devices and multi-gang boxes for more than 2 devices. Boxes for switches and receptacles on unfinished walls may be screw-joint type with covers to fit the devices.
- E. Grounding Terminal: Provide a grounding terminal in each box containing a green equipment ground conductor or serving motors or receptacles. Grounding terminal shall be green colored washer-in-head machine screw or grounding bushing.

2.2 PULLBOXES

- A. Minimum NEC requirements unless larger box is noted. As specified for outlet boxes with blank cover for pullboxes with internal volume not more than 150 cubic inches. As specified for cabinets or pullboxes with internal volume over 150 cubic inches, except covers to have same thickness as box with corrosion-resistant screw or bolt attachment.

2.3 WETWELL JUNCTION BOXES

- A. Junction boxes located within any wet well, if used, shall meet the requirements of NFPA 820.
- B. Lift Station Junction Box:
 - 1. Supply above grade junction box near the lift station as shown on the drawings. The junction box shall allow for easy removal of the pumps by disconnection of the pump cable at the terminal blocks in the junction box. The junction box shall be a Nema 4X stainless steel junction box with structural supports.
 - 2. A permanent seal off shall be installed at the outlet (control box side) of the lift station junction box, no more than 6-inches from the enclosure, to restrict the passage of gases or vapors from the lift station to the control panel. The inlet (pump side) of the enclosure shall also be sealed off with duct putty.
- C.

PART 3: EXECUTION

3.1 OUTLET BOXES

- A. Mounting Heights: The mounting height of a wall-mounted outlet box shall be construed to mean the height from the finished floor to the horizontal centerline of the cover plate. On exposed tile, block or brick construction, mount outlet boxes at the nearest bed joint to the mounting height indicated. The height of all outlets shall be at the same height when there is a secondary type wall construction along with the masonry construction. The height in the masonry construction shall be the governing factor.

3.2 PULLBOXES

- A. Provide additional pullboxes wherever necessary to meet requirements for maximum lengths of conduit runs and maximum numbers of bends as specified under "Conduit and Fittings".

3.3 IDENTIFICATION

- A. Identify all exposed junction and pullboxes according to the system carried by means of painted-on stencils or labels with legible letters and contrasting colors without abbreviations. In general, use yellow color. Painting shall be in accordance with DIVISION - FINISHES.

END OF SECTION

SECTION 26 13 30

CABINETS

PART 1: GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

- A. The general provisions of the Contract, including General Conditions, Supplementary General Conditions (if any) and General Requirements apply to the work specified in this section.
- B. General Provisions: Section 26 01 00.
- C. Grounding: Section 26 45 00.

PART 2: PRODUCTS

2.1 GENERAL

- A. Sheet steel except those exposed to wet or rain conditions that shall be raintight unless otherwise noted. Cabinets without through feeder wiring shall be arranged to provide a wiring gutter not less than 4" wide for branch circuit panelboards served by feeders up to 4/0. Panelboards served by feeders in excess of 4/0, up to and including 750 MCM, shall be provided with top, bottom and side gutters 8" wide. Panelboard cabinets in all cases shall meet or exceed the minimum requirements of Article 373-6 of the National Electrical Code. Cabinets shall be of standard make and shall be equal in all respects to those bearing the Underwriters Laboratories label. Cabinets, including boxes shall be made of galvanized steel. All outside surfaces of trim and doors shall be given a factory finish coat of No. 61 ANSI gray paint, or approved manufacturer's standard. Cabinet for telephone and communications systems shall have 5/8" exterior grade, one-face B-grade or equal plywood backboard inside with maximum height and width.

2.2 FEED THROUGH GUTTERS

- A. Where feeders go through panelboard cabinets to serve panelboards above or beyond, the wiring gutters in panelboard cabinets shall be a minimum of 8" on sides, top and bottom.

2.3 FRONTS

- A. One piece sheet steel frame and a hinged door with catch and lock for flush cabinets. Telephone and signal cabinets for surface mounting shall be equipped with a door hinged directly to cabinet. One piece sheet steel with 3/4" flange with all edges shaped to cover edge of box. Fronts may be secured to box by means of flathead screws with captive nuts or clamps.

2.4 DOORS

- A. Doors shall close against a rabbet placed all around the inside edge of the frame with a close fitting joint between door and frame. The doors shall be fitted with substantial flush hinges placed not over 24" apart, nor more than 6" from ends of doors, and fastened

permanently to the door and frame with flat-headed rivets or spot welds, or with concealed flush piano hinges. Fastening screws of fronts shall be set not over 24" apart. Doors over 48" in height shall be equipped with a vault hinge and a three point catch.

2.5 DOOR-IN-DOOR

- A. Both surface and flush cabinets shall be door-in-door. The door over the interior of the cabinet shall be provided with hinges and combined lock and latch. The outside door over the cabinet gutters shall have a hinge on one side, and machine screws into threaded holes in the cabinet on the other three sides. In order to insure the rigidity of the outside door, surface type cabinets shall have a 1/2" deep lip bent over all around, with the corners welded and grounded; or in the case of flush cabinets, a steel angle frame, equivalent in strength to the bent over lip, shall be welded to the inside of the door. The outside door shall be of such size as to allow a minimum of 2-3/4" opening to all four sides of the wiring gutter. All locks shall be keyed alike.

2.6 LOCKS

- A. Furnish each cabinet with a combination catch and flat key lock. The telephone, electrical and signal cabinet locks shall be fitted to separate keying for each system. Furnish two keys for each cabinet.

2.7 GROUND BAR

- A. Each cabinet for a panelboard shall be provided with a copper interior ground bar suitably braced or bolted to the cabinet wall. The equipment ground bar shall be equivalent in current carrying pressure connector terminations for the associated feeders, branch circuits, etc.

PART 3: EXECUTION

3.1 CABINETS

- A. Cables installed in the wiring gutters of cabinets shall be neatly bundled, routed and supported. Minimum bending radii as recommended by the cable manufacturer shall not be reduced. Lighting and power cabinets shall be installed with tops 6'-6" above floor and bottoms not less than 12" above floor. The height above floor of the highest over current device handle shall not exceed 6'-6".

END OF SECTION

SECTION 26 14 00

WIRING DEVICES

PART 1: GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

- A. The general provisions of the Contract, including General Conditions, Supplementary General Conditions (if any) and General Requirements apply to the work specified in this section.
- B. General Provisions: Section 26 01 00.
- C. Grounding: Section 26 45 00.

PART 2: PRODUCTS

2.1 RECEPTACLE

- A. General: Configuration and requirements for all connector or outlet receptacles shall be in accordance with NEMA Publication WDI-1965, Part 3 and Part 10. Single or duplex as shown or noted on Drawings. Ivory color unless otherwise noted on the drawings. Double grip contacts for each prong.
- B. Grounding Type: All receptacles shall be grounding type with a green colored hexagonal equipment ground screw of adequate size to accommodate an insulated grounding jumper (based on Table 250-95 of the NEC with minimum size No. 14 AWG). Grounding terminals of all receptacles shall be internally connected to the receptacle mounting yoke.
- C. Unless otherwise noted, receptacles shall be as follows:

Type	Hubbell	Bryant	P&S
Spec. Grade Duplex - 20 amp	5362-I	5362-I	5362-I
GFCI, Spec. Grade Duplex - 20 amp	GF-5362-I	GFR53FT-I	2091-FI

- D. Special: Receptacles for special applications shall be as indicated on the Drawings.

2.2 PLUG CAPS

- A. Except for duplex receptacles and cleaning combination receptacles one matching plug cap shall be provided for each receptacle. No plug caps are required for duplex receptacles.

2.3 DEVICE PLATES

- A. General: Provide device plates for each switch, receptacle, signal and telephone outlet and special purpose outlet. Do not use sectional gang plates. Provide multi-gang outlet plates for multi-gang boxes. Plates shall be Stainless Steel unless otherwise noted.

- B. Exposed: Plates for exposed joint fittings shall match the fittings with edges of plates flush with edges of fittings. Heavy cadmium steel plates with gasket. Plates for cast type boxes at locations subject to wet or rain conditions shall be of cast, vapor tight type. Provide hinged lift covers for devices.
- C. Plates for special purpose outlets shall be of a design suitable for the particular applications.

PART 3: EXECUTION

3.1 DEVICE PLATES

- A. Install with alignment tolerance of 1/16" and all edges in continuous contact with wall surfaces.

END OF SECTION

SECTION 26 15 00

MOTORS

PART 1: GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

- A. The general provisions of the Contract, including General Conditions, Supplementary General Conditions (if any) and General Requirements apply to the work specified in this section.
- B. General Provisions: Section 26 01 00.
- C. Grounding: Section 26 45 00.

PART 2: PRODUCTS

2.1 GENERAL

- A. Motors will be furnished with the equipment they are intended to operate and therefore generally will be furnished under other sections of these specifications. Furnish nameplates indicating manufacturer, horsepower, phase, cycle, voltage, RPM, type of motor windings, NEMA design and type of enclosure.

2.2 SIZE

- A. Adequate for the duty to be performed without exceeding their full rated load or safe operating temperature when the driven equipment is operating at specified capacities with ambient temperatures and altitude compensation simulating actual job conditions.

2.3 TYPE

- A. Suitable for the application but not less than Class A insulation and continuous duty classification, based on 40 degrees C. ambient temperature with drip proof frames and totally enclosed for exterior use. Conform to design, construction and performance requirements of NEMA and the Rotating Electrical Machinery Standards of ANSI.

2.4 VOLTAGE RATING

- A. NEMA Standard to correspond to circuit voltage serving the motor. Motors operating on 208 volt systems shall be rated 200 volts or shall be specifically wound for the voltage. Rated and covered by the plus or minus 10% rated voltage warranty for 208 volts.

PART 3: EXECUTION

3.1 INSTALLATION

- A. In accordance with related work specified in other sections of these Specifications and standard industry practice.

END OF SECTION

SECTION 26 16 00

PANELBOARDS

PART 1: GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

- A. The general provisions of the Contract, including General Conditions, Supplementary General Conditions (if any) and General Requirements apply to the work specified in this section.
- B. General Provisions: Section 26 01 00.
- C. Cabinets: Section 26 13 30.
- F. Grounding: Section 26 45 00.

1.2 SUBMITTALS

- A. Submit complete shop drawings with outline dimensions, descriptive literature and complete description of the frame size, trip setting, class and interrupting rating of all overcurrent devices. Identify available space.

PART 2: PRODUCTS

2.1 GENERAL

- A. Dead front, safety type with voltage ratings as scheduled. Panelboards shall be of the type required for the short circuit and duty ratings indicated on the drawings. Panelboards shall be as manufactured by General Electric, ITE, Square D, or Eaton Cutler-Hammer and shall be circuit breaker or fusible type as scheduled.

2.2 CABINETS

- A. Each panelboard shall be enclosed in a single sheet metal cabinet with front doors, catches, locks, etc., as specified in Section 26 13 30, Cabinets.

2.3 DOOR-IN-DOOR

- A. Both surface and flush panels shall be door-in-door NEMA 3R. The door over the interior of the panel shall be provided with hinge and combined lock and latch. The outside door over the panel gutters shall have a hinge on one side and machine screws into threaded holes in the panelboard cabinet on the other three sides. In order to insure the rigidity of the outside door, surface type panels shall have a 1/2" deep lip bent over all around with the corners welded and ground; or, in the case of flush panels a steel angle frame, equivalent in strength to the bent over lip shall be welded to the inside of the door.

The outside door shall be of such size as to allow a minimum of 2-3/4" opening to all four sides of the wiring gutter or as required by NEC All locks shall be keyed alike.

2.4 BREAKERS

- A. Molded-case or combination molded-case and current limited fuses as scheduled or required. Provide quick make and quick break toggle mechanism, inverse time trip characteristics and trip free operation on overload or short circuit. Automatic tripping shall be indicated by a handle position between the manual OFF and ON position. Provide a trip element for each pole, a common trip bar for all poles and a single molded insulating material handle. Handle ties will not be accepted. Adjustable magnetic trip devices shall be set at the factory to the low trip setting. Provide breaker frame sizes as required for the continuous rating or the interrupting capacity, whichever is larger.

2.5 BOLTED TYPE

- A. Circuit breaker current-carrying connections to the bus shall be of the bolted type, factory assembled. Stab in type not permitted. Provide bus bars for three phase panelboards of the sequence phased type connection and arranged for three-phase, four wire mains, unless otherwise indicated on the Drawings.

2.6 SPACE ONLY

- A. Where "Space Only" is noted on the drawings, provide necessary connectors, mounting brackets, etc., for the future insertion of an overcurrent device.

2.7 DIRECTORIES

- A. Provide circuit directories on the inside face of the door of each panel.

2.8 LABELS

- A. Labels for identifying the breakers shall be engraved laminated plastic strips attached by screws or phenolic buttons or small window frame type. Adhesive stick on labels alone will not be acceptable unless specifically approved.

2.9 SKIRTS

- A. Where noted on the Drawings panelboards shall be skirted with complete metal enclosures and barriers separating the panel interior.

PART 3: EXECUTION

3.1 DIRECTORIES

- A. Provide typewritten circuit descriptions referencing permanent room numbering assigned in lieu of the room numbering shown on the Drawings inserted in plastic holder. Text shall be able to be read entirely without moving the card.

3.2 CIRCUIT NUMBERING

- A. Circuit numbering shown on the Drawings is based on pole position in the panelboard and not consecutive numbering.

3.3 PHASE ROTATION

- A. Phase A, left bus; phase B, center bus; phase C, right bus (front viewing).

END OF SECTION

SECTION 26 19 00

RELAYS AND CONTACTORS

PART 1: GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

- A. The general provisions of the Contract, including General Conditions, Supplementary General Conditions (if any) and General Requirements apply to the work specified in this section.
- B. General Requirements: Section 26 01 00.
- C. Grounding: Section 26 45 00.

PART 2: PRODUCTS

2.1 GENERAL

- A. Electromagnetically operated, mechanically held unless otherwise required. Rugged construction substantially made conforming to NEMA and IEEE test standards for industrial type power relays and the requirements of UL 508, Standards for Safety Industrial Control Equipment. Relays and contactors shall be as manufactured by General Electric, ITE, Square D, or Cutler-Hammer.

2.2 RATINGS

- A. As indicated on the Drawings or required, suitable for the application.

2.3 CONTACTS

- A. Double break, renewable, solid wiping type, silver to silver or silver tungsten alloy, self aligning, quick make, quick break, with a minimum inductive load rating adequate for the load controlled, but not less than 25 amps.

2.4 ENCLOSURES

- A. NEMA 1 for surface mounting in dry locations. Flush mounted with hinged door and flush latch where indicated. Sound-absorbing enclosures where located in or adjacent to occupied areas.

PART 3: EXECUTION

3.1 INSTALLATION

- A. Install and connect in accordance with related work specified in other sections of these Specifications.

END OF SECTION

SECTION 26 45 00

GROUNDING

PART 1: GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

- A. The general provisions of the Contract, including General Conditions, Supplementary General Conditions (if any) and General Requirements apply to the work specified in this section.
- B. General Provisions: Section 26 01 00.
- C. Raceways: Section 26 11 00.
- D. Outlet Boxes: Section 26 13 00.
- E. Wires and Cables: Section 26 12 00.
- F. Wiring Devices: Section 26 14 00.
- G. Cabinets: Section 26 13 30.

PART 2: PRODUCTS

- 2.1 Materials, equipment and devices related to the grounding system are specified under other sections of these Specifications.

PART 3: EXECUTION

3.1 GENERAL

- A. Install two separate grounding systems, a service grounding system and an equipment grounding system. The service equipment, conduit systems, supports, cabinets, equipment, and neutral conductor shall be grounded in accordance with the minimum code requirements and as further indicated on the Drawings or as specified. Connect the two grounding systems together only at the main service equipment and at the secondary terminals of transformers creating separately derived distribution systems such as dry-type transformers.

3.2 EQUIPMENT GROUNDING SYSTEM

- A. General: Provide a complete equipment grounding system in accordance with the minimum code requirements and as further indicated on the Drawings or specified. The equipment ground (green conductor) consists of metallic connections to ground of non-current-carrying metal parts of the wiring system or apparatus connected to the system. The primary purpose of equipment grounding is to provide greater safety by limiting the electrical potential between non-current-carrying parts of the system and to provide a low impedance path to ground for possible ground fault currents.

- B. Common Ground Point: Establish one common ground point as specified elsewhere in this section of the specifications for interconnection of the equipment grounding system and the service grounding electrode conductor.
- C. Service Equipment Enclosure: Bond the enclosure of the main service equipment to the uninsulated equipment ground box (or bar) with a conductor or bar sized for 50% of the largest service overcurrent device.
- D. Ground Bar: Provide an uninsulated equipment ground bar, separate from any insulated neutral bar, in all panelboards, starters, disconnect switches, cabinets, etc. for grounding the enclosure and for connecting other equipment ground conductors. The ground bar shall be an integrally mounted and braced bus bar in panelboards or a separately mounted bar adequately braced or bolted to the enclosure after thoroughly cleaning both surfaces to assure good contact. Provide solderless pressure connectors for all conductor terminations. Number and size of pressure connectors on equipment grounding bars as required for the termination of equipment grounding conductors. In addition to the active circuits, provide pressure connectors for all three-phase spares and spaces.
- E. Conduits: Where metallic conduits terminate without mechanical connection to a metallic housing of electrical equipment by means of lock nut and bushings, provide ground bushing connected with a bare copper conductor to the ground bar in the electrical equipment. Metallic conduits containing ground wiring only shall be bonded to the ground wire at both conduit entrance and exit. Install grounding conductor in each nonmetallic conduit or duct except those used for telephone, sound, or low voltage signals and in all flexible conduit that does not have a built-in ground conductor. Bond the conductor at both ends to the equipment grounding system.
- F. Feeders and Branch Circuits: Provide a separate green insulated equipment grounding conductor for each single or three phase feeder and each branch circuit with a three phase protective device. Provide a separate green insulated equipment grounding conductor for single phase branch circuits where indicated on the Drawings. Install the required grounding conductor in the common conduit or raceway with the related phase and/or neutral conductors and connect to the box or cabinet grounding terminal. Where there are parallel feeders installed in more than one raceway each raceway shall have a green insulated equipment ground conductor installed.
- G. Devices: Install a minimum No. 12 green insulated equipment bonding conductor from a grounding terminal in the respective outlet or junction box to the green ground terminal of all receptacles and through flexible conduit to all light fixture housings and other fixed equipment.
- H. Motors: Install a separate green insulated equipment grounding conductor from the equipment ground bar in the motor control center or separate starter through the conduit and flexible conduit to the ground terminal in the connection box mounted on the motor. Install the grounding conductor in the common conduit or raceway with the related motor circuit conductors.

3.3 GROUNDING CONDUCTORS

- A. The grounding conductors for both service ground electrodes shall be insulated or bare copper, sized in accordance with NEC 250-94, including the conductor for the made electrode. The conductors shall be continuous without joint or splice and shall be

installed in conduit with the conduit bonded to the conductor at each end. Install the conductor to permit the shortest and the most direct path and terminate in the main service equipment on the common ground point. Equipment grounding conductors shall be green insulated conductors equivalent to the insulation on the associated phase conductor, but not less than Type TW. The equipment grounding conductor or straps shall be sized in accordance with NEC. Where one feeder serves a series of panelboards of transformers the equipment grounding conductor shall be continuous without splices. Grounding conductors shall not be installed through metal sheathed holes. All connections shall be available for inspection and maintenance.

3.4 GROUND CONNECTIONS

- A. Clean surfaces thoroughly before applying ground lugs or clamps. If surface is coated the coating must be removed down to the bare metal. After the coating has been removed apply a non-corrosive approved compound to cleaned surface and install lugs or clamps. Where galvanizing is removed from metal it shall be painted or touched up with "Galvanoz", or equal.

3.5 TESTS

- A. Remove all jumpers between the equipment ground busses and the service (neutral) ground busses in the main service panel and all separately derived systems. See Section 3.02.C.
- B. For each grounding system, using a megger, measure the resistance between the two ground busses at the panel where the jumper was installed. The resistance shall be greater than 10 megohms.
- C. Re-connect the equipment and service bus jumpers on all systems. See Section 3.02.C.
- D. For each grounding system, using a megger, measure the resistance between the two ground busses at the panel farthest away (electrically) from the panel where the jumper was installed. The resistance shall be less than 5 ohms.
- E. Submit a written report to the Engineer for approval. The service shall not be energized if the test shows more than 5 ohms, unless approved by the Owners Representative.

END OF SECTION