Project Manual Including Specifications for The Construction of

SANTA FE COUNTY CAÑONCITO-ELDORADO WATERLINE Santa Fe, New Mexico 87507 March 2020

County Project No. 2019 – 0007 – PW/CW

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Santa Fe, New Mexico 87507

ENGINEER: MOLZEN CORBIN
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ENGINEER OF RECORD

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The technical material and data contained in the specifications were prepared under the supervision and direction of the undersigned, whose seal as a Professional Engineer, licensed to practice in the State of New Mexico, is affixed below.



Steven Morrow, P.E.

N.M.P.E. No. 13679

All questions about the meaning or intent of these documents shall be submitted only to the Engineer of Record, stated above, in writing.

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SECTION 01 00 01

SPECIFICATION FORMAT

PART 1 GENERAL

1.01 FORMAT

- A. The Division 1 through 48 Specifications are written in imperative and abbreviated form. This imperative language is directed at the Contractor, unless specifically noted otherwise. Incomplete sentences shall be completed by inserting "shall", "the Contractor shall", and "shall be" or similar mandatory phrases by inference in the same manner as they are applied to notes on the Drawings. The words "shall be" are to be placed by inference where a colon (:) is used within sentences or phrases. Except as worded to the contrary, the Contractor shall fulfill (perform) all indicated requirements whether stated imperatively or otherwise.
- B. All equipment and facilities shall be furnished, installed, and constructed by the Contractor to provide the Owner with complete, ready to use components, systems, and facilities. All necessary materials and Work required to accomplish this are the responsibility of the Contractor alone, whether or not specifically indicated on the Drawings or stated in the Specifications.
- C. The various Sections of the Division 1 through 48 Specifications may contain references to standards, other specification sections, or items that do not apply to the Work covered in this project. These inappropriate references are to be considered irrelevant and ignored by the Contractor. If conflicts arise from erroneous references or lack of references to standards or other specification sections, Engineer will determine the relevancy of the apparent conflicts.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 11 00

SUMMARY OF WORK

PART 1 GENERAL

1.01 WORK INCLUDED

A. Work under this Contract consists of constructing a new water transmission line in accordance with the Drawings and these Specifications for Santa Fe County.

1.02 DESCRIPTION

- A. Work included under this Contract:
 - 1. Pipeline #1 3.8 miles of new 12-inch DR18 PVC, at the originating 16-inch feeder line to/from the Rancho Viejo water tank, conveys water to the County-to-District Connection point (owned and operated by County) at the Eldorado Well 2A/2B site. Work includes:
 - a. Vertical wet tap connection for 3" air valve.
 - b. Horizontal wet tap connection to existing 16" line from the Rancho Viejo tank.
 - c. Eight Arroyo Crossings HDD.
 - d. Five stub-out connections for future development at Rancho Viejo.
 - e. Master water meter in the County-to-District Connection Structure on the Well 2A/2B site.
 - 2. Pipeline #2 0.6 miles of new 8-inch DR18 PVC originating at the District-to-County Connection point (owned and operated by District) at the District's northeastern border, conveys water to the County's Hondo 2 Fire Station where it terminates at the new Hondo 2 Fire Storage Tank. Work includes:
 - a. HDD under I-25 and ramps.
 - b. Fire Storage Tank: 157,000-gallon steel ground storage tank with altitude valve vault, submersible mixer, overflow/drain pad, and detention pond.
 - c. Hondo 2 Pump Station: 578 sq. ft. CMU building, 1,100 gpm package booster pump skid, 3,232-gallon surge tank, meter vault, emergency generator, connection to fire station water service, and related yard piping, site work, and electrical work.
 - 3. Pipeline #3 2.8 miles of new 10-inch DR18 PVC originating from the Hondo 2 Pump Station conveys water easterly to a point within the community of Cañoncito where another 0.8 miles of 8-inch DR18 PVC runs eastward to a point of connection to an existing 8-inch line at the Old Las Vegas Highway. Work Includes:
 - a. Jack and bore underneath old Las Vegas highway for 10" waterline.
 - b. Jack and bore underneath old Las Vegas highway for waterline stub outs.

- c. Open cut with encasement across the Cañada de los Alamos (San Marcos) Arroyo for 10" waterline.
- d. PRV station installation.

1.03 CONTRACT

A. The Work shall be performed under unit prices/lump sum bid items and reimbursable allowances.

1.04 SUMMARY BY REFERENCES

A. Work of the Contract can be summarized by references to the Contract, General Conditions, Supplementary Conditions, Specification Sections, Drawings, Addenda and Modifications to the Contract Documents issued subsequent to the initial printing of this Project Manual and including, but not necessarily limited to, printed material referenced by any of these. It is recognized that work of the Contract is also unavoidably affected or influenced by governing regulations, natural phenomenon, including weather conditions and other forces outside the Contract Documents.

1.05 CONTRACTOR USE OF THE PREMISES

A. The immediate premises of work will be at the disposal of the Contractor during the construction period.

1.06 SPECIAL CONDITIONS

- A. Borrow Sites for Fill Material:
 - 1. Designated borrow sites for fill material are not available along the project limits.

1.07 FILL MATERIAL

- A. All fill material provided by Contractor shall be in full compliance with requirements stipulated in Section 31 23 00 Excavation, Backfill, and Compaction for Structures, Section 31 23 33 Trenching and Backfilling, and where specified elsewhere in the Contract Documents.
- B. Contractor is solely responsible for providing suitable backfill material where needed at no additional cost to Owner.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 EXECUTION

A. General: Immediately after award of the Contract, thoroughly and clearly advise all necessary personnel as to the nature and extent of the project.

END OF SECTION

SECTION 01 12 16

WORK SEQUENCE AND SPECIAL PROJECT REQUIREMENTS

PART 1 GENERAL

1.01 GENERAL DESCRIPTION OF WORK SEQUENCE

- A. Preliminary Work: Storm Drainage Discharge Compliance:
 - 1. Prepare a Storm Water Pollution Prevention Plan and file all required USEPA-NPDES Program documents prior to commencement of construction; see Section 01 74 17 Storm Drainage Discharge Compliance for requirements.
 - 2. Contractor shall implement and maintain full compliance of USEPA-NPDES Program requirements during construction.
- B. Phase 1: Line 2, Hondo 2 Fire Storage Tank and Pump Station, and Line 3. Substantially complete Phase 1 Work and deliver water from the Eldorado Water & Sanitation District to the Cañoncito branch connections by September 1, 2020.
- C. Phase 2: Line 1. Phase 2 Work shall be completed after Phase 1 when the Owner issues written authorization to proceed with Phase 2.

1.02 COORDINATION AND GENERAL REQUIREMENTS

- A. Coordination with Cañoncito Phase II Waterline Project: The Cañoncito Regional Water System Improvements Phase II will be constructed by others concurrently with this Project. The Canoncito Regional Water System Improvements Phase II will be constructed within the community of Cañoncito located on the north side of Old Las Vegas Highway main line between stations 151+38 and 193+64. Waterlines from the two Projects connect at four 6-inch branches off the Old Las Vegas Highway main line, as shown on the Drawings. Coordinate construction of the connections through the County's Project Manager.
- B. Do not operate or adjust existing valves without specific case-by-case approval of Owner's water department manager. After shakedown, do not operate or adjust new valves unless Owner's water department manager is notified and such action is needed for training, warranty work, or emergencies.
- C. Emergency Response:
 - 1. Contractor's representative available at all times to respond to emergencies related to Work.
 - 2. Provide response within 60-minutes of notice.
 - 3. Provide positive method of contacting Contractor's representatives by Engineer and by Owner's representative at any time.

D. Contractor is responsible for all damages during the course of construction resulting from breaking existing pipes, spills, and any other discharge violations during construction.

1.03 RELATED SECTIONS

A. Section 01 74 17 – Storm Drainage Discharge Compliance

1.04 FACILITIES REQUIREMENTS

- A. General: Applies to work noted in Paragraph 1.01.
 - 1. Pressure Testing, Flushing, and Disinfection of Waterlines.

B. Archaeological Sites:

- 1. Although no sites are anticipated, if the Contractor encounters an archaeological site during construction or has any reason to believe it may be an archaeological site, report immediately to the Engineer and the Owner.
- 2. If buried archeological or cultural deposits are discovered during construction, work shall cease in the affected area, and the Contractor shall contact the NMDOT Environmental Bureau (Steve Lakatos by phone at 505-827-5513 or by email at Steven.Lakatos@state.nm.us)
- C. New Mexico Department of Transportation Permit:
 - 1. Contractor shall comply with permit requirements (at no additional cost to Owner) identified in the Permit. Permit is included in Appendices of the Contract Documents.
 - 2. The Owner delegates compliance of all applicable items in the Permit to the Contractor.
 - 3. Refer to Section 01 71 23.17 New Mexico Department of Transportation Utility Permit Survey Requirements for additional information.

1.05 ADJUSTMENTS TO SEQUENCING REQUIREMENTS

A. The Owner may require the Contractor to make adjustments to the requirements of the Section to accommodate unforeseen conditions and situations. Reasonable adjustments shall be made by the Contractor at no additional cost to the Owner or additional Contract time.

1.06 SUBSTANTIAL COMPLETION

A. Refer to Section 01 77 00 – Contract Closeout, for description of Substantial Completion.

1.07 SPECIAL CONSIDERATIONS

A. No electrical power exists along the majority of the construction areas. Provide all necessary power generation equipment or temporary electrical power supply for construction.

- B. Provide temporary pumps, power generator, piping, fittings, labor, and equipment to produce water for construction, testing, flushing, and disinfection of water lines.
- C. No County water sources are available on the Project site. Refer to Section 01 15 00 Temporary Utilities.
- 1.08 TIME EXTENSIONS FOR ABNORMAL AND UNFORSEEABLE WEATHER (ADVERSE WEATHER DELAYS)
 - A. This provision specifies the procedure for the determination of time extensions for abnormal and unforeseeable weather in accordance with General Conditions Section 12.03 Delays. In order for the Engineer to award a time extension under this clause, the following conditions must be satisfied:
 - 1. The weather experienced at the project site during the contract period must be found to be unusually severe; that is, more severe than the adverse weather anticipated for the project location during any given month.
 - 2. The abnormal and unforseeable weather must actually cause a delay to the completion of the project. The delay must be beyond the control and without the fault or negligence of the Contractor.
 - B. The following schedule of monthly anticipated adverse weather delays is based on National Oceanic and Atmospheric Administration (NOAA) or similar data for the project location and will constitute the base line for monthly weather time evaluations. The Contractor's progress schedule must reflect these anticipated adverse weather delays in all weather-dependent activities.

Monthly Anticipated Adverse Weather Delay Work Days Based on 5-Day Work Week

<u>JAN</u>	<u>FEB</u>	<u>MAR</u>	<u>APR</u>	<u>MAY</u>	<u>JUN</u>	<u>JUL</u>	<u>AUG</u>	<u>SEP</u>	<u>OCT</u>	<u>NOV</u>	<u>DEC</u>
3	2	1	1	1	1	3	3	3	3	1	2

- C. An actual adverse weather day must prevent work for 50 percent or more of the Contractor's workday, delay work critical to the timely completion of the project, and be documented by the Contractor. The Owner's representative observing the construction shall determine on a daily basis whether or not work can proceed on a given date, within two (2) calendar days of that date. The Owner will use the above-written notification in determining the number of working days for which work was delayed during each month.
- D. The number of actual adverse weather delay days shall include days impacted by actual adverse weather (even if adverse weather occurred in previous month), be calculated chronologically from the first to the last day of each month, and be recorded as full days. If the number of actual adverse weather delay days exceeds the number of days anticipated in paragraph (B) above, the Engineer will convert any qualifying delays to calendar days, giving full consideration for equivalent fair

weather work days, and issue a modification in accordance with the General Conditions.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECTION (NOT USED)

END OF SECTION

SECTION 01 14 02

UTILITY OBSTRUCTIONS

PART 1 GENERAL

1.01 WORK INCLUDED

A. General provisions for handling utility obstructions and relocations.

1.02 UTILITIES SHOWN ON DRAWINGS

A. The Engineer has made reasonable efforts to show the general location of existing underground and overhead utility lines on the Drawings; however, Contractor shall recognize that buried utilities may not be in the locations shown on the Drawings, or there may be other utilities that are not shown on the Drawings.

1.03 CONTRACTOR RESPONSIBILITIES

- A. For excavation work in New Mexico, Contractor is responsible to comply with the New Mexico Excavation Law (NMEL), as published in New Mexico Statutes Annotated (NMSA) 1978, section 62-14. Section 62-14-3 of the law requires the excavating Contractor to:
 - 1. Call the local notification center of NM811 One-Call in advance of excavating.
 - 2. NM811 One-Call will notify utility owners or operators to locate and mark their utilities.
 - 3. Notify directly all utility owners or operators who are not members of the local one-call center to locate and mark their utilities.
 - 4. In general, any utility located on the Owner's plant or station property belongs to the Owner past the utility meter or other termination point. The Owner is responsible to locate and mark such utilities.
 - 5. Do not start excavation until all utility owners have located and marked their utilities.
 - 6. Do not use mechanical excavation equipment, including bores and plows, within 18-inches horizontally of the utility marks (tolerance zone) until the Contractor exposes the utility by non-mechanical means such as hand digging or vacuum/dry type potholing.
 - 7. Repair any damage to utilities caused by Contractor, and report to utility owner and NM811 One-Call.
- B. This work will be considered incidental Work to the Contract Documents' bid items.

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1.04 RELOCATION OF OVERHEAD UTILITIES

A. Determine in advance of construction operations if overhead utility lines, support structures, poles, guys, etc., whether shown on the Drawings or not, will obstruct construction operations. If any obstruction to construction operations is evident, coordinate with the appropriate utility company to remove or relocate the utility obstructions. Any charges by any utility company for removal or relocation of overhead utilities are the sole responsibility of the Contractor at no additional cost to the Owner.

1.05 RELOCATION OF UNDERGROUND UTILITIES

- A. Determine in advance of construction operations locations of all underground utilities (gas, telephone, fiber optic cable, electrical, cable TV, water, sewer), whether shown on the Drawings or not, that may interfere with Contractor's construction operations.
- B. All Underground Utilities Except Water and Sewer Lines: Coordinate with the appropriate utility company to remove or relocate the existing utilities which interfere with construction. Utility company charges for relocating these existing utilities will be paid from the utility line relocation allowance listed on the Bid Proposal.
- C. Water and Sewer Lines:
 - 1. Adjust alignment on any waterline which Contractor is constructing to avoid existing underground utility lines and/or to maintain a minimum three feet of cover; Take other measures necessary (encasement of water or sewer line, change of pipe material, etc.) to protect new and existing lines.
 - 2. Adjust alignment of all existing waterlines as appropriate or required to avoid interference with:
 - a. new sewer lines, or:
 - b. new structures, or;
 - c. new roadway, or;
 - d. to maintain at least three feet of cover over existing waterlines unless otherwise approved in writing by Engineer.
 - 3. Incidental work to be performed at no additional cost to Owner: All work required to adjust alignment of new waterlines around any existing waterlines or sewer lines, or other measures necessary to protect new and existing lines.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SFC184-11 01 14 02-2

SECTION 01 14 03

REGULATORY REQUIREMENTS

PART 1 GENERAL

1.01 APPLICABLE CODES AND ORDINANCES

- A. All Work shall conform to the current versions of all applicable building, mechanical, plumbing, and electrical codes.
- B. Contractor is responsible for acquiring all applicable building, mechanical, plumbing, and electrical permits related to this project.
- C. Comply with all local laws, ordinances, and regulations which may impact Contractor's work.

1.02 OSHA REQUIREMENTS

- A. All equipment and facilities provided, including but not limited to, handrails, guardrails, grating, hoists, equipment guards, ladders, etc., shall meet OSHA requirements whether or not such requirements are specifically indicated or described in the Contract Documents.
- B. Any conflicts between OSHA requirements and Contract Documents shall be brought to the attention of the Engineer on a timely basis for resolution.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 14 16.01

COORDINATION WITH PUBLIC AND UTILITY INTERRUPTIONS

PART 1 GENERAL

1.01 PUBLIC ACCESS

- A. Provide for continuous public access to all residences, businesses, and properties via existing roads, alleys, and driveways whenever practical.
- B. Provide alternate public access to all residences, businesses, and properties in coordination with affected residents and occupants when existing access arrangements must be disrupted by Contractor's work whenever practical.
- C. Notify public at least three (3) calendar days in advance of interrupting public access.

1.02 UTILITY INTERRUPTIONS

- A. Coordinate any water shut-off operation with the Owner not less than three (3) working days prior to initiating any work affecting existing water utilities. Limit water service shut-off to four (4) hours. Keep Owner informed of work areas on a daily basis, and specifically notify Owner of areas where fire hydrants will be out of service.
- B. Notify all customers at least three (3) calendar days in advance of interrupting utility service.
- C. Keep interruptions of utility service at a minimum as to number of users and duration.

1.03 NOTICES

- A. Construction Notices Before Construction:
 - 1. Delivered not more than seven (7) calendar days nor less than four (4) calendar days prior to actual physical construction on each line or line segment.
 - 2. Corrected notices delivered if construction does not start within 48 hours of date given in notice.
 - 3. Written notice to state:
 - a. Contractor's name, address, and local telephone number.
 - b. Nature of work to be done.
 - c. Disruption residents or businesses might expect.
 - d. Expected duration of construction.
 - e. Contractor's local telephone number to which complaints may be made during normal working hours.
 - f. Contractor's local telephone number to which emergency conditions can be reported during non-working periods.

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- B. Construction Notices After Construction:
 - 1. Delivered not more than seven (7) calendar days following construction on each line or line segment.
 - 2. Written notice to state:
 - a. Contractor's name, address, and telephone number.
 - b. Thank residents and businesses for cooperation and report work is completed in applicable area.

C. Special Notices:

1. Inform residents and businesses personally and by written notice whenever access to property will be impaired or utility service will be interrupted, stating scheduling of such action.

D. Notice Delivery:

- 1. Hand delivery to each resident and business adjacent to or which may be reasonably expected to be affected by construction.
- 2. Do not deliver notices in mail boxes or mail slots. Use other delivery methods such as door hangers.

1.04 SCHEDULE OF SPECIAL REQUIREMENTS FOR THIS PROJECT

- A. Provide all notices included above.
- PART 2 PRODUCTS (NOT USED)
- PART 3 EXECUTION (NOT USED)

END OF SECTION

SAF184-11 01 14 16.01-2

SECTION 01 14 19

USE OF SITE

PART 1 GENERAL

1.01 AVAILABLE SITES

- A. Sites and easement limits available for the construction of the project are shown on the Drawings. Contractor shall not utilize any land not indicated as being available without the written approval of the applicable land owner.
- B. If the Contractor requires the entire width of right-of-way or easement for construction, it shall be the Contractor's responsibility to have a licensed land surveyor establish the right-of-way line where it is not apparent.

1.02 PROTECTION AND RESTORATION

- A. All existing features and improvements to or on easements shall be restored by the Contractor equivalent to those existing prior to construction at no additional cost to the Owner. Compliance with special requirements or considerations indicated on the Drawings for the use of easements shall be the Contractor's responsibility at no additional cost to the Owner.
- B. Trees within construction easement shall be preserved to maximum practical extent, unless specifically indicated in the Drawings.

1.03 SPECIAL CONSTRUCTION METHODS

- A. Special and hand construction methods may be required to remain within the available easements. Such methods shall be used by the Contractor at no additional cost to the Owner.
- B. Other Contractors could be working on related work at or near the site; therefore, the Contractor is expected to cooperate and provide adequate access to all other working parties at or near the site.

1.04 STAGING AREAS

A. Staging area is not provided by the Owner. Locating staging area(s) on private land is the responsibility of the Contractor. Contractor staging areas shall be provided by the Contractor at no additional cost to the Owner. Contractor staging areas are to be considered incidental Work to the Contract Documents' bid items.

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PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 21 00

ALLOWANCES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedure for administration of Allowances.

1.02 RELATED REQUIREMENTS

A. Individual Technical Specification sections listed under "Schedule of Allowances" at the end of this Section.

1.03 ALLOWANCE

- A. The allowance is a sum of money included in the Contract Price to cover the cost of a service, all inclusive, to be provided under the Contract by a party other than the Contractor.
- B. The allowance is included in the Bid Form.
- C. The sum of an allowance is an estimated amount.
- D. The Contractor will be reimbursed only for the costs invoiced by the party providing the service, and no mark up, such as overhead and profit shall be charged by the Contractor.
- E. Services may be less than, equal to, or greater than, the estimated allowance amount. Contractor will be paid only the actual cost of the services.

1.04 ADJUSTMENT OF BONDS AND INSURANCE

A. Adjustment to Contractor's bonds and insurance on account of adjustment to allowance will only be dealt with in the final pay application considering the final cost of the project in comparison to the Bid Price.

1.05 SCHEDULE

A. A Schedule of Allowances for this Contract is included at the end of this Section.

1.06 ENGINEER RESPONSIBILITIES

A. Consult with Contractor in consideration of supplier of services.

1.07 CONTRACTOR RESPONSIBILITIES

- A. Execute purchase agreement with designated supplier.
- B. For additional information, refer to specific specification sections referenced in Schedule of Allowances.

1.08 PAYMENT PROCEDURES

- A. Payment will be made under the Bid Item for the specified Allowance.
- B. Contractor submit invoices on a monthly basis with pay application.
- C. Pay application will not be accepted without invoices for allowance services performed during the pay application pay period.
- D. Pay invoice on approval of Engineer.

1.09 SCHEDULE OF ALLOWANCES

- A. Relocation of Underground Utilities: Allow the amount of \$300,000.00. For additional information, see Section 01 14 02 Utility Obstructions and Bid Form.
- B. Testing Allowance: Allow the amount of \$125,000.00. For additional information, see Section 01 45 23 Testing Laboratory Services and Bid Form.
- C. Electrical Service Allowance: Allow the amount of \$30,000.00. For additional information, see Section 26 27 10 Electrical Service and Bid Form.
- D. Pre-authorized Changes During Construction Allowance: Allow the amount of \$150,000.00. For additional information, see Standard General Conditions of the Construction Contract, Paragraph 10.01.C Authorized Changes in the Work (as amended by Supplementary Conditions), Paragraph 11.02 C Contingency Allowance, and the Bid Form. Changes to Work are governed under the Change Order provisions of the Contract Documents. If the cumulative price of Changes to Work total less than the Pre-authorized Changes During Construction Allowance, the Contract Price will be adjusted under Article 11 of the Standard General Conditions of the Construction Contract. For all Changes to Work in excess of the allowance amount, the Contract Price will be adjusted under Article 12 of the Standard General Conditions of the Construction Contract.
- E. Water Meter Allowance: Allow the amount of \$6,800.00, see Bid Form Item 6.10.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 25 00

SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. For the purposes of this Specification Section, the terms "material and equipment" and "Products" have the same meaning and are used interchangeably.

1.02 RELATED REQUIREMENTS

- A. Conditions of the Contract
- B. Equipment Suppliers List

1.03 SUBSTITUTIONS AND PRODUCT OPTIONS

A. Contractor's Options:

- 1. For Products specified only by reference standard, select any product meeting that standard.
- 2. For Products specified by naming several products or manufacturers, select any one of the products or manufacturers named, which complies with the specifications.
- 3. For Products specified by naming one or more Products or manufacturers and "or equal", "or Engineer approved equivalent", or "Engineer reviewed equivalent", or similar term, Contractor shall submit a request as for substitutions for any Product or manufacturer not specifically named. The use of brand names is for the purpose of describing the standard of quality, performance and characteristics desired, and is not intended to limit or restrict competition.
- 4. For Products specified by naming only one Product and manufacturer, there is no option. This is usually done in cases where the Owner has standardized on previously purchased products and spare parts at its facilities, and needs to maintain consistent training, operation, and maintenance programs.

B. Substitutions:

- 1. For a period of 30 days after the Preconstruction Conference, Engineer will consider written requests from Contractor for substitution of Products.
- 2. Submit a separate request for each Product, supported with complete data, with drawings and samples as appropriate, including:
 - a. Comparison of the qualities of the proposed substitution with that specified.
 - b. Changes required in other elements of the work because of the substitution.
 - c. Effect on the construction schedule.

- d. Cost data comparing the proposed substitution with the Product specified.
- e. Any required license fees or royalties.
- f. Availability of maintenance service, and source of replacement materials.
- 3. Engineer shall be the judge of the acceptability of the proposed Product substitution.

C. Contractor's Representation:

- 1. A request for a Product substitution constitutes a representation that Contractor:
 - a. Has investigated the proposed Product and determined that it is equal to or superior in all respects to that specified.
 - b. Will provide the same warranties or bonds for the substitution as for the Product specified.
 - c. Will coordinate the installation of an accepted substitution into the Work, and make such other changes as may be required to make the Work complete in all respects. Upon request, submit to Engineer to-scale dimensioned electronic drawing files of the specific model of the requested substituted equipment items. Drawings shall show general arrangement plan and sections. Drawing files shall be in AutoCAD dwg format.
 - d. Waives all claims for additional costs or contract time, under his responsibility, which may subsequently become apparent.
- D. Engineer will review requests for substitutions with reasonable promptness, and notify Contractor, in writing, of the decision to accept or reject the requested substitution.

1.04 INTENT OF TECHNICAL SPECIFICATIONS

- A. Since the specified materials and details of equipment and component fabrication and assembly are given for specific functional, operational, maintainability, and compatibility reasons, which are not detailed in the Contract Documents, any substitution shall provide the functional intent as well as the specified intent in all details, as determined by the Engineer.
- PART 2 PRODUCTS (NOT USED)
- PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 29 00

PAYMENT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Measurement and Payment
- B. Schedule of Values
- C. Application for Payment

1.02 ADDITIONAL REQUIREMENTS

- A. Agreement and corresponding Bid.
- B. Conditions of the Contract: Progress payments and final payments.

1.03 MEASUREMENT AND PAYMENT

A. Unit Price Items:

- 1. Estimated Ouantities:
 - a. Estimated quantities in Bid Form are approximate and used only for:
 - 1) Basis for estimating probable cost of Work.
 - 2) Comparison of Bids submitted for Work.
 - b. Actual Work done or materials furnished under Unit Price item may differ from estimated quantities.
 - c. Basis of payment: Actual amount of Work as determined by applying the appropriate Unit Price as Bid.
- 2. Water Line, Effluent Line, or Sewage Force Main in Place:
 - a. Unit Price per lineal foot for each item of Work to include all costs, unless otherwise specified.
 - b. Includes all trenching, backfilling, compaction, testing, and disinfection including bacteria testing.
 - c. Includes all fittings required for the Work, whether or not shown, except valves.
 - d. No extra payment for dewatering, rock excavation, select backfill, shoring, bracing or other attendant work, unless specifically provided in the Bid Schedule.
- 3. Trenching and Backfilling:
 - a. Unit Price Bid per lineal foot for each item of Work to include all costs, unless otherwise specified.
 - b. All Trenching Unclassified: The Bid Unit Price applies equally for any conditions encountered and any obstructions encountered for which separate Bid Items are not included in the Contract.

- c. Depth of Trench: Height between existing ground surface and invert of pipe based on survey cut sheets.
- d. No progress payments for lengths of trench that have not been backfilled as specified.
- e. No extra payment will be made for dewatering, rock excavation, sheeting, shoring, bracing or other attendant work, unless specifically provided in the Bid Schedule.
- f. No payment for trenching and backfilling until corresponding pipe in place is acceptable and pipe detection systems are in place and successfully tested.

4. Crossing:

- a. Each crossing itemized in the Bid Schedule shall be paid as lump sum amount.
- b. Amount to include all Work or material required for complete ready to use installation.

5. Removal and Replacement:

- a. When itemized in the Bid Schedule, payment to include all work and materials including removal, hauling and disposal, and replacement.
- b. Pavement:
 - 1) Payment for trench pavement replacement to be to the limits specified in Section 32 09 00 Removal and Replacement of Existing Surfaces, or as indicated on Drawings.
 - 2) Payment for pavement replacement required for water service line connections and water meter installations shall be incidental to each connection detail.

c. Sidewalks:

- 1) There will be no additional payment for replacement of sidewalks unless itemized on Bid Schedule.
- d. Gravel Surfaces: There will be no additional payment for replacement of gravel surfaces.

6. Other Unit Price Items:

- a. Unit complete in place and ready for use including all Work.
- B. Lump Sum Items: Payment for all lump sum bid items includes all Work, labor, and materials required to provide a complete ready to use installation.

C. Materials:

- 1. Payment for materials delivered but not fully incorporated in project only made if such materials are included in the Schedule of Values and if such materials are available for inspection at Contractor's jobsite yard.
- 2. For small projects for which a schedule of values is not required, payment for materials delivered but not fully incorporated in the project will only be made if such materials are available for inspection at Contractor's jobsite yard, and for which invoices are presented to Engineer.
- 3. Payment for materials delivered but not fully incorporated into the project is only allowed if made without any Contractor markup or any other associated fees.

D. Allowance Items: Contractor's actual costs for allowance items listed in Section 01 21 00 – Allowances based on invoices received for actual time and materials expenses.

E. Incidental Work:

- 1. All Work, labor, materials, appurtenances, activities, and requirements to complete the facilities complete in place and ready for use, and to comply with all requirements and conditions of the Contract Documents are considered incidental Work to the Contract Documents' bid items. No separate, additional or special payment will be due the Contractor for incidental Work.
- 2. Above, on, or below ground obstructions, utilities, features or improvements which interfere with the Work or which must be moved, removed and/or restored to accomplish the Work are considered as incidental Work for which separate payment will not be made if separate bid items or allowances are not specifically given for such in the Contract Documents.
- 3. Final adjustment of existing or new manhole rims, water valves, water meter lids, and fire hydrants to new finished grade, unless otherwise specifically provided in the Bid Schedule.
- 4. All clearing and disposal costs.
- 5. Preparation of shop drawings prior to delivery of materials.
- F. Operation and Maintenance Manual: For equipment requiring operation and maintenance manuals, no payment for installation of said equipment will be made to the Contractor until final operation and maintenance manuals have been submitted and accepted by the Engineer.
- G. Mobilization, Insurance and Bonds: Bid item amount is shown on the Bid Form.
- H. Demobilization and Submittal of All Closeout Documents: Bid item is shown on the Bid Form. Fifty percent of bid item will not be paid until Contractor has completed all closeout submittals to Engineer as specified in Section 01 77 00 Contract Closeout.

1.04 SCHEDULE OF VALUES

A. Requirements Included:

- 1. Submit to the Engineer a Schedule of Values allocated to the various portions of the Work, within fifteen (15) days after start of Contract Time.
- 2. Upon request of the Engineer, support the values with data which will substantiate their correctness.
- 3. The Schedule of Values, unless objected to by the Engineer, shall be used only as the basis for the Contractor's Application for Payment.

- B. Form and Content of Schedule of Values:
 - 1. Type schedule on 8-1/2 in. x 11 in. white paper; Contractor's standard forms and automated printout will be considered for approval by Engineer upon Contractor's request. Identify schedule with:
 - a. Title of Project and location.
 - b. Engineer and Project number.
 - c. Name and address of Contractor.
 - d. Contract designation.
 - e. Date of submission.
 - 2. Schedule shall list the installed value of the component parts of the Work in sufficient detail to serve as a basis for computing values for progress payments during construction. Schedule shall include all Work shown on Drawings and indicated in Specifications. Schedule shall be subdivided by categories with subtotals shown for each bid item listed in the Bid.
 - 3. Follow the table of contents of this Project Manual as the format for listing component items.
 - a. Identify each line item with the number and title of the respective major section of the specifications.
 - b. List items paid via allowances separately from the rest of the Work and at the end of the Schedule.
 - 4. For each major line item list subvalues of major products or operations under the item.
 - 5. Each of the various portions of the Work (excluding allowance items) listed in the Schedule of Values shall include a directly proportional amount of the Contractor's overhead and profit.
 - 6. The unit values of the materials or equipment for which progress payments will be requested prior to installation and demonstration shall be broken down into:
 - a. Cost of the material or equipment, delivered and unloaded at the site, with taxes paid.
 - b. Installation costs, including Contractor's overhead and profit.
 - c. Shakedown and demonstration of equipment and/or systems.
 - d. Operator training and/or manufacturer's inspection and/or certifications if required.
 - 7. The unit quantity for bulk materials shall include an allowance for normal waste.
 - 8. The sum of all values listed in the schedule shall equal the total amount of Contract.
 - 9. No payment will be made exclusively for Contractor's preparation of submittals.

1.05 APPLICATIONS FOR PAYMENT

A. Requirements Included:

1. Submit Applications for Payment to Engineer in accordance with the schedule established by conditions of the Contract and Agreement between Owner and Contractor.

B. Format and Data Required:

- 1. Cover and signature page: As reviewed and approved by Engineer.
- 2. Sheet size: 8.5" x 11" or 8.5" x 14".
- 3. Payment items: Follow approved schedule of values.
- 4. Preparation: Typed or machine printed.
- 5. Columns Included:
 - a. Bid or payment item (from schedule of values)
 - b. Unit
 - c. Contract:
 - 1) Contract or scheduled unit price
 - 2) Quantity
 - 3) Total price
 - d. Previously completed:
 - 1) Quantity
 - 2) Total price
 - e. Completed this period:
 - 1) Quantity
 - 2) Total price
 - f. Total to date:
 - 1) Quantity
 - 2) Total price
- 6. Contractor's standard format can be used if it meets these requirements or is approved by the Engineer.
- 7. Submit draft payment applications electronically in Microsoft "EXCEL" spreadsheet format to Engineer for review. Include all supporting documents in e-mail to Engineer. Note: Payment applications in .pdf format for review purposes are not allowed.

C. Preparation of Application for Each Progress Payment:

- 1. Application Form:
 - a. Fill in required information, including that for Change Orders executed prior to date of submittal of application.
 - b. Fill in summary of dollar values to agree with respective totals indicated on continuation sheets.
 - c. Execute certification with signature of a responsible officer of Contract firm.

2. Continuation Sheets:

- a. Fill in total list of all scheduled component items of Work, with item number and scheduled dollar value for each item.
- b. Fill in dollar value in each column for each scheduled line item when Work has been performed or products stored.
- c. List each Change Order executed prior to date of submission, at the end of the continuation sheets.
- d. List by Change Order Number and description, as for an original component item of Work.

- 3. Limits of Payment for partially complete Water Line:
 - a. Not to exceed 80% of Unit Price for sections of line for which trench compaction tests and finish grading of the trench are complete but pressure testing has not been successfully completed.
 - b. Not to exceed 90% of Unit Price for sections of line for which disinfection has not been successfully completed.
- D. Substantiating Data for Progress Payments:
 - 1. Submit with each copy of application:
 - a. Properly identified invoices supporting requests for materials payments.
 - b. Properly identified invoices for inspection testing allowance payments.
 - c. Labor standards certificate in accordance with example form to be provided by Engineer.
 - d. If required by Engineer, certificate of payment of all suppliers and subcontractors for which payment has previously been received from Owner, in accordance with example form to be provided by Engineer.
 - e. Copy of construction schedule showing progress to date.
- E. Preparation of Application for Final Payment:
 - 1. Fill in application form as specified for progress payments.
 - 2. Provide certificate of payment of all suppliers and subcontractors.
 - 3. Provide release of lien certificates from all subcontractors.
- F. Submittal Procedure:
 - 1. Review quantities and obtain concurrence of Engineer's field representative before submission.
 - 2. Submit Applications for Payment to Engineer at the times stipulated in the Agreement.
 - 3. Number: Seven (7) printed copies of each final, executed application, unless otherwise agreed to at the Pre-Construction Conference.
 - 4. When Engineer finds Application properly completed and correct, he will transmit certificate for payment to Owner, with copy to Contractor.
- PART 2 PRODUCT (NOT USED)
- PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 31 19

PROJECT MEETINGS

PART 1 GENERAL

1.01 MEETINGS

- A. Contractor to attend at no additional cost to Owner.
- B. Preconstruction conference to be scheduled by Engineer.
- C. Monthly progress meetings.
- D. Special meetings as deemed necessary and scheduled by Owner or Engineer.
- E. Special and final inspections by Owner or Engineer when requested.
- F. Contractor responsible for preparing progress meeting agenda and distribution of meeting notes at no additional cost to Owner.

1.02 SCHEDULE OF SPECIAL REQUIREMENTS FOR THIS PROJECT

- A. Contractor responsible for preparing and providing meeting agenda and meeting minutes.
 - 1. Contractor shall provide printed copies of the progress meeting agenda.
 - 2. Meeting notes shall be provided electronically.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 32 13

CONSTRUCTION SCHEDULES

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Promptly after award of the Contract, prepare and submit to Engineer estimated initial baseline construction progress schedules for the Work.
- B. Submit revised progress schedules.
- C. Schedule subject to approval of Engineer.
- D. Schedule construction working hours.

1.02 FORM OF SCHEDULES

- A. Basis of Schedule: Critical path network analysis of construction activities.
- B. Format of Graphic Display of Schedule Submitted to Engineer:
 - 1. Gantt horizontal bar chart as a printed copy or in pdf electronic file format, as specified herein.
 - 2. Horizontal Time Scale: Identify the first work day of each week.
 - 3. Provide separate horizontal bar for each activity. In general, subdivide activities into sub-activities having durations no more than 15 working days, so that progress can be easily tracked.
 - 4. List the activities in chronological order according to the start date of each activity.
 - 5. Indicate durations and start/stop dates for each activity.
 - 6. Indicate the predecessor and successor activities for each activity.
 - 7. Identify which activities are on the critical path.

1.03 CONTENT OF SCHEDULES

- A. Activities: Show the complete sequence of construction by activity.
 - 1. Include activities for:
 - a. Preparation of submittals for major equipment items.
 - b. Procurement of major equipment items.
 - c. Mobilization.
 - d. Preparation of operation and maintenance manuals for major equipment items.
 - e. Shakedown/startup testing.
 - f. Punchlist work.
 - g. Preparation of closeout documents.

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- h. Any sequence or scheduling constraints specified in Section 01 12 16 Sequence of Work.
- B. Milestones: Indicate milestone dates for:
 - 1. Notice to Proceed.
 - 2. Notice of Substantial Completion.
 - 3. Final Completion.

1.04 PROGRESS REVISIONS

- A. Indicate effective date of revision and show progress of each activity to date of submission.
- B. Show changes occurring since previous submission of schedule:
 - 1. Major changes in scope.
 - 2. Activities modified since previous submission.
 - a. Revised projections of progress and completion.
 - b. Revised critical path activities.
 - c. Other identifiable changes.
- C. Provide a narrative report as needed to define:
 - 1. Problem areas, anticipated delays, and the impact on the schedule.
 - 2. Corrective action to be taken.

1.05 SUBMISSIONS

- A. Submit initial baseline schedules within fifteen (15) days after start of Contract Time.
 - 1. Engineer will review schedules and return review comments within 10 days after receipt.
 - 2. If required, resubmit within 7 days after return of review copy.
- B. Submit updated schedules to show actual progress of Work with each application for payment: Section 01 29 00 Payment Procedures.
- C. Submit revised progress schedules when requested by Engineer or whenever project is more than 5% behind approved schedule as determined by monthly request for payment.

1.06 DISTRIBUTION

- A. Distribute copies of the initial baseline and monthly updated schedules as follows:
 - 1. Engineer's Review Copy: One (1) printed copy or electronic file in .pdf format.
 - 2. Engineer's Record Copy: Four (4) printed copies.

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1.07 CONSTRUCTION WORKING HOURS SCHEDULING

- A. Notify Engineer at least 48 hours in advance of any work to be done outside of usual working hours or any change in usual working hours.
- PART 2 PRODUCTS (NOT USED)
- PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 33 23

SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Shop Drawings
- B. Product Data
- C. Samples
- D. Contractor Responsibility
- E. Engineer Responsibility
- F. Architectural Finishes
- G. Schedule of Submittals

1.02 RELATED WORK/REQUIREMENTS SPECIFIED ELSEWHERE

A. Conditions of the Contract: Definitions and Additional Responsibilities of Parties

1.03 SHOP DRAWINGS

- A. Present drawings in a clear and thorough manner.
 - 1. Sufficient detail to show kind, size, and arrangement and function of component materials and devices.
- B. Minimum sheet size: 8-1/2" x 11".

1.04 PRODUCT DATA

A. Preparation:

- 1. Provide information required in individual Sections.
- 2. Where sheets are reproduced from a pamphlet, catalog, or similar publication, print the manufacturer's name and the title of the publication on each sheet, or set of sheets, if it is not already on the sheet.
- 3. Clearly mark each copy to identify applicable products or models by both neatly encircling pertinent data and marking the circle with an arrow or by crossing out all extraneous data, with black, indelible ink. Do not use highlighter because it will not reproduce well.
- 4. For items that may be installed at multiple locations throughout the project, such as pipe materials, valves, other pipe appurtenances, and field coatings, indicate in a cover letter where each item is intended to be installed.

- 5. Show performance characteristics and capacities.
- 6. Show dimensions and clearances required.
- 7. Indicate weights of major components.
- 8. Indicate materials of construction.
- 9. Do not prepare submittal materials from facsimile (FAX) copies of product data unless specifically authorized by Engineer.
- 10. Material described on Drawings but not shown in the Specifications: Provide cut sheets as a minimum, or as called for on the Drawings.
- B. Installation data for all materials and equipment for which operation and maintenance manuals will not be provided. Also provide installation data with shop drawing prior to delivery of equipment, if specified in the equipment Section.
 - 1. Provide manufacturer's installation instructions and recommendations.
 - 2. Provide referenced standards for installation.
- C. Manufacturer's standard schematic drawings, diagrams, descriptions and information:
 - 1. Modify to delete information that does not apply to Work.
 - 2. Supplement to provide information specifically applicable to the Work.

1.05 SAMPLES

- A. Samples shall be of sufficient size and quantity to clearly illustrate:
 - 1. Functional characteristics of the project, with integrally related parts and attachment devices.
 - 2. Full range of color, texture, and pattern.
- B. Include identification on each sample, with full project information.

1.06 CONTRACTOR RESPONSIBILITIES

- A. If substitutions of materials are proposed, conform to Section 01 25 00 Substitution Procedures.
- B. Submit exactly the required quantity of materials.
- C. Review Shop Drawings, Product Data, Certificates, Electrical Schematics, Electrical Connection Diagrams, Test Reports, Installation Instructions, Samples, and similar required submittal materials for completeness and accuracy prior to submission. Return unsatisfactory submittal materials to the supplier or manufacturer for correction.
- D. Determine and Verify:
 - 1. Field measurements.
 - 2. Field construction criteria.
 - 3. Catalog numbers and similar data.

- 4. Conformance with Specifications.
- 5. Conflicts with other items of construction past, present, or future.
- 6. Submittal materials are legible.
- E. Coordinate each submittal with requirements of the Work and of the Contract Documents.
- F. Notify the Engineer in writing, at time of submission, of any deviations in submittal from Contract requirements.
- G. Begin no fabrication or work that requires submittals until return of submittals with Engineer's final review.

1.07 SUBMITTAL PROCEDURES

- A. Make submittals promptly and in such sequence as to cause no delay in the Work.
- B. Execute and attach "Contractor Submittal Form" to each submittal. Sample form is attached to the end of this Section. Sign, date, and forward the Form and the Contractor reviewed submittal materials to the Engineer.
- C. Number submittals by respective section number followed by an "S" for submittals, "P" for preliminary O&M, and "F" for final O&M.
- D. Include a copy of the respective Specification Section(s). For each paragraph of the Specifications, confirm that the submittal complies and include a tab and sheet number where the information can be found for each paragraph of the Specification. If the submittal does not comply with a paragraph, identify as such and provide an explanation why it does not. If this information is not provided with each submittal and preliminary O&M, then the Engineer will return as "Not Reviewed". Final O&Ms are excluded from this requirement.

1.08 RESUBMISSION REQUIREMENTS

- A. Make corrections/changes in the submittals to comply with comments made by the Engineer and resubmit until final review.
 - 1. Attach Engineer's comments from previous submittal annotated with action taken in the current submittal.
- B. Number resubmittals as identified in paragraph entitled "Submittal Procedures", and follow with a numeric value which identifies the number of resubmittals pertaining to that specific submittal.
- C. Shop Drawings and Product Data:
 - 1. Revise initial drawings or data, and resubmit as specified for the initial submittal.
 - 2. Indicate any changes that have been made other than those requested by the Engineer.

- D. Samples: Submit new samples as required for initial submittal.
- E. Specifically direct attention in writing to revisions other than the corrections called for by the Engineer on previous submittals.
- F. Include a copy of previous "Contractor Submittal Forms".
- G. Include a copy of previous Engineer's comments, marked to show Contractor's responses. If not provided, submittal will be returned as "Rejected/Resubmit."
- H. Furnish all applicable information in the resubmittal, including information on material that was favorably reviewed. Upon request, the Engineer will return all but one of the original submittals for reuse by the Contractor.
- I. Partial resubmittals are allowed, but following favorable review of the partial resubmittal, provide complete resubmittals including all favorably reviewed material.

1.09 DISTRIBUTION

- A. Copy and distribute submittals returned by Engineer marked "No Exception Taken" or "Make Corrections Noted":
 - 1. Job site file.
 - 2. Job site record documents file.
 - 3. Subcontractors and suppliers as appropriate.
- B. If returned by Engineer, distribute samples marked "No Exception Taken" or "Make Corrections Noted" as directed by the Engineer.

1.10 ENGINEER RESPONSIBILITIES

- A. Review submittals with reasonable promptness as specified herein in the Timeliness subsection.
- B. Return submittals with completed Contractor Submittal Form with signature and attach review comments if needed.
- C. Return one copy of submittal to Contractor.
- D. Submittal Review Status Categories:
 - 1. "NO EXCEPTION TAKEN" Reviewed for general conformity to the requirements of the Contract Documents. Quantities shown not verified. Contractor's full responsibility is in no way relieved by this action.
 - 2. "MAKE CORRECTIONS NOTED" Reviewed and noted for general conformity to requirements of the Contract Documents. Quantities shown not verified. Contractor's responsibility is in no way relieved by this action. Resubmittal is not required, provided Contractor concurs with, accepts, and complies with A/E's comments.

- 3. "REVISE & RESUBMIT" Reviewed and not accepted. Provide missing information, make corrections as noted, and resubmit full submittal.
- 4. "REJECTED/RESUBMIT" Reviewed or partially reviewed and not accepted. Resubmit information in conformance with the Contract Documents.
- 5. "RECEIPT ACKNOWLEDGED" Submittal for Section is not required or submittal is being held by A/E for coordination of work with that of another Section.
- E. Return submittals with only cursory review and marked "Revise & Resubmit" or "Rejected/Resubmit" when:
 - 1. It becomes apparent the submittal is not acceptable,
 - 2. The submittal has not been thoroughly reviewed by the Contractor,
 - 3. Submittal does not cover all of a Section,
 - 4. Submittal improperly contains information for more than one Section, or
 - 5. Submittal is illegible.
- F. Return resubmittals only containing partial information.
- G. Discard submittal copies in excess of those scheduled.

1.11 LIMITS OF ENGINEER'S RESPONSIBILITY

- A. Engineer's review does not constitute acceptance or responsibility for accuracy of dimensions or quantities.
- B. Engineer's review does not relieve the Contractor from meeting requirements of the Contract Documents.
- C. Engineer's review does not constitute approval for any deviation from the Contract Documents unless such deviations are specifically stated as such on the submittal and specifically allowed by the Engineer by specific written notification for each such variation.
- D. Engineer's review does not relieve the Contractor from responsibility for errors or omissions in the Shop Drawings or from responsibility for having complied with the Contractor's Responsibilities portion of this Section.
- E. Engineer's review will be only for conformance with the design concept of the Project and for compliance with the information given in the Contract Documents and shall not extend to means, methods, techniques, sequences or procedures of construction or to safety precautions or programs incident thereto. The review of a separate item as such will not indicate approval of the assembly in which the item functions.

1.12 PAYMENT AND TIME FOR REVIEW OF EXCESSIVE SUBMITTALS

- A. Submittals after first resubmittal:
 - 1. Owner will charge Contractor for all of Engineer's review time and costs at Engineer's standard billing rates through a credit by Change Order.
 - 2. Reviewed by Engineer at convenience of the Engineer.

1.13 FORMAT

- A. Furnish individual submittal packages for each Section. Include a separate Contractor Submittal Form for each Section.
- B. The Contractor may elect to make a single submittal for all Sections supplied by a single manufacturer/supplier. Such single submittal must conform to the following:
 - 1. Index the submittal with tabs with one and only one Section under a single tab.
 - 2. Include a separate Contractor Submittal Form for each Section.
 - 3. Identify submittal packages on the front or on the first page with the Owner's name, the project name, the Contractor's name, the subcontractor's name, the date, and the contents of the binder, including the Specification Section(s), title(s), and number(s).

C. Minimum Acceptable Binding Methods:

- 1. Submittals of no more than six sheets per set, including cover sheets: Staple in sets.
- 2. Submittals of seven to 25 sheets per set: Punch sheets and assemble in a soft-cover binder with 3-hole metal fold-down clips to hold pages or in a ring binder.
- 3. Submittals of 26 to 75 sheets: Punch sheets and assemble in a hard-cover ring binder.
- 4. Submittals of more than 75 sheets: Punch sheets and assemble in a hard-cover D-ring binder.
- 5. Fold 11" x 17" drawings to fit into bound sets of submittals.
- 6. Furnish drawings larger than 11" X 17" folded and inserted in pockets in the binders. Provide a complete index in the submittal literature set.

1.14 TIMELINESS

A. As a minimum, the Contractor shall allow the following number of calendar days for submittal process:

	Engineer's Review Time
Initial Submittal	14
Resubmittal	7
Operation and Maintenance Manuals	16

- 1. Engineer's Review Time is the time the submittal is in the Engineer's office.
- 2. The Engineer will process first those items with higher priority based on a written request from the Contractor.

- B. Turnaround time for complex submittals (such as process equipment systems with multiple components, mechanical systems, electrical equipment, instrumentation control systems, and electrical process and instrumentation drawings) may exceed the total indicated in Paragraph 1.14A.
- C. Materials, equipment, supplies, or labor to install such materials or equipment for which submittals have not been marked "No Exception Taken" or "Make Corrections Noted" are not eligible for payment and such materials and equipment shall not be allowed on the job site.

1.15 ARCHITECTURAL FINISHES

A. Definition:

- 1. Exterior and interior finishes which require selection of color, pattern and texture by the A/E
- 2. Finishes which are listed on the architectural drawings and within the Architectural Specification Sections, including pre-selected finishes

B. Architect shall:

- 1. Select Architectural Finishes for exterior materials along with interior, as a complete package.
- 2. Hold submittals requiring finish selections until all finish samples and product data are received.
- 3. Prepare Exterior and Interior Color Boards and submit them to the Owner for its approval.
- 4. Notify the Contractor if further samples or information are required.
- 5. Process complete submittals and return them to the Contractor after Owner has approved final Architectural Finishes package.

C. Contractor shall:

- 1. Submit color and finish samples along with product data for exterior and interior materials requiring finish selections, during the period agreed upon at the Pre-Construction Conference.
- 2. Provide products of the manufacturer named in the Specification for items not submitted during the finish selection period.
- 3. Order no items requiring a finish selection, even where finish has been preselected and listed, until the Owner has approved the final Architectural Finishes package.
- D. Schedule of Finishes: refer to Schedules and Legends on the Architectural Drawings and Architectural Specification Sections within Divisions 02 through 14.

1.16 PROJECT RECORD DOCUMENTS

A. If the equipment installed deviates in any way from the submittal for the equipment, then submit copies of submittals that are corrected to show actual equipment supplied.

1.17 ATTACHMENTS TO THIS SECTION

- A. Contractor Submittal Form
- 1.18 REQUIRED SUBMITTALS
 - A. Quantity, submit in **one** of the following formats:
 - 1. Electronic Format:
 - a. Submittals in electronic searchable .pdf format are allowed.
 - b. Engineer's submittal review will be returned to Contractor in electronic format.
 - c. After an electronic submittal is accepted by the Engineer as final, submit one printed copy to Engineer to retain for field use.
 - d. Any additional printed copies received will be discarded by Engineer.
 - e. Refer to Section 01 78 39 Project Record Documents for submittal of one printed record set of submittals at Contract close-out.
 - 2. Or Printed Format:
 - a. For submittals in printed format only, submit five copies. Engineer will retain four copies.
 - b. Engineer will return one copy to Contractor.
 - c. Any additional copies received will be discarded by Engineer.
 - B. See individual Specification Sections for description of required submittals.
- PART 2 PRODUCTS (NOT USED)
- PART 3 EXECUTION (NOT USED)
- PART 4 PAYMENT
- 4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	<u>Pay Unit</u>
Bid Item Containing	Prepare	Incidental
Associated Submittal	Submittal	

END OF SECTION

#	CONTRACTOR SUBMITTAL FORM		
	Project: Cañoncito-Eldorado Waterline	Contractor's Submittal No.:	
		Date: Product Description:	
	CONTRACTOR:	Dates of any previous submissions:	
	CONTRACTOR.	Dates of any previous suchnissions.	
	Subcontractor / Supplier:	Manufacturer:	
on No. iption:	Specification No.:	Drawing Nos.:	
Specification No. Title/Description:	Are there any deviations to the Contract Documents? No Yes (Explain and Identify:)		
Specif Title/I	Undisclosed deviations/modifications do not relieve the Contractor from the obligation to provide the specified product and detail of installation, and may be cause for rejection of the Work. Deviations and modifications must be listed here or in a separate Request for Substitution.		
CONTRACTOR'S CERTIFICATION: This submittal has been reviewed by the Contractor in compliance with Submittal Procedures of the CONTRACT DOCUMENTS' SPECIFICATIONS. Any deviations or substitutions to the CONTRACT DOCUMENTS have been identified above and submitted in compliance with the CONTRACT DOCUMENTS.			
If this is a re-submittal, identify on a sheet(s) attached to this form all responses to comments on the previous submittal and all changes other than those specifically requested by the A/E on the previous submittal.			
Signed _		Date:	
		CW RESPONSE on for explanation of categories.)	
Date Rec	reived:	o. Copies Received:	
□ NO	EXCEPTION TAKEN		
MA	KE CORRECTIONS NOTED		
REV	/ISE & RESUBMIT		
☐ REJ	ECTED/RESUBMIT		
☐ RECEIPT ACKNOWLEDGED			
By:	Date:		
Date Ret	e Returned: No. Copies Returned:		
A/E'S Co	OMMENTS, IF ANY:		
A/E'S ATTACHMENTS, IF ANY:			
	OT combine items from different specification sections into one places called for in the Section. If provisions in the "General"	MOLZENCORBIN	

Note: DO NOT combine items from different specification sections into one submittal unless called for in the Section. If provisions in the "General Conditions" conflict with this form, the provisions as stated in the "General Conditions" shall prevail.

ENGINEERS | **ARCHITECTS** | **PLANNERS** 2701 Miles Road SE, Albuquerque, NM 87106

SECTION 01 35 29

HEALTH, SAFETY, AND EMERGENCY RESPONSE PROCEDURES

PART 1 GENERAL

1.01 WORK INCLUDED

A. Prepare a Health and Safety Plan (HASP) to protect health and safety of personnel and visitors to the project site, and comply with OSHA requirements and EPA guidelines referenced herein as applicable to Contractor's activities.

B. Scope of Work:

- 1. Develop and submit a site-specific HASP prior to commencement of construction, and implement and maintain strategies to prevent injuries and work-related illness throughout construction of the Project.
- 2. Contractor shall maintain and update the HASP as necessary and required by project site conditions.
- 3. Contractor shall have the HASP available for review at all times.

C. Health and Safety Plan Requirements:

- 1. Organizational Structure:
 - a. List of key personnel that are responsible for site safety, emergency response, and public health protection.
- 2. Workplan:
 - a. Project site description and work area.
 - b. Description of available resources and access.
- 3. Job Hazard Analysis:
 - a. Description of known hazards and evaluation of the risks associated with each activity conducted.
 - b. Control measures for protecting workers and visitors from accidents involving large equipment, power tools, hand tools, or weather-related emergencies.
- 4. Site Control:
 - a. Procedures to gain access to site.
- 5. Training Program
- 6. Medical Surveillance Requirements
- 7. Personal Protective Equipment (PPE)
- 8. Exposure Monitoring
- 9. Emergency Response Plan
- 10. Standard Operating Procedures
- 11. Confined Space Programs
- 12. Hot Work
- 13. Lockout/Tagout

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1.02 REFERENCES

- A. EPA Order 1440.1 Safety, Health, and Environmental Management Program Guidelines
- B. EPA Order 1440.2 Health and Safety Requirements for Employees Engaged in Field Activities
- C. EPA Order 1440.3 Respiratory Protection
- D. EPA Standard Operating Safety Guide, Publication 9285.1-03
- E. OSHA regulations
- F. State and local regulations
- PART 2 PRODUCTS (NOT USED)
- PART 3 EXECUTION (NOT USED)
- PART 4 PAYMENT
- 4.01 PAYMENT ITEMS

Payment will be made under:

Bid Item No. Pay Item Pay Unit 6.01 Prepare HASP Lot

END OF SECTION

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SECTION 01 42 13

ABBREVIATIONS AND ACRONYMS

PART 1 GENERAL

1.01 SPECIAL

- A. A/E Architect/Engineer.
- B. EAWSD Eldorado Area Water and Sanitation District (District).
- C. EPA United States Environmental Protection Agency.
- D. NMAC New Mexico Administrative Code.
- E. NMDOT New Mexico Department of Transportation.
- F. NMED New Mexico Environment Department.
- G. NMSA New Mexico Statutes Annotated.
- H. OSE Office of State Engineer.
- I. OSHA Occupational Safety and Health Administration.
- J. PNM Public Service Company of New Mexico.
- K. SFCO Santa Fe County (County).
- L. SLO State Land Office.
- M. TAC Technical Advisory Committee (County).

1.02 OTHER

- A. As indicated on the Drawings, as apparent from the Drawings, or in accordance with standard practice.
- PART 2 PRODUCTS (NOT USED)
- PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 42 19

REFERENCE STANDARDS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Abbreviations and acronyms used in Contract Documents to identify reference standards.

1.02 QUALITY ASSURANCE

- A. Application: When a standard is specified by reference, comply with requirements and recommendations stated in that standard, except when requirements are modified by the Contract Documents, or applicable codes establish stricter standards.
- B. Publication Date: The publication in effect on the date of bid, except when a specific publication date is specified.

1.03 ABBREVIATIONS, NAMES, AND ADDRESSES OF ORGANIZATIONS

A. Obtain copies of referenced standards direct from publication source, when needed for proper performance of Work, or when required for submittal by Contract Documents.

AA Aluminum Association

818 Connecticut Avenue, NW Washington, D.C. 20006

AASHTO American Association of State Highway

and Transportation Officials 444 North Capital Street, NW Washington, DC 20001

ABMA American Bearing Manufacturers Association

(formerly Anti-friction Bearing Manufacturers Association)

2025 M. Street, NW, Suite 800 Washington, DC 20036-3309

ACI American Concrete Institute

Box 19150 Reford Station Detroit, MI 48219

ADAAG Americans with Disabilities Accessibility Act Guidelines

www.access-board.gov/adaag

ADC Air Diffusion Council

230 North Michigan Avenue

Chicago, IL 60601

AGMA American Gear Manufacturers Association

1001 N. Fairfax Street, Suite 500 Alexandria, VA 22314-1587

AI Asphalt Institute

Asphalt Institute Building College Park, MD 20740

AISC American Institute of Steel Construction

1221 Avenue of the Americas

New York, NY 10020

AISI American Iron and Steel Institute

1000 16 Street, NW Washington, DC 20036

ANSI American National Standards Institute

1430 Broadway

New York, NY 10018

APWA American Public Works Association

1313 E. 60th Street Chicago, IL 60637

ASHRAE American Society of Heating, Refrigerating

and Air Conditioning Engineers

345 East 47 Street New York, NY 10017

ASME American Society of Mechanical Engineers

345 East 47 Street New York, NY 10017

ASTM American Society for Testing and Materials International

1916 Race Street

Philadelphia, PA 19103

AWI Architectural Woodwork Institute

1411 S. Rimpau Avenue, Suite 213

Corona, CA 92879-7500

AWWA American Water Works Association

6666 W. Quincy Avenue Denver, CO 80235

AWS American Welding Society

2501 NW 7 Street Miami, FL 33125

CBM Certified Ballast Manufacturers

1422 Euclid Avenue Cleveland, OH 44115

CPSC Consumer Products Safety Commission

www.cpsc.gov

CRSI Concrete Reinforcing Steel Institute

180 North LaSalle Street, Suite 2110

Chicago, IL 60601

CSA Canadian Standards Association

178 Rexdale Boulevard

Rexdale, Ontario, Canada M9W 1R3

DHI Door and Hardware Institute

7711 Old Springhouse Road

McLean, VA 22102

EEI Edison Electric Institute

1111 19 Street, NW Washington, DC 20036

ETL Electrical Testing Laboratories

2319 Dorris Place

Los Angeles, CA 90031

FM Factory Mutual

www.fmglobal.com

FS Federal Specification

General Services Administration

Specifications and Consumer Information

Distribution Section (WFSIS) Washington Navy Yard, Bldg. 197

Washington, DC 20407

www.fss.gsa.gov/pub/fed-specs.cfm

GA Gypsum Association

1603 Orrington Avenue Evanston, IL 60201

HI Hydraulic Institute

6 Campus Drive, First Floor North

Parsippany, NJ 07054-4405

IBC International Building Code published by

International Code Council

500 New Jersey Avenue, NW, 6th floor

Washington, DC 20001

ICEA Insulated Cable Engineers Association

P.O. Box P

South Yarmouth, MA 02664

IEEE Institute of Electrical and Electronics Engineers

345 East 47 Street New York, NY 10017

ISA Instrument Society of America

67 Alexander Drive P.O. Box 12277

Research Triangle Park, NC 27709

MIL Military Specification

Naval Publications and Forms Center

5801 Tabor Avenue Philadelphia, PA 19120

NACE National Association of Corrosion Engineers

P.O. Box 21830 Houston, TX 77218

NEC National Electric Code

Batterymarch Park P.O. Box 9101 Quincy, MA 02269

NEMA National Electrical Manufacturers' Association

2101 L Street, NW

Washington, DC 20037

NESC National Electric Safety Code

345 East 47 Street New York, NY 10017

NFPA National Fire Protection Association

470 Atlantic Avenue Boston, MA 02210

NFPA National Forest Products Association

1619 Massachusetts Avenue, NW

Washington, DC 30036

NMBC New Mexico Building Code

Code Regulations Licensing Department

Construction Industries Divisions

725 St. Michaels Drive Santa Fe, NM 87504

NRCA National Roofing Contractors Association

www.nrca.net

NSF National Sanitation Foundation International

P.O. Box 130140 789 N. Dixboro Road Ann Arbor, MI 48105

NWWDA National Wood Window and Door Association

P.O. Box 34518 Memphis, TN 38184

OSHA Occupational Safety & Health Administration

www.osha.gov

PCA Portland Cement Association

5420 Old Orchard Road

Skokie, IL 20076

PCI Prestressed Concrete Institute

20 North Wacker Drive Chicago, IL 60606

SDI Steel Door Institute

712 Lakewood Center North

Cleveland, OH 44107

SIGMA Sealed Insulating Glass Manufacturer's Association

111 East Wacker Drive Chicago, IL 60601

SJI Steel Joist Institute

1703 Parham Road

Suite 204

Richmond, VA 23229

SMACNA Sheet Metal and Air Conditioning

Contractors' National Association, Inc.

8224 Old Court House Road

Vienna, VA 22180

SSPC The Society for Protective Coatings (formerly Steel Structure

Painting Council) 40 24th Street, 6th Floor Pittsburgh, PA 15222-4656

(877) 281-7772

UBC Uniform Building Code

International Conference of Building Officials

5360 Workman Mill Road Whittier, CA 90601-2298

UL Underwriters' Laboratories, Inc.

333 Pfingston Road Northbrook, IL 60062

UPC Uniform Plumbing Code

International Association of Plumbing/Mechanical Officials

20001 Walnut Drive, South Walnut, CA 91789-2825

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 45 16.14

DIGITAL VIDEO RECORDING

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Digital video record entire area affected by construction prior to construction.
- B. Perform additional digital video recording during project as directed by Engineer.
- C. Have digital video files available with viewing facilities for viewing by Engineer, Owner, and Contractor when requested.
- D. Digital video recording requirement part of Contractor's general overhead for which separate payment shall not be made.

1.02 EQUIPMENT REQUIREMENTS

- A. Digital Video Camera Equipment:
 - 1. Recording Media: DVD.
 - 2. Format: Digital files compatible with standard playback equipment, and as agreed upon beforehand with Owner.
 - 3. Color picture.
 - 4. Audio, clear narration in English of significant features observed during recording.
 - 5. Zoom lens.
 - 6. Indexing of locations on discs for easy reference.
 - 7. File downloading capability: To a personal computer (PC) that operates on Microsoft operating system of Windows XP or higher.
- B. Video Viewing System:
 - 1. Screen: 26 inches (diagonal dimension) or greater.
 - 2. Color picture.
 - 3. Audio.
 - 4. Indexing of locations on discs for easy reference.
 - 5. Slow motion.
 - 6. Stop frame for viewing single picture.
 - 7. Reversing.
 - 8. Compatible with digital recording equipment.
- C. Discs:
 - 1. Catalogued, cross-referenced, indexed.

1.03 SYSTEM OPERATOR REQUIREMENTS

A. Familiar and experienced with equipment and equipment operations.

1.04 AVAILABILITY

- A. Recording equipment and operator available on-site within 0.5 hours of Engineer's request during Contractor's normal working hours if scheduled.
- B. Viewing system and appropriate discs available at meetings as scheduled or when requested by Engineer.
- C. Deliver one (1) complete set of files to the Owner upon acceptance by the Engineer.

1.05 DIGITAL VIDEO RECORDING REQUIRED IF SCHEDULED

- A. All streets, alleys, curbs, culverts, vaults, manholes, areas, locations where construction will be done:
 - 1. Both directions along utility line or street to be constructed or reconstructed.
 - 2. Maximum speed of camera movement 4 feet per second.
 - 3. Lateral and close-up view of any features or facilities that may be affected by construction.
 - 4. Not more than 14 calendar days prior to actual construction.
 - 5. Include data documentation on disc.
 - 6. Audio explanation of significant features observed during recording.
 - 7. Recording results acceptable to Engineer.
 - 8. Special documentation if requested by Engineer.

B. Drainage Documentation:

- 1. Following general rainfall over area.
- 2. Prior to any construction if practical.
- 3. All areas where work will be performed.
- 4. Recorded to document general preconstruction drainage patterns, problems, street surface conditions, and related items.
- 5. On request of Engineer.

1.06 SCHEDULE OF REQUIRED DIGITAL VIDEO RECORDING

- A. Provide digital video recording as outlined in Part 1.05 A.
- PART 2 PRODUCTS (NOT USED)
- PART 3 EXECUTION (NOT USED)
- PART 4 PAYMENT
- 4.01 PAYMENT ITEMS

Bid Item No. Pay Item Pay Unit
6.01 Digital Video Recording Lot

END OF SECTION

SECTION 01 45 23

TESTING LABORATORY SERVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Employ and pay for the services of an independent testing laboratory to perform specified services and testing associated with soil gradation and density, concrete, and asphalt.
- B. If the work includes bacteriological testing of water associated with disinfection, refer to Section 33 13 13 Disinfection of Domestic Water Systems, for certification of the water test laboratory and payment procedures for bacteriological testing.
- C. If the Work includes a water well, refer to Section 33 21 00 Water Well, for certification of the water test laboratory and payment procedures for bacteriological and water quality testing.

1.02 ADDITIONAL REQUIREMENTS

- A. Conditions of the Contract: Testing required by laws, ordinances, rules, regulations, orders or approval of public authorities.
- B. Each specification section listed: Laboratory tests required and standards for testing.

1.03 SUBMITTALS

- A. Submit for Engineer's review the name of proposed Laboratory to perform required testing and their statement of qualifications.
 - 1. Name(s) of professional engineer(s) registered in the state in which the project is located who will be signing test results.
 - 2. Qualifications of technicians and their certifications, such as NICET (National Institute for Certification in Engineering Technologies), to perform testing required for this project as specified in ASTM E329.
 - 3. Evidence of current participation in the AASHTO Materials Reference Laboratory (AMRL) program, and accreditation of the laboratory and list of test methods currently accredited by the AASHTO Accreditation Program (AAP).

1.04 QUALIFICATION OF LABORATORY

- A. Meet basic requirements of ASTM E329, "Standard Specification Agencies Engaged in Testing and/or Inspection of Materials Used in Construction".
- B. Authorized to operate in the State in which the Project is located by the local governing authority for the AASHTO Accreditation Program.

- C. Testing Equipment:
 - 1. Calibrated at reasonable intervals by devices of accuracy traceable to either:
 - a. National Institute of Standards and Technology (NIST) (formerly National Bureau of Standards).
 - b. Accepted values of natural physical constants.
- D. Office Location: The location at which specified services and testing will be performed or from which Testing Laboratory staff will mobilize to perform field work shall be within 50 miles of the project site.

1.05 LABORATORY DUTIES

- A. Cooperate with Engineer and Contractor; provide qualified personnel after due notice.
- B. Perform specified inspections, sampling and testing of materials and methods of construction:
 - 1. Comply with specified standards.
 - 2. Ascertain compliance of materials with requirements of Contract Documents.
- C. Promptly notify Engineer and Contractor of observed irregularities or deficiencies of work or products.
- D. Promptly submit written report of each test; one copy to Engineer, one copy to Structural Engineer, and copies as required to Contractor. Each report shall include:
 - 1. Date issued.
 - 2. Project title and number.
 - 3. Testing laboratory number, address, and telephone number.
 - 4. Name and signature of laboratory technician.
 - 5. Date and time of sampling or field testing.
 - 6. Record of temperature and weather conditions.
 - 7. Date of test.
 - 8. Identification of product and specification section.
 - 9. Location of sample or test in the Project.
 - 10. Type of test.
 - 11. Results of tests and compliance with Contract Documents.
 - 12. Interpretation of test results when requested by Engineer.
- E. Perform additional tests as required by Engineer or the Owner.
- F. In all cases, the Engineer shall determine the number, type and location of tests.
- G. Provide signature and seal of a Professional Engineer, licensed in the State where work is being performed, and who is employed by the Laboratory on all test results.

1.06 LIMITATIONS OF AUTHORITY OF TESTING LABORATORY

- A. Laboratory is not authorized to:
 - 1. Release, revoke, alter or enlarge on requirements of Contract Documents.
 - 2. Approve or accept any portion of the Work.
 - 3. Perform any duties of the Contractor.

1.07 CONTRACTOR'S RESPONSIBILITIES

- A. Cooperate with laboratory personnel, provide access to Work, and manufacturer's operations.
- B. Secure and deliver to the laboratory adequate quantities of representational samples of materials proposed to be used and which require testing.
- C. Provide to the laboratory the preliminary design mix proposed to be used for concrete and other material mixes which require control by the testing laboratory.
- D. Furnish copies of Product test reports as required.
- E. Furnish Incidental Labor and Facilities:
 - 1. To provide access to Work to be tested.
 - 2. To obtain and handle samples at the Project site or at the source of the product to be tested.
 - 3. To facilitate tests.
 - 4. For storage and curing of test samples.
- F. Make arrangements with laboratory and pay for additional samples and tests required for Contractor's convenience and retests required for previously failed tests.
- G. Notify testing laboratory at least 48-hours in advance of all testing required by job progress or conditions, or the Engineer.
- H. Provide on-site facilities as required for initial curing of concrete cylinders.

1.08 PAYMENT

- A. An allowance is included in the Bid Proposal to cover field testing performed by an independent testing laboratory. In accordance with Section 01 21 00 Allowances, the Owner will reimburse the Contractor for the actual cost of all such testing based on invoices received from the laboratory.
- B. The invoiced cost of mileage for all vehicles used shall be no greater than the standard mileage rate for business miles in effect at the times of occurrence, as published by the Internal Revenue Service (IRS).

- C. The testing allowance stated in the Bid Proposal is an estimated dollar amount. The final dollar amount reimbursed to the Contractor for testing may be less than, equal to, or more than the stated allowance.
- D. Actual reasonable sample shipping costs will be paid to the Contractor in the same manner and under the testing allowance.
- E. Costs for testing described in Paragraph 1.07.F are not eligible for reimbursement.
- PART 2 PRODUCTS (NOT USED)
- PART 3 EXECUTION (NOT USED)
- PART 4 PAYMENT
- 4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
6.07	Testing Laboratory Services	Allowance

END OF SECTION

SECTION 01 51 00

TEMPORARY UTILITIES

PART 1	GENERAL
1 1 1 1 1	

1.01 WATER

A. No County water facilities are available on the Project Site, except at the Rancho Viejo tank feeder line. Contractor is responsible for obtaining water for construction at its sole expense.

1.02 ELECTRICITY

A. Contractor's sole responsibility and expense.

1.03 OTHER

A. All other temporary utilities required to accomplish the Work to be the responsibility of and at the Contractor's sole expense.

1.04 RELATED REQUIREMENTS

A. Section 01 52 13 – Field Offices and Sheds

1.05 SPECIAL PROJECT REQUIREMENTS SCHEDULE

A. Provide sanitary facilities for Contractor's personnel.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No. 6.01	Pay Item Install temporary facilities for	Pay Unit Lot
	Contractor's use, including PNM's cost to install temporary power.	
6.02	Dismantle temporary facilities	Lot

END OF SECTION

SECTION 01 52 13

FIELD OFFICES AND SHEDS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Furnish, install, and maintain storage and work sheds needed for construction and temporary field offices during entire construction period.
- B. At completion of Work, remove field offices, sheds, and contents.

1.02 OTHER REQUIREMENTS

- A. Prior to installation of offices and sheds, consult with Engineer on location, access, and related facilities.
- B. Furnish, install, and maintain temporary electrical, internet, and other services, as needed.

1.03 REQUIREMENTS FOR FACILITIES

A. Construction:

- 1. Structurally sound, weathertight, with floors raised above ground.
- 2. Temperature transmission resistance: Compatible with occupancy and storage requirements.
- 3. At Contractor's option, portable or mobile buildings may be used. Mobile homes, when used, shall be modified for office use.
- B. Contractor's Office and Facilities:
 - 1. Size: As required for general use.

C. Storage Sheds:

- 1. To requirements of various trades.
- 2. Dimensions: Adequate for storage and handling of products.
- 3. Ventilation: Comply with specified codes and requirements for products stored.
- 4. Heating: Adequate to maintain temperatures specified in respective sections for products stored.

D. Office for Engineer's Resident Project Representative:

- 1. Structure physically separate from Contractor's office.
- 2. 15 ft. x 8 ft. minimum floor dimensions.
- 3. Adequate lights, electricity, and thermostat-controlled heating and refrigerated air cooling.

- 4. Combination copy/file/printer machine with scan capability for 8-1/2" x 11" and 11" x 17" sheets. Contractor shall pay monthly service charge and shall furnish paper and toner cartridges sufficient to copy up to 500 sheets per month.
- 5. Internet connection capable of fast (minimum of 1.5 Mbps) download of information. The system shall be unlimited in connection use, uninterruptible and continuous until contract completion. The Contractor shall pay for all services associated with this connection/installation.
- 6. Desk (minimum 4 drawer), four (4) drawer legal size filing cabinet, swivel desk chair, 3 ft. x 5 ft. drafting table, adjustable drafting chair or adjustable stool, and visitor's chair.
- 7. Office to be installed at site before any payment made to Contractor and maintained at site until Substantial Completion is reached on all portions of the Work.
- 8. Locking door with only Engineer to have key.
- 9. Identified with sign stating:
 - a. Molzen Corbin Consulting Engineers:
 - b. No hiring done here.
 - c. No deliveries made here.
 - d. No telephone available.
- 10. Security of office is Contractor's responsibility.

1.04 USE OF EXISTING FACILITIES

A. Existing facilities at site shall not be used for field offices or for storage.

1.05 MATERIALS, EQUIPMENT, FURNISHINGS

A. May be new or used, but must be serviceable, adequate for required purpose, and must not violate applicable codes or regulations.

1.06 PREPARATION

A. Fill and grade sites for temporary structures to provide surface drainage.

1.07 INSTALLATION

- A. Construct temporary field offices and storage sheds on proper foundations; provide connections for utility services.
 - 1. Secure portable or mobile buildings when used.
 - 2. Provide steps and landings at entrance doors.

1.08 MAINTENANCE AND CLEANING

A. Provide periodic maintenance and cleaning for temporary structures, furnishings, equipment, and services.

- 1.09 REMOVAL
 - A. Remove temporary field offices, contents, and services when no longer needed.
 - B. Remove storage sheds when no longer needed.
 - C. Remove foundations and debris; grade Site to required elevations and clean areas.

1.10 MEASUREMENT AND PAYMENT

A. Field offices and sheds are considered incidental to the Work to be completed. No separate payment shall be made for field offices and sheds.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	<u>Pay Unit</u>
6.01	Install field offices and sheds.	Lot
6.02	Dismantle field offices and sheds.	Lot

END OF SECTION

SECTION 01 55 00

TRAFFIC REGULATION

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Provide, operate and maintain equipment, services and personnel, with traffic control and protective devices as required to expedite public vehicular traffic flow and access on haul routes, at site entrances, on-site access road, parking areas, and any areas affected by construction operations.
- B. Remove temporary equipment and facilities when no longer required, restore grounds to original, or to specified conditions.

1.02 RELATED REQUIREMENTS

- A. Section 01 14 16.01 Coordination with Public and Utility Interruptions
- B. Section 01 56 00 Barriers

1.03 SUBMITTALS

- A. Section 01 33 23 Shop Drawings, Product Data, and Samples
 - 1. Qualifications of person who prepares the Traffic Control Plan (TCP).
 - 2. Submit Traffic Control Plan to Engineer.

1.04 TRAFFIC CONTROL SIGNALS AND SIGNS

- A. Submit proposed Traffic Control Plan (TCP) prior to implementation:
 - 1. Full conformance with the Department of Transportation "Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD)," latest edition.
 - 2. TCP shall be prepared by a person possessing one of the following current certifications:
 - a. Traffic Control Supervisor (TCS) certified by the American Traffic Safety Services Association (ATSSA).
 - b. Design and operation of Work Zone Traffic Control course credits offered by the National Highway Institute.
 - c. Work Zone Temporary Traffic Control Technician certified by the International Municipal Signal Association (IMSA).
 - 3. The person who prepares the TCP shall visit the project site prior to preparing the TCP.

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B. Provide traffic control and directional signs for all closures and detours, mounted on barricades or standard posts with warning flashing lights. Any deviation from "MUTCD" requires prior approval of Engineer.

1.05 CONSTRUCTION PARKING CONTROL

A. Control Contractor's and construction personnel's private vehicular parking to preclude interference with public traffic or parking, access by emergency vehicles or Owner's operations.

1.06 SPECIAL REQUIREMENTS FOR THIS PROJECT

- A. Provide traffic and detour controls and signs as required on Drawings and as necessary to meet the requirements of this Section, Section 01 14 16.01 Coordination with Public and Utility Interruptions.
- B. The Contractor shall have a responsible person on site during working hours and on call during non-working hours to inspect and maintain project traffic control.
- C. All non-applicable signing shall be removed or covered completely with an opaque non-light transmitting material. All remaining, non-applicable traffic control devices are to be removed.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
3.06, 3.07, 3.08	Traffic Regulation	Linear Feet
5.02	Traffic Regulation	Lump Sum

END OF SECTION

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SECTION 01 56 00

BARRIERS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Furnish, install, and maintain suitable barriers as required to prevent public entry, and to protect the public, Work, and existing facilities; remove when no longer needed or at completion of Work.

PART 2 PRODUCTS

2.01 MATERIALS, GENERAL

A. Materials may be new or used, suitable for the intended purpose, but must not violate requirements of applicable codes and standards.

2.02 BARRIERS

A. Materials to Contractor's option, as appropriate to serve required purpose.

PART 3 EXECUTION

3.01 GENERAL

- A. Install facilities of a neat and reasonable uniform appearance, structurally adequate for required purposes.
- B. Maintain barrier during entire construction period.
- C. Relocate barriers as required by progress of construction.
- D. Provide barriers to protect the public from excavations and hazardous conditions and operations.
- E. If a trench or excavation, where accessible to the public, is left open at night or weekends, it must be barricaded with flashing lights.

3.02 FENCES

A. Fence Location:

1. Locate fence to enclose substantially entire Project site or that portion the Contractor establishes as required to encompass entire Project construction operation.

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2. Locate vehicular entrance gates in suitable relation to construction facilities; and to avoid interference with traffic on public thoroughfares.

B. Chainlink Fence:

- 1. Fence not generally required for sewer lines, waterlines, and street work.
- 2. Fence generally required for treatment plant, pump stations, and similar facilities.

3.03 REMOVAL

- A. Completely remove barricades, including foundations, when construction has progressed to the point that they are no longer needed.
- B. Clean and repair damage caused by installation, fill and grade areas of the site to required elevations and slopes, and clean the area.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	<u>Pay Unit</u>
1.01, 1.02, 1.03	Barriers	Lump Sum
1.06, 1.07, 2.03, 3.06, 3.07, 3.08	Barriers	Linear Foot
5.03	Barriers	Lump Sum

END OF SECTION

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SECTION 01 57 00

TEMPORARY CONTROLS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Provide and maintain methods, equipment, and temporary construction, as necessary to provide controls over environmental conditions at the construction site and related areas under Contractor's control; remove physical evidence of temporary facilities at completion of Work.

1.02 NOISE CONTROL

- A. Limit to practical extent.
- B. Limit to normal working hours when practical.

1.03 DUST CONTROL

A. Provide positive methods and apply dust control materials to minimize raising dust from construction operations, and provide positive means to prevent airborne dust from dispersing into the atmosphere.

1.04 WATER CONTROL

- A. Provide methods to control surface water to prevent damage to the Project, the site, or adjoining properties.
 - 1. Control fill, grading and ditching to direct surface drainage away from excavations, pits, tunnels and other construction areas; and to direct drainage to proper runoff.
- B. Provide, operate and maintain hydraulic equipment of adequate capacity to control surface water.
- C. Dispose of drainage water and dewatering water in a manner to prevent flooding, erosion or other damage to any portion of the site or to adjoining areas. Any public agency or private landowner arrangements, permits, or other approvals required for the discharge of water are the sole responsibility of the Contractor.

1.05 PEST CONTROL

A. As found necessary during construction.

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1.06 RODENT CONTROL

- A. Provide rodent control as necessary to prevent infestation of construction or storage area.
 - 1. Employ methods and use materials which will not adversely affect conditions at the site or on adjoining properties.
 - 2. Should the use of rodenticides be considered necessary, submit an informational copy of the proposed program to Owner with a copy to Engineer. Clearly indicate:
 - a. The area or areas to be treated.
 - b. The rodenticides to be used, with a copy of the manufacturer's printed instructions.
 - c. The pollution preventive measures to be employed.
- B. The use of any rodenticide shall be in full accordance with the manufacturer's printed instructions and recommendations and applicable laws and regulations.

1.07 DEBRIS CONTROL

- A. Maintain all areas under Contractor's control free of extraneous debris.
- B. Initiate and maintain a specific program to prevent accumulation of debris at construction site, storage and parking areas, or along access roads and haul routes.
 - 1. Provide containers for deposit of debris as specified in Section 01 74 00 Cleaning and Waste Management.
 - 2. Prohibit overloading of trucks to prevent spillages on access and haul routes.
 - a. Provide periodic inspection of traffic areas to enforce requirements.
- C. Schedule periodic collection and disposal of debris as specified in Section 01 74 00 Cleaning and Waste Management.
 - 1. Provide additional collections and disposals of debris whenever the periodic schedule is inadequate to prevent accumulation.

1.08 POLLUTION CONTROL

- A. Provide methods, means and facilities required to prevent the discharge of hazardous substances from construction operations.
- B. Perform emergency measures required to report, contain and transport harmful substance discharges or spills by complying with Federal and State regulations.
- C. Take special measures to prevent harmful substances from entering public waters.
 - 1. Prevent disposal of wastes, effluents, chemicals or other such substances adjacent to streams, or in sanitary or storm sewers.

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- D. Provide systems for control of atmospheric pollutants.
 - 1. Prevent toxic concentrations of chemicals.
 - 2. Prevent harmful dispersal of pollutants into the atmosphere.

1.09 EROSION CONTROL

- A. Plan and execute construction and earthwork by methods to control surface drainage from cuts and fills, and from borrow and waste disposal areas, to prevent erosion and sedimentation.
 - 1. Hold the areas of bare soil exposed at one time to a minimum.
 - 2. Provide temporary control measures such as berms, dikes, drains, straw bales, silt fences, and wattles.
- B. Construct fills and waste areas by selective placement to eliminate surface silts or clays which will erode.
- C. Periodically inspect earthwork to detect any evidence of the start of erosion, apply corrective measures as required to control erosion.

1.10 SECURITY CONTROL

- A. Provide temporary padlocks during construction on gates, hatches, doors, panels, and boxes having hasps. Coordinate with Owner to install specified permanent padlocks at completion of project.
- PART 2 PRODUCTS (NOT USED)
- PART 3 EXECUTION (NOT USED)
- PART 4 PAYMENT
- 4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
1.06, 1.07, 2.03, 3.06, 3.07, 3.08	Temporary Controls	Linear Foot
5.02	Temporary Controls	Lump Sum

END OF SECTION

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SECTION 01 58 01

PROJECT BULLETIN BOARD

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Provide and Maintain Bulletin Board:
 - 1. Weathertight
 - 2. Approximately 3' x 5'
 - 3. Location approved by Owner/Engineer
 - 4. Accessible to employees
- B. Display:
 - 1. Equal employment opportunity poster
 - 2. Federal and State wage rate information
 - 3. Safety posters
 - 4. Official announcements and notices
- PART 2 PRODUCTS (NOT USED)
- PART 3 EXECUTION (NOT USED)
- PART 4 PAYMENT
- 4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	<u>Pay Unit</u>	
6.01	Project Bulletin Board	Lot	

END OF SECTION

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SECTION 01 58 13

PROJECT IDENTIFICATION SIGNS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Furnish, install, and maintain project identification sign(s).
- B. Remove signs on completion of construction.
- C. Allow no other signs to be displayed.

1.02 RELATED REQUIREMENTS

- A. Funding agency supplemental conditions may contain additional requirements.
- 1.03 PROJECT IDENTIFICATION SIGN(S)
 - A. Painted sign(s) of size, design, lettering, as scheduled.
 - B. Locate as directed by Engineer.

1.04 QUALITY ASSURANCE

- A. Sign Painter: Professional experience in type of work required.
- B. Finishes, Painting: Adequate to resist weathering and fading for scheduled construction period.

1.05 PAYMENT

A. Incidental to contract, no separate payment.

PART 2 PRODUCTS

2.01 SIGN MATERIALS AND CONSTRUCTION

- A. Unless Otherwise Scheduled:
 - 1. Sign size: 4' x 8'
 - 2. Sign material: 0.75 inch thick exterior grade plywood.
 - 3. Supports: Two, 4" x 4" x 8' supports, sign bolted to supports.
 - 4. Color: White background, black lettering.
 - 5. Lettering: Minimum 2" height.

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PART 3 EXECUTION

3.01 MAINTENANCE

- A. Maintain signs and supports in a neat, clean condition; repair damages to structure, framing, or sign.
- B. Relocate signs if required by progress of the work.

3.02 REMOVAL

A. Remove signs, framing, supports, and foundations at completion of project.

3.03 SCHEDULE

A. Text and graphics will be furnished by the Owner prior to notice to proceed.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
6.01	Project Identification Signs	Lot

END OF SECTION

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SECTION 01 66 01

PRODUCT DELIVERY, STORAGE, AND HANDLING REQUIREMENTS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

- A. For the purposes of this Specification Section, the terms "material and equipment" and "Products" have the same meaning and are used interchangeably.
- B. Material and equipment incorporated into the Work:
 - 1. New and free of defect unless otherwise shown on the Drawings.
 - 2. Conform to applicable specifications and standards.
 - 3. Comply with size, make, type and quality specified, or as specifically approved in writing by the Engineer.
 - 4. Manufactured and Fabricated Products:
 - a. Design, fabricate and assemble in accordance with the best engineering and shop practices.
 - b. Manufacture like parts of duplicate units to standard sizes and gages, to be interchangeable.
 - c. Two or more items of the same kind shall be identical, by the same manufacturer.
 - d. Products shall be suitable for service conditions.
 - e. Equipment capacities, sizes and dimensions shown or specified shall be adhered to unless variations are specifically approved in writing.
 - 5. Do not use material or equipment for any purpose other than that for which it is designed or is specified.

1.02 REUSE OF EXISTING MATERIAL

- A. Except as specifically indicated or specified, materials and equipment removed from the existing structure shall not be used in the completed Work.
- B. For material and equipment specifically indicated or specified to be reused in the Work:
 - 1. Use special care in removal, handling, storage, and reinstallation to assure proper function in the completed Work.
 - 2. Arrange for transportation, storage, and handling of products which require offsite storage, restoration or renovation. Perform such work at no additional cost to Owner.

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1.03 MANUFACTURER'S INSTRUCTIONS

- A. When Contract Documents require that installation of work shall comply with manufacturer's printed instructions, such instructions shall be included with:
 - 1. Shop drawing and/or product data submitted if an operation and maintenance manual is not required, or if specified in the Shop Drawing subsection of the equipment section.
 - 2. Operation and maintenance data if required.
- B. Handle, install, connect, clean, condition, and adjust products in strict accordance with such instructions and in conformity with specified requirements.
 - 1. Should job conditions or specified requirements conflict with manufacturer's instructions, consult with Engineer for further instructions.
 - 2. Do not proceed with work without clear instructions.
- C. Perform work in accordance with manufacturer's instructions. Do not omit any preparatory step or installation procedure unless specifically modified or exempted by Contract Documents.

1.04 TRANSPORTATION AND HANDLING

- A. Arrange deliveries of Products in accordance with construction schedules, coordinate to avoid conflict with work and conditions at the site.
 - 1. Deliver Products in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible.
 - 2. Immediately on delivery, inspect shipments to assure compliance with requirements of Contract Documents and approved submittals, and that Products are properly protected and undamaged.
- B. Provide equipment and personnel to handle Products by methods to prevent soiling or damage to Products or packaging.

1.05 STORAGE AND PROTECTION

- A. Store Products in accordance with manufacturer's instructions, with seals and labels intact and legible.
 - 1. Store products subject to damage by the elements in weathertight enclosures.
 - 2. Maintain temperature and humidity within the ranges required by manufacturer's instructions.

B. Exterior Storage:

- 1. Store fabricated Products above the ground, on blocking or skids, prevent soiling or staining. Cover Products which are subject to deterioration with impervious sheet coverings, provide adequate ventilation to avoid condensation.
- 2. Store loose granular materials in a well-drained area on solid surfaces to prevent mixing with foreign matter.

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- C. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored Products to assure that Products are maintained under specified conditions, and free from damage or deterioration.
- D. Protection After Installation:
 - 1. Provide substantial coverings as necessary to protect installed Products from damage from traffic and subsequent construction operations. Remove when no longer needed.
- E. Repair Damage:
 - 1. Repair damaged materials and equipment to new condition or replace with new, to the satisfaction of the Engineer. Refer to Conditions of the Contract.

1.06 NAMEPLATE DATA

- A. Provide original component manufacturer's permanent operational data nameplate on each item of power operated mechanical equipment, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliance, and similar essential data. Locate nameplates in an accessible location.
- PART 2 PRODUCTS (NOT USED)
- PART 3 EXECUTION (NOT USED)
- PART 4 PAYMENT
- 4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
Bid Item Containing	Project Delivery,	Incidental
Delivery of Equipment or Materials.	Storage, and Handling Requirements	Incidental

END OF SECTION

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SECTION 01 71 23

FIELD ENGINEERING

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Provide and Pay for Field Engineering Services Required for Project:
 - 1. Survey work required in execution of Project.
 - 2. Engineering work for civil, structural or other professional engineering services specified or required to execute Contractor's construction methods.

1.02 QUALIFICATIONS OF SURVEYOR OR ENGINEER

- A. Survey work during construction may be completed by the Contractor. However, all locations/elevations must be verified at the completion of the contract by a qualified land surveyor registered in the state in which the construction is being done. Final survey data shall be documented on the Record Drawings.
- B. Engineering work by qualified professional engineer registered in the state in which the construction is being done.

1.03 SURVEY REFERENCE POINTS

- A. Original basic horizontal and vertical control points for the Project are those designated on Drawings.
- B. Locate existing control points, re-establish original control points, protect control points prior to starting site work, and preserve all permanent reference points during construction.
 - 1. Make no changes or relocations without prior written notice to Engineer.
 - 2. Report to Engineer when any reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.
 - 3. Require surveyor to replace Project control points which may be lost or destroyed.
 - 4. Establish replacements based on original survey control.
- C. Reconfirm all existing and original vertical elevation control points prior to the use of such points for project surveying. Reference control point for such reconfirmation is shown on Drawings.
- D. Refer any apparent discrepancies to Engineer for resolution. Surveyor to assist Engineer with field work required for resolution of such apparent discrepancies.

1.04 PROJECT SURVEY REQUIREMENTS

- A. Establish lines and levels, locate and lay out, by instrumentation and similar appropriate means:
 - 1. Site improvements:
 - 2. Stakes for grading, fill and topsoil placement.
 - 3. Utility slopes and invert elevations.
 - 4. Batter boards for structures.
 - 5. Building foundation, column locations, and floor levels.
 - 6. Controlling lines and levels required for mechanical and electrical trades.
- B. From time to time, verify layouts by same methods as required for control of the Work and when requested by the Engineer.
- C. The Contractor shall take reasonable efforts to protect all existing property corners, permanent bench marks, right-of-way markers, government established monuments, and similar reference points. If any must be disturbed, the monuments must be referenced before removal and replaced as soon as work in the area is completed. Referencing and replacing shall be done by a licensed surveyor, and in the case of U.S.G.S. monuments and NMDOT right-of-way markers, shall be a first order survey work.

1.05 RECORDS

- A. Maintain a complete, accurate log of all control and survey work as it progresses.
- B. On completion of improvements, prepare record drawings showing all dimensions, locations, and elevations of construction.

1.06 SUBMITTALS

- A. Submit name and address of surveyor and professional engineer to Engineer.
- B. Submit documents certifying current registration of surveyor and engineer.
- C. On request of Engineer, submit documentation to verify accuracy of field engineering work.
- D. Survey data and computations for all Work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.Pay ItemPay Unit6.05Field EngineeringLump Sum

END OF SECTION

SECTION 01 71 23.17

NEW MEXICO DEPARTMENT OF TRANSPORTATION UTILITY PERMIT SURVEY REQUIREMENTS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Provide and pay for professional survey services required for the Project:
 - 1. Survey work required in execution of the Project to complete "as-built" drawings in accordance with the New Mexico Department of Transportation Department utility permit surveying requirements.
 - 2. All work within the right-of-way under the jurisdiction of the New Mexico Department of Transportation Department.

1.02 QUALIFICATIONS OF SURVEYOR

A. Qualified land surveyor registered in the State of New Mexico, acceptable to Contractor and Owner.

1.03 HIGHWAY UTILITY PERMIT FOR THIS PROJECT

- A. Copy of Executed Permits to install utility facilities within right-of-way is included in Appendix E of this Project Manual.
- B. Contractor must comply with all Permit conditions identified in the Permit at no additional cost to the Owner.

1.04 UTILITY SURVEY REQUIREMENTS

- A. All utility survey work shall be certified by a New Mexico Registered Land Surveyor.
- B. Contractor shall provide "as-built" horizontal and vertical utility location information in hard copy and electronic file in AUTOCAD DWG (3D) format (AUTOCAD Release 14 or later).
- C. The standard horizontal datum shall be the North American Datum 1983 (NAD83) and the standard projections shall be the New Mexico State Plane Coordinate System 1983 (NMSPCS83).
- D. The standard vertical datum shall be the North American Vertical Datum 1988 (NAVD88).
- E. Submit data in CD ROM.
- F. Utility location information shall be tied to New Mexico Department of Transportation monuments and referenced to highway mile posts.

- G. Provide description on the electronic file of survey control, horizontal datum, vertical datum used to prepare the "as-built" documents, including the following:
 - 1. New Mexico Department of Transportation District Utility Permit Number (provided by Engineer).
 - 2. Name, address, registration number, and telephone number of responsible land surveyor.
 - 3. Date survey completed.
 - 4. Equipment used to conduct the survey.
 - 5. Horizontal and vertical control marks used to tie the survey to the NMSPC83 and NAVD88.
 - 6. Ground to Grid combined scale factor used.
 - 7. Utility Line Work: Elevations shall be provided every 500 feet and at all survey break points, including all high and low points.
 - 8. Structures: Elevations at all changes in elevations, i.e, top of structure surfaces, pipe inverts, bottom slab, etc.

1.05 RECORDS

A. On completion of improvements, prepare record (as-built) drawings showing all dimensions, locations, and elevations of construction as permitted under Part 1.04 of this Section.

1.06 SUBMITTALS

- A. Section 01 33 23 Shop Drawings, Product Data, and Samples.
 - 1. Number of Sets: Four (4).
 - 2. Printed Copy Drawing Size: 11" x 17".
 - 3. Electronic File: AUTOCAD DWG format as specified herein.
 - 4. Submit before certifying Project is substantially complete. Project will not be considered substantially complete without complete submittal of utility permit survey data.
- PART 2 PRODUCTS (NOT USED)
- PART 3 EXECUTION (NOT USED)
- PART 4 PAYMENT
- 4.01 PAYMENT ITEMS

Bid Item No.	<u>Pay Item</u>	Pay Unit
6.05	NMDOT Utility Permit	Lump Sum
	Survey Requirements	-

END OF SECTION

SECTION 01 74 00

CLEANING AND WASTE MANAGEMENT

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Execute cleaning, during progress of the Work, and at completion of the Work, as required by General Conditions.

1.02 RELATED REQUIREMENTS

- A. Conditions of the Contract
- B. Each Specification Section: Cleaning for specific products or work.

1.03 DISPOSAL REQUIREMENTS

A. Conduct cleaning and disposal operations to comply with codes, ordinances, regulations, and anti-pollution laws.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Use only those cleaning materials which will not create hazards to health or property and which will not damage surfaces.
- B. Use only those cleaning materials and methods recommended by manufacturer of the surface material to be cleaned.
- C. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

PART 3 EXECUTION

3.01 DURING CONSTRUCTION

- A. Execute periodic cleaning to keep the Work, the site and adjacent properties free from accumulations of waste materials, rubbish and windblown debris, resulting from construction operations.
- B. Provide on-site containers for the collection of waste materials, debris and rubbish.
- C. Remove waste materials, debris and rubbish from the site periodically and dispose of at legal disposal areas away from the site.

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3.02 DUST CONTROL

- A. Clean interior spaces prior to the start of finish painting and continue cleaning on an as-needed basis until painting is finished.
- B. Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly-coated surfaces.

3.03 FINAL CLEANING SCHEDULE

- A. Type 1 For Buildings:
 - 1. Employ skilled workmen for final cleaning.
 - 2. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from sight-exposed interior and exterior surfaces.
 - 3. Wash and shine glazing and mirrors.
 - 4. Polish glossy surfaces to a clear shine.
 - 5. Ventilating Systems:
 - a. Clean permanent filters and replace disposable filters if units were operated during construction.
 - b. Clean ducts, blowers and coils if units were operated without filters during construction.
 - 6. Broom clean exterior paved surfaces; rake clean other surfaces of the grounds.
 - 7. Prior to final completion, or Owner occupancy, Contractor shall conduct an inspection of sight-exposed interior and exterior surfaces, and all work areas, to verify that the entire Work is clean.
- B. Type 2 For Grounds and Exposed Concrete Work:
 - 1. Broom clean exterior paved surfaces; rake clean other ground surfaces.
 - 2. Broom clean all concrete slabs.
 - 3. Remove grease, mastic, adhesives, dust, dirt, stains, labels and other foreign materials from all piping systems surfaces and equipment.
 - 4. Prior to final completion or Owner occupancy, Contractor shall conduct an inspection of sight-exposed interior and exterior surfaces and all work areas to verify that the entire Work is clean.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
6.02	Cleaning and Waste Management	Lot

END OF SECTION

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SECTION 01 74 17

STORM DRAINAGE DISCHARGE COMPLIANCE

PART 1 GENERAL

1.01 WORK INCLUDED

A. Prepare a Storm Water Pollution Prevention Plan (SWPPP) to control storm water discharges from construction activities during the Project that disturb one or more acres, and comply with all other requirements of the USEPA-NPDES Program.

B. Scope of Work:

- Work includes compliance with the U.S. Environmental Protection Agency (EPA), National Pollution Discharge Elimination System (NPDES) Regulations for Storm Water Discharges from construction sites, per 40 CFR, Parts 122, 123, and 124. Additional information on the EPA Construction General Permit (CGP) and SWPPP for construction activities can be found at: https://www.epa.gov/sites/production/files/2017-06/documents/2017_cgp_final_permit_508.pdf
 https://www.epa.gov/npdes/2017-construction-general-permit-cgp
- 2. Develop and submit a site-specific SWPPP prior to commencement of construction, and implement and maintain Best Management Practices (BMPs) identified in this plan to control erosion, pollution, sediment, and runoff during the construction of the Project. Storm water pollution prevention practices shall meet the current standards of the industry and all of the requirements of the current CGP. Contractor is encouraged to use the SWPPP template and reporting forms provided at the referenced web site.
- 3. Contractor shall determine and identify in the SWPPP if the Project is in an Arid or Semi-Arid area as defined in Appendix A Definitions and Acronyms, of the CGP.
- 4. If the disturbed area is less than five acres, the Project duration is short and avoids the wet season, and the erosivity index (R factor) for the site is low, Contractor may apply for a Low Erosivity Waiver (LEW) Certification. The LEW calculation procedures and Certification Form are found on the referenced EPA websites. Contractor may use the calculation tool on the following EPA website to determine whether or not the site is eligible for a LEW. https://www.epa.gov/npdes/rainfall-erosivity-factor-calculator-small-construction-sites

If the site is eligible for a LEW and Contractor properly submits the LEW Certification Form, Contractor is exempt from the requirements to prepare a SWPPP. Although the Contractor is not required to prepare a formal SWPPP document, it shall still be responsible for general good housekeeping of the site such as track-out prevention, concrete washout, erosion control, litter control, and any other appropriate efforts.

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- 5. Contractor shall conduct site inspections, monitoring, and testing as required in the CGP and complete reports within the time required.
- 6. Contractor shall maintain and update the SWPPP as necessary and required by the CGP.
- 7. Contractor shall have the SWPPP available for review at all times.
- 8. Contractor shall remove non-permanent BMPs at completion of the Project.
- 9. All work specified in this Specification Section shall be provided by Contractor under the bid item listed in the Bid Form or, if no bid item is listed, shall be provided as incidental work at no additional cost to Owner.
- C. Compliance with Storm Drainage Discharge Requirements:
 - 1. Contractor shall meet all requirements of the most current version of the NPDES General Permit for Discharge from Construction Activities (CGP).
 - 2. Contractor shall file a Notice of Intent (NOI) at least 14 days prior to commencing earth-disturbing activities and is required to use EPA's electronic NOI system or "eNOIsystem" to prepare and submit the NOI. In addition to submitting the Contractor's NOI, the Contractor shall assist the Owner in a timely fashion with the preparation and submittal of the NOI that is required to be submitted by the Owner.
 - 3. Contractor shall file a Notice of Termination (NOT) and is required to use EPA's electronic NOI system or "eNOIsystem" to prepare and submit the NOT. In addition to submitting the Contractor's NOT, the Contractor shall assist the Owner with the preparation and submittal of the NOT that is required to be submitted by the Owner.
 - 4. Owner will assist Contractor with the necessary information for preparation and certification of its subsequent NOI and NOT.
- D. Contractor shall also submit one (1) copy of the completed SWPPP to Owner at the time Contractor submits his NOI.
- E. By completing the NOI, Contractor is certifying to Owner that a SWPPP has been completed in conformance with the CGP Permit and is in Contractor's possession.
- F. Contractor is the designated "Operator" of the Permit and is solely responsible for execution of the Project construction in conformance with CGP Permit condition(s) and requirement(s), including work performed by any subcontractor(s). Contractor shall immediately correct conditions related to the Project that are in violation of Permit requirements. Failure by Contractor to correct such conditions in a timely manner may subject Contractor to fines and/or penalties.
- G. Contractor shall indemnify, defend, and hold Owner and its Representative(s) harmless from any fines and/or penalties issued for violations of Permit conditions.
- H. In the event Contractor fails to comply with NPDES Permit requirements, Owner retains the right to enter upon the Project site and perform corrective measures. Any costs associated with corrective measures shall be the responsibility of, and shall be paid by, Contractor. Owner shall be entitled to deduct such costs from remaining

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Contract Amounts, and if insufficient Contract Amounts exist, Contractor shall reimburse Owner for any deficiency.

I. If payment for the SWPPP is listed as a bid item in the Bid Form, payment shall be made in increments equal to the percent complete on the overall Project.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
6.04	Storm Drainage Discharge Compliance	Lump Sum

END OF SECTION

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SECTION 01 75 01

FIELD SERVICE REPRESENTATIVE

PART 1 GENERAL

1.01 FIELD SERVICE REPRESENTATIVE

- A. Shall be employed by the manufacturer and shall regularly engage in field checkout, calibration, testing, trouble-shooting, installation supervision, and start-up of equipment or systems.
- B. Shall have qualifications and experience acceptable to the Owner and the Engineer. Submit name and qualifications of Field Service Representative with the shop drawing submittal of the applicable equipment item.
- C. A manufacturer's sales representative will not be acceptable as a field service representative unless the Contractor applies for and receives in writing a waiver for such from the Owner.
- D. Shall be thoroughly familiar with the specific equipment or system for this project on arrival at the jobsite. The Field Service Representative shall perform installation supervision, field check-out, calibration, testing, troubleshooting, adjustment or other services as specified in the pertinent section.
- E. The Engineer reserves the right to require a substitute Field Service Representative, at no extra cost to the Owner, if the Field Service Representative supplied by the manufacturer is not able to properly perform the required tasks.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 TEST EQUIPMENT

A. Coordinate requirements for test equipment with Field Service Representative and ensure that all necessary standard and special test, calibration, and diagnostic equipment is available for start-up testing.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	<u>Pay Unit</u>
Bid Items Containing Associated	Field Service	Incidental
Equipment Vendor Field Service	Representative	

END OF SECTION

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SECTION 01 77 00

CONTRACT CLOSEOUT

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Comply with requirements stated in Conditions of the Contract and in Specifications for administrative procedures in closing out the Work.

1.02 RELATED REQUIREMENTS

- A. Conditions of the Contract. Fiscal provisions, legal submittals and additional administrative requirements.
- B. Section 01 29 00 Payment Procedures
- C. Section 01 33 23 Shop Drawings, Product Data, and Samples
- D. Section 01 78 23 Operation and Maintenance Data
- E. Section 01 91 01 Pump Station Shakedown Operations

1.03 SUBSTANTIAL COMPLETION

- A. When Contractor considers the Work is substantially complete, Contractor shall submit to Engineer:
 - 1. A written notice that the Work, or designated portion thereof, is substantially complete.
 - 2. A list of items to be completed or corrected.
- B. Within a reasonable time after receipt of such notice, Engineer will make an inspection to determine the status of completion. If acceptable to Engineer and Owner, Engineer will notify Contractor in writing. Work is substantially complete when:
 - 1. All systems are complete and functional.
 - 2. All final Operation and Maintenance Manuals have been accepted.
 - 3. Any required shakedown testing periods have been completed.
 - 4. Utilities, alarms, electrical, area lighting, monitoring, controls, drains, piping, paving, and related components are in place and completed.
 - 5. Facilities can be put to intended use.
 - 6. Owner is able to use for intended use at no additional cost to Owner.
- C. Should Engineer determine that the Work is not substantially complete:
 - 1. Engineer will promptly notify the Contractor in writing, giving the reasons therefor.

- 2. Contractor shall remedy the deficiencies in the Work, and send a second written notice of substantial completion to the Engineer.
- 3. Engineer will reinspect the Work.
- 4. Owner may charge Contractor for all of Engineer's reinspection time and costs at Engineer's standard billing rates through a credit by Change Order.
- D. Contractor's warranty start date for equipment systems will be the date of Substantial Completion accepted by the Engineer/Owner for that specified equipment system.
- E. After the Engineer and Owner have accepted the Work, or designated portion thereof, Owner will assume responsibility for operation and maintenance of the facilities and equipment, or designated portion thereof.

1.04 FINAL INSPECTION

- A. When Contractor considers the Work is complete, Contractor shall submit written certification that:
 - 1. Contract Documents have been reviewed.
 - 2. Work has been inspected for compliance with Contract Documents.
 - 3. Work has been completed in accordance with Contract Documents.
 - 4. Equipment and systems have been tested in the presence of the Owner's representative and are operational.
 - 5. Work is completed and ready for final inspection.
- B. Engineer will make an inspection to verify the status of completion with reasonable promptness after receipt of such certification.
- C. Should Engineer consider that the Work is incomplete or defective:
 - 1. Engineer will promptly notify the Contractor in writing, listing the incomplete or defective work.
 - 2. Contractor shall take immediate steps to remedy the stated deficiencies, and send a second written certification to Engineer that the Work is complete.
 - 3. Engineer will reinspect the Work.
- D. When the Engineer finds that the Work is acceptable under the Contract Documents, Engineer will request the Contractor to provide closeout submittals as listed in subsection 1.06.

1.05 REINSPECTION FEES

- A. Should Engineer perform reinspections due to failure of the Work to comply with the claims of status of completion made by the Contractor:
 - 1. Owner will compensate Engineer for such additional services.
 - 2. Owner will deduct the amount of such compensation from the final payment to the Contractor.

1.06 CONTRACTOR'S CLOSEOUT SUBMITTALS TO ENGINEER

- A. Evidence of compliance with requirements of governing authorities.
- B. Warranties and Bonds: To requirements of General Conditions.
- C. Evidence of Payment and Release of Liens: To requirements of General and Supplemental Conditions.
- D. Consent of Surety: To requirements of General Conditions.
- E. Project Record Documents: To requirements of Section 01 78 39.
- F. Operating and Maintenance Data: To requirements of Section 01 78 23.
- G. Instructions to Owner's Personnel: To requirements of Section 01 79 01.
- H. Spare Parts and Maintenance Materials: To requirements of Section 01 78 44.

1.07 FINAL ADJUSTMENT OF ACCOUNTS

- A. Submit a final statement of accounting to Engineer.
- B. Statement shall reflect all adjustments to the Contract Sum:
 - 1. The original Contract Sum.
 - 2. Additions and deductions resulting from:
 - a. Previous Change Orders
 - b. Allowances
 - c. Unit Prices
 - d. Deductions from uncorrected Work
 - e. Deductions for liquidated damages
 - f. Deductions for reinspection payments
 - g. Other adjustments
 - 3. Total Contract Sum, as adjusted
 - 4. Previous payments
 - 5. Sum remaining due
- C. Engineer will prepare a final Change Order, reflecting approved adjustments to the Contract Sum which were not previously made by Change Orders.

1.08 FINAL APPLICATION FOR PAYMENT

A. After receiving written notification from the Engineer that Contractor has completed all requirements specified in subsections 1.03, 1.04, 1.06, and 1.07, Contractor shall submit the final Application for Payment in accordance with procedures and requirements stated in the Contract Documents.

- B. Contractor shall provide the consent of surety to final payment when submitting the application for final payment.
- C. Contractor shall provide all other documents specified in Supplementary Conditions SC-14.07.
- PART 2 PRODUCTS (NOT USED)
- PART 3 EXECUTION (NOT USED)
- PART 4 PAYMENT
- 4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
6.02	Closeout Documentation	Lot

END OF SECTION

SECTION 01 78 23

OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Format and Content of Manuals
- B. Submittal of Manuals
- C. Schedule of Submittals

1.02 RELATED WORK

- A. Section 01 29 00 Payment Procedures
- B. Section 01 77 00 Contract Closeout
- C. Section 01 79 01 Manufacturer's Instruction of Owner's Personnel
- D. Section 01 91 01 Pump Station Shakedown Operations

1.03 QUALITY ASSURANCE

- A. Preparation of data shall be done by personnel:
 - 1. Trained and experienced in maintenance and operation of the described products.
 - 2. Completely familiar with requirements of this Section.
 - 3. Skilled as a technical writer to the extent required to communicate essential data.
 - 4. Skilled as a draftsman competent to prepare required drawings.
- B. Manuals for equipment and systems shall be prepared by the equipment manufacturer or system supplier.

1.04 FORMAT

- A. Prepare data in the form of an instructional manual for use by Owner's personnel.
 - 1. Binders:
 - a. Preliminary manuals: Heavy paper covers.
 - b. Final manuals: Commercial quality substantial, permanent, 3-ring or 3-post binders with durable, cleanable plastic covers. Covers of adequate size to easily contain required information.

- B. Cover and Spine: Identify each volume with typed or printed title "OPERATING AND MAINTENANCE INSTRUCTIONS". List:
 - 1. Title of Project.
 - 2. Identity of separate structure as applicable.
 - 3. Identity of general subject matter covered in manual.
- C. Assemble and bind material in the same order as specified in Paragraph 1.06 with the material grouped in the same manner as the applicable portions of the CONTRACT DOCUMENTS.
- D. Text: Manufacturer's printed data, or typewritten data on 20 lb. minimum, white, paper. Size: 8-1/2 x 11.

E. Drawings:

- 1. Provide reinforced punched binder tab, bind in with text.
- 2. Reduced to 8-1/2" x 11" or 11" x 17" and folded to 8-1/2" x 11".
- 3. Where reduction is impractical, folded and placed in 8-1/2" x 11" envelopes bound in text.
- 4. Suitably identified on drawings and envelopes.
- F. Provide binder tab for each separate product, or each piece of operating equipment.
 - 1. Provide typed description of product, and major component parts of equipment.
 - 2. Provide indexed tabs corresponding to items listed in the table of contents.

1.05 CONTENT OF MANUALS

A. Table of Contents:

- 1. Provide title of project.
- 2. Contractor, name of responsible principal, address and telephone number.
- 3. Schedule of products and systems, indexed to the content of the volume.
- 4. List, with each product, the name, address and telephone number of:
 - a. Subcontractor or installer.
 - b. Maintenance contractor, as appropriate.
 - c. Local source of supply for parts and replacement.
 - d. Manufacturer.
- 5. Identify each product by product name and other identifying symbols as set forth in Contract Documents.

B. Product Data:

- 1. Include only those sheets which are pertinent to the specific product.
- 2. Annotate each sheet to:
 - a. Clearly identify the specific product or part installed.
 - b. Clearly identify the data applicable to the installation.
 - c. Delete references to inapplicable information.
- 3. Preventive maintenance information shall be given for each major component of every piece of equipment in the format attached to the end of this Section.

C. Drawings:

- 1. Supplement product data with drawings as necessary to clearly illustrate:
 - a. Relations of component parts of equipment and systems.
 - b. Control and flow diagrams.
- 2. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
- 3. Do not use Project Record Documents as maintenance drawings.

D. Written Text:

- 1. Supplement product data for the particular installation.
- 2. Organize in a consistent format under separate headings for different procedures.
- 3. Provide a logical sequence of instructions for each procedure.

E. Warranties and Bonds:

- 1. Copy of each Warranty, Bond and Service Contract Issued.
- 2. Provide information sheet for Owner's personnel.
- 3. Proper procedures in the event of failure.
- 4. Instances which might affect the validity of warranties or bonds.
- F. Provide an installation, operation and maintenance manual for each item of equipment or system listed in the schedule of manuals in the quantity listed in the submittal schedule.
- G. Additional Requirements for Operation and Maintenance Data: The respective sections of specifications.

1.06 MANUAL FOR EQUIPMENT AND SYSTEMS

- A. Each Item of Equipment and Each System. Include and identify:
 - 1. Description of unit or system and component parts.
 - 2. Function, normal operating characteristics, and limiting conditions.
 - 3. Performance curves, with engineering data and tests.
 - 4. Complete nomenclature and commercial number of all replaceable parts.
- B. Installation Instructions, include:
 - 1. Manufacturer's complete installation instructions and recommendations.
- C. Operating Procedures, include:
 - 1. Startup, break-in, and routine normal operating instructions and sequences.
 - 2. Regulation, control, stopping, shutdown and emergency instructions.
 - 3. Summer and winter operating instructions, as applicable.
 - 4. Special operating instructions.
- D. Maintenance Requirements, include:
 - 1. Routine procedures and guide for trouble-shooting.
 - 2. Disassembly, repair and reassembly instructions.

- 3. Alignment, adjusting, balancing and checking instructions.
- 4. Preventive maintenance information for each major component of every piece of equipment as required on the "Preventive Maintenance Information & Equipment Data Sheet" attached at the end of this section.
- E. Servicing and Lubrication Schedule, provide:
 - 1. List of lubricants required.
 - 2. Lubrication information for each major component of every piece of equipment as required on the "Preventive Maintenance Information & Equipment Data Sheet" attached at the end of this section.
- F. Provide manufacturer's printed operation and maintenance instructions.
- G. Include sequence of operation by controls manufacturer.
- H. Provide original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
- I. Provide list of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.
- J. Provide control diagrams by controls manufacturer as installed.
- K. Provide other data as required under pertinent sections of specifications.

1.07 MANUAL FOR ELECTRIC AND ELECTRONIC ITEMS OR SYSTEMS

- A. Description of system and component parts, include and identify:
 - 1. Function, normal operating characteristics, and limiting conditions.
 - 2. Performance curves, engineering data and tests.
 - 3. Complete nomenclature and commercial number of replaceable parts.
- B. Circuit Directories of Panelboards; provide:
 - 1. Electrical service characteristics
 - 2. Controls
 - 3. Communications
- C. Provide as-installed color coded wiring diagrams.
- D. Operating Procedures, include:
 - 1. Routine and normal operating instructions.
 - 2. Sequences required.
 - 3. Special operating instructions.
- E. Maintenance Requirements, include:
 - 1. Routine procedures and guide to trouble-shooting.
 - 2. Adjustment, balancing and checking instructions.

- F. Provide manufacturer's printed operation and maintenance instructions.
- G. Provide list of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.
- H. Provide other data as required under pertinent sections of specifications.

1.08 SUBMITTAL OF MANUALS

- A. Preliminary Submittal of Manuals.
 - 1. Quantity:
 - a. Submit number of preliminary manuals required by Contractor plus number to be retained by Engineer.
 - b. As scheduled.
 - 2. Submit prior to the date of shipment of equipment or system.
 - 3. Engineer will review for acceptance and return to Contractor with comments as appropriate.
 - 4. Resubmittal Process:
 - a. If unacceptable, Contractor to resubmit same number of preliminary copies for Engineer's review.
 - b. Manuals will not be reviewed in detail once determined by the Engineer that a manual is not acceptable.
 - c. No partial payment will be made for equipment materials or related system materials delivered to the site until preliminary manuals for that equipment are submitted and are acceptable to the Engineer.

B. Final Submittal of Manuals

- 1. Quantity:
 - a. Submit number required by Contractor plus number to be retained by Engineer.
 - b. As scheduled.
- 2. Submit copies no less than 30 calendar days prior to putting equipment or system in service.
- 3. Engineer will review and compare with accepted preliminary manual.
- 4. If acceptable, manuals will be distributed as follows:
 - a. Contractor: For project record documents.
 - b. Engineer: For files.
 - c. Owner: Held by Engineer for later transmittal to Owner.
- 5. If not acceptable, all copies will be returned to Contractor for revision or retained by Engineer and the necessary revision data requested from Contractor, at Engineer's option.
- 6. No portion of the Work is substantially complete until final equipment and system manuals relating to that portion of the Work are accepted by Engineer.
- 7. Submit copies of any revisions found desirable during instruction of Owner's personnel, with instructions for insertion for revising copies of manual.

- C. Funding agency funds may be withheld from Owner if Owner's acceptable operation and maintenance manual is not submitted as required by the agencies. If this occurs and such is partially attributable to a delay by the Contractor in submitting the required operation and maintenance materials:
 - 1. Owner may withhold payments from Contractor.
 - 2. Contractor shall not terminate or suspend work.
 - 3. No additional costs or Contract time shall be claimed by Contractor if Owner withholds payments.
- D. If Contractor requires additional copies of the operation and maintenance manuals for the Contractor's, subcontractor's or suppliers' use, such may be submitted and will be returned upon review by the Engineer.

1.09 REIMBURSEMENT FOR ENGINEER'S REVIEW COSTS

- A. For all manual reviews beyond one review of the preliminary manual and one review of final manual:
 - 1. Owner may charge Contractor for all of Engineer's review time and costs at Engineer's standard billing rates through a credit by Change Order.
 - 2. Engineer will perform these unscheduled reviews in the same manner as other unscheduled work.

1.10 SUBSTANTIAL COMPLETION

A. Project will not be considered substantially complete until final O&M Manuals and manufacturer's instruction of Owner's personnel have been accepted by Engineer.

1.11 SCHEDULE OF SUBMITTALS

- A. Prepare O&M Manuals for pieces of equipment where specified in the individual specification sections.
- B. Quantities to be Processed by Engineer:
 - 1. Preliminary Manuals: Submit Preliminary Manuals in <u>one</u> of the following formats:
 - a. Electronic Format:
 - 1) Electronic file in searchable .pdf format, delivered via email or on one (1) CD.
 - 2) One (1) printed copy properly formatted in binder with labels and dividers as specified. Engineer will retain copy.
 - 3) Engineer's submittal review including submittal file will be returned to Contractor in electronic format.
 - b. Or Printed Format:
 - 1) Two (2) printed copies properly formatted in binder with labels and dividers as specified.
 - 2) Engineer will return one (1) copy to Contractor.
 - 3) Any additional copies received will be discarded by Engineer.

- 2. Final Manuals: Submit Final Manuals in **each** of the following formats:
 - a. Electronic Format:
 - 1) Three (3) copies of electronic files in searchable .pdf format, delivered on three (3) CDs.
 - b. And Printed Format:
 - 1) Three (3) printed copies.
 - 2) Engineer will retain three (3) copies.
- C. The "Preventive Maintenance Information & Equipment Data Sheet" at end of this Section shall be completed and submitted with the preliminary and final operation and maintenance manuals.
- PART 2 PRODUCTS (NOT USED)
- PART 3 EXECUTION (NOT USED)
- PART 4 PAYMENT
- 4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
Bid Items Containing	Prepare O&M Manuals	Incidental
Associated Vendor		
O&M Manuals		

PREVENTIVE MAINTENANCE INFORMATION AND EQUIPMENT DATA SHEET

1.	Equipment Name:
2.	Equipment Number:
3.	Equipment Manufacturer:
	Address:
	Phone: ()
4.	Equipment Supplier:
	Address:
	Phone: ()
5.	Nameplate Data: Drive Unit: hp, rpm, volts, O FLA Motor class (dripproof, TEFC, etc.)
	Manufacturer
	Model No Serial No Other
	Driven Unit: Flow with units
	Other
6.	Method of Power Transmission (direct coupled, V-belt, etc.)
7.	Maintenance Requirements (list on next sheet)
	Maintenance Operation: List briefly each maintenance operation required and refer to specific information in manufacturer's standard maintenance manual, if applicable.
	Frequency: List required frequency of each maintenance operation.
	Lubricant (if applicable): Refer by symbol to recommended lubricant from list in Item
Q	Comments: Give other applicable comments concerning maintenance operation

Maintenance Operation	<u>Frequency</u>	<u>Lubricant</u>	Comments
(including a	any special tools required)		
A.			
В.			
C.			

9. Lubricant List (provide Mobil number in addition to any other recommended manufacturers):

Reference Symbol	Mobil	Chevron	Shell	Arco	Or Equal
List symbols used in Item 7, above	List equivalent lubricants, as distributed by each manufacturer for the specific use recommended.				

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Use additional sheets if necessary.

10.	This data sheet prepared by:					
	Firm:					
	Date:					

END OF SECTION

SECTION 01 78 39

PROJECT RECORD DOCUMENTS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Maintain one (1) printed record copy of the following record documents at the site for the Owner:
 - 1. Drawings
 - 2. Engineer's response to Requests for Information (RFIs)
 - 3. Engineer Field Orders or written instructions
 - 4. Accepted Shop Drawings, Product Data and Samples
 - 5. Field Test records
 - 6. Receipts for delivery of items to Owner
- B. Prepare and submit to Owner record utility location survey data as specified herein.

1.02 MAINTENANCE OF DOCUMENTS AND SAMPLES

- A. Store documents and samples in Contractor's field office apart from documents used for construction.
 - 1. Provide files and racks for storage of documents.
 - 2. Provide locked cabinet or secure storage space for storage of samples.
- B. File documents and samples in accordance with specification format.
- C. Maintain documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.
- D. Make documents and samples available at all times for inspection by Engineer and Owner.

1.03 MARKING DEVICES

A. Provide felt tip marking pens for recording information in the color code designated by Engineer.

1.04 RECORDING

- A. Label each document "PROJECT RECORD" in neat, large printed letters.
- B. Record information concurrently with construction progress.
 - 1. Do not conceal any work until required information is recorded.

- C. Drawings: Legibly mark to record actual construction:
 - 1. Changes made by addenda.
 - 2. Depths of various elements of foundation in relation to finish first floor datum.
 - 3. Horizontal and vertical locations of underground utilities and appurtenances, including bends in pipes; and internal utilities and appurtenances concealed in the construction. Measure and show locations on the Record Drawings by either:
 - a. Referenced to permanent surface features or referenced to visible and accessible features of the structure.
 - b. Or tabulate and plot coordinates on the Record Drawings measured using survey grade GPS or GNSS to an accuracy of 0.1 meter (4 inches) using a baseline tied into the project coordinate system control points.
 - 4. Field changes of dimension and detail.
 - 5. Changes made by Field Order or by Change Order.
 - 6. Details not on original Contract Drawings.
 - 7. For sewer lines: Invert elevations at manholes, line and manhole alignment and locations, and location of each service line referenced by distance from downstream manhole and distance from sewer centerline to end of service line.

1.05 SUBMITTALS

- A. At Contract close-out, deliver Record Documents to Engineer for the Owner.
- B. Submit to-scale dimensioned electronic drawing files of major equipment items installed that were not the design basis manufacturer. Drawings shall show general arrangement plan and sections. Drawing files shall be in AutoCAD dwg format.
- C. Submit hard copies and electronic files of record utility location survey data as specified in Part 3.
- D. Accompany submittals with transmittal letter in duplicate, containing:
 - 1. Date
 - 2. Project title and number
 - 3. Contractor's name and address
 - 4. Title and number of each Record Document
 - 5. Signature of Contractor or his authorized representative

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 RECORD UTILITY LOCATION SURVEY REQUIREMENTS

- A. Provide and pay for professional survey services required for the Project.
 - 1. Survey work shall be performed by a land surveyor registered in the State of New Mexico, acceptable to Engineer and Owner. Submit name of surveyor prior to proceeding with survey.

- B. Contractor shall provide "as-built" horizontal and vertical utility location information in two (2) hard copies and an electronic file in AUTOCAD DWG (3D) format (AUTOCAD Release 14), and ArcGIS 10.3 Geodatabase file.
- C. The standard horizontal datum shall be the North American Datum 1983 (NAD83) and the survey shall be the New Mexico State Plane Coordinate System 1983 (NMSPCS83).
- D. The standard vertical datum shall be the North American Vertical Datum 1988 (NAVD88).
- E. Submit in electronic format.
- F. Provide description on the electronic file of survey control, horizontal datum, vertical datum used to prepare the "as-built" documents, including the following:
 - 1. Name, address, registration number, and telephone number of responsible professional land surveyor.
 - 2. Date survey is completed.
 - 3. Equipment used to conduct the survey.
 - 4. Horizontal and vertical control marks used to tie the survey to the NMSPC83 and NAVD88.
 - 5. Ground to Grid combined scale factor to be used.
 - 6. Map Projection: World Geodetic System WGS84 Web Mercator Auxiliary Sphere.
 - 7. Utility Line Work: Elevations shall be provided every 500 feet and at all grade break points, including all high and low points.
 - 8. Pipes and Appurtenances: All changes in elevations, i.e., top of pipe surfaces, pipe inverts, ground elevations (including hydrants and valves), etc. shall be measured and recorded.
 - 9. Layer and GIS Attributes to include:
 - a. Water Service Meters: Type, manufacturer, model number, serial number, register multiplier.
 - b. Air Valves: Type (air release, air/vacuum, combination, and well service), manufacturer, model number, installation date.
 - c. Pressure Regulating Valves: Type (reducing, relief, sustaining, and altitude), inlet size, port size, manufacturer, model number, pressure settings, and installation date.
 - d. Buried Isolation Valves: Type (gate, butterfly, and plug), size, and manufacturer.
 - e. Fire Hydrants: Type (dry barrel, wet barrel), size, manufacturer, model number.
 - f. Water and Sewer Pipes: Size, material, depth to top of water pipes, invert elevations of sewer pipes, date installed.
 - g. Wastewater Lift Stations and Water Pump Stations:
 - 1) Pumps: Type, fluid pumped, manufacturer, model and impeller numbers, serial number, date installed.

- 2) Pump Motors: Horsepower, voltage, phase, drive (constant speed or variable).
- h. Manholes: Depth, inlet and outlet pipe sizes.
- i. Chlorination Systems: Form of chlorine used (liquid bleach, tablets, gas, on-site generation), ventilation fans information, dose pump information (type, dose setting, manufacturer, model number, serial number), installation date.
- j. Tanks: Type (ground, buried, elevated), volume, diameter, height, overflow elevation, material (welded steel, bolted steel, concrete), installation date.

B. Survey Submittals:

1. Submit before certifying Project is substantially complete. Project will not be considered substantially complete without complete submittal of utility survey data and GIS attributes.

PART 4 PAYMENT

4.01 RECORD DRAWINGS

- A. Project record documents are incidental Work to the Contract Documents' bid items for which no separate payment will be made.
- B. No payment will be made to the Contractor for any portion of the Work for which the project record documents are not complete.

4.02 UTILITY SURVEY

A. All surveying and GIS services are included in the Bid Schedule for this Work.

4.03 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
6.02	Prepare Record Documents	Lot

END OF SECTION

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SECTION 01 78 40

DELIVERIES TO OWNER

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDE

- A. Obtain signature of Owner's representative's on Master List developed per Section 01 78 44 Spare Parts and Maintenance Materials, for all spare parts, supplies, maintenance materials, salvage, and similar items delivered to Owner.
- B. Keep Master List and delivery receipts with Project Record Documents.
- C. All deliveries to Owner shall be coordinated to occur during hours designated by Owner's warehouse for receiving such items as described in Paragraph A.
- D. Deliver all materials to Owner at one time at end of the Project. Payment for Extra Materials will not be made until after the Owner has accepted delivery.
- E. Provide copy of Master List to both Owner and Engineer once all deliveries have been completed.
- F. The Owner and/or Engineer will check the delivered items against the Master List. If the delivery is not complete and as stated on List, or if items are not correctly marked, then provide a schedule of when the remaining items shall be delivered.

1.02 RELATED REQUIREMENTS

- A. Section 01 78 39 Project Record Documents
- B. Section 01 78 44 Spare Parts and Maintenance Materials
- PART 2 PRODUCTS (NOT USED)
- PART 3 EXECUTION (NOT USED)
- PART 4 PAYMENT
- 4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
6.02	Deliveries to Owner	Lot

END OF SECTION

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SECTION 01 78 44

SPARE PARTS AND MAINTENANCE MATERIALS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDE

A. Provide spare parts and maintenance materials as specified in this Section and in specifications for work in Divisions 2 through 48 that are part of this project.

1.02 RELATED REQUIREMENTS

A. Section 01 78 40 – Deliveries to Owner.

1.03 SUBMITTALS

- A. Section 01 33 23 Shop Drawings, Product Data, and Samples:
 - 1. Prepare and submit a Master List of all spare parts and maintenance materials to be delivered to Owner. Specific requirements for those spare parts and maintenance materials to be delivered are as stated within individual Specification Sections for work in Divisions 2 through 48.

1.04 MAINTENANCE MATERIALS

A. Provide:

- 1. Lubricant for all equipment and facilities sufficient for three months normal usage, unless specified otherwise.
- 2. Any non-standard tools required to adjust or service equipment supplied.
- B. Label all materials by equipment name and usage.

1.05 SPARE PARTS

- A. Label and identify by equipment name, part name, part number.
- B. Packaged for storage.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 79 01

MANUFACTURER'S INSTRUCTION OF OWNER'S PERSONNEL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Instruction of Owner's Personnel
- B. Video Recording of Manufacturer's Instruction
- C. Schedule of Instruction

1.02 QUALITY ASSURANCE

A. Instruction shall be performed by a qualified, experienced regular employee of the equipment or system manufacturer or a full-time field service representative (not sales personnel) approved by the equipment or system manufacturer.

1.03 INSTRUCTION OF OWNER'S PERSONNEL

- A. Prior to final inspection or acceptance, fully instruct Owner's designated personnel in the operation, adjustment and maintenance of all scheduled products, equipment and systems.
- B. Manufacturer's Operation and Maintenance Manual shall constitute the basis of instruction for:
 - 1. Review of contents of manual with Owner's personnel in full detail to explain all aspects of operation and maintenance.
 - 2. Review in field with Owner's personnel in full detail the operation and maintenance of each scheduled system or equipment.
- C. Additional requirements for specialized instruction of Owner's personnel are given in the detailed equipment specifications.
- D. Submit in writing proposed dates for instruction of Owner's personnel at least 15 days in advance of date when instruction is proposed to start; resubmit alternate schedule if proposed dates are not acceptable to Engineer or Owner.
- E. Do not begin instruction of Owner's personnel until equipment for which instruction is required is fully operational and functioning satisfactorily and Final Operation and Maintenance Manuals for same have been reviewed and accepted by Engineer.

- F. If the Engineer or Owner judges the instruction to be incomplete, inadequate, or inaccurate, additional instruction shall be scheduled and provided at no additional cost to the Owner.
- G. Prepare and include additional data when the need for such data becomes apparent during the instruction of Owner's personnel or as necessary to provide complete operation and maintenance instructions.

1.04 VIDEO RECORDING OF MANUFACTURER'S INSTRUCTIONS

- A. If scheduled, video record the equipment manufacturer's instructions to the Owner's personnel. Furnish digital video files on DVD or other media compatible with standard playback equipment and as agreed upon beforehand with Owner. Edit files to include only material relevant to instruction.
- B. For instruction which will be video recorded, coordinate with persons providing the instruction to provide the following:
 - 1. Provide to Engineer when instruction is scheduled, detailed outline of topics, materials, procedures, information, etc. to be covered during instruction.
 - 2. Provide instruction and presentation in format that can be easily video recorded.
 - 3. Cooperate with video recording efforts if instruction is recorded by others.

1.05 SCHEDULE OF INSTRUCTION

- A. Instruct Owner's personnel on pieces of equipment where specified in the individual specification sections or as scheduled herein.
- B. Contractor shall video record the equipment manufacturer's instruction to the Owner's personnel and provide two copies of each video file. Label the front side of each video disk with the contents of the file.
- C. See "Training Schedule" attached to end of this Section. Verify that all training requirements specified in the Contract documents are listed on the Training Schedule. Provide all training specified in the Contract Documents whether or not the sessions are listed on the Schedule.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No. Pay Item Pay Unit
Bid Items Containing Manufacturer's Training Incidental
Associated Vendor Training and Video Recording

TRAINING SCHEDULE

MINIMUM HOURS TO A TENNING		NNEL			
EQUIPMENT	NO. OF SESSIONS	PER SESSION	Maint.	Oper.	COMMENTS
Variable Frequency Drives	1	1	X	X	
Diesel Engine Driven Generator System	2	4/1			4 hour classroom 1 hour field
Hydropneumatic Tanks	1	6	X	X	
Water Storage Tank Submersible Mixers	1	2	X	X	
Self-Contained Control Valves	1	8	X	X	
Package Booster Pumping System	1	8	X	X	Also start-up services
	Variable Frequency Drives Diesel Engine Driven Generator System Hydropneumatic Tanks Water Storage Tank Submersible Mixers Self-Contained Control Valves Package Booster Pumping	EQUIPMENT SESSIONS Variable Frequency Drives 1 Diesel Engine Driven 2 Generator System 1 Hydropneumatic Tanks 1 Water Storage Tank 1 Submersible Mixers 1 Self-Contained Control Valves 1 Package Booster Pumping 1	EQUIPMENT SESSIONS NO. OF SESSIONS Variable Frequency Drives 1 1 Diesel Engine Driven Generator System Hydropneumatic Tanks 1 6 Water Storage Tank Submersible Mixers Self-Contained Control Valves Package Booster Pumping 1 HOURS PER SESSION 1 1 1 8 HOURS PER SESSION 2 4/1 1 8 HOURS PER SESSION 2 4/1 8 8 HOURS PER SESSION 1 1 8 8 HOURS PER SESSION 2 4/1 8 8 HOURS PER SESSION 1 1 8 HOURS PER SESSION 1 8 8 HOURS PER SESSION 1 1 8 HOURS PER SESSION 8 4/1 1 8 Residence Self-Contained Self-Containe	HOURS PER SESSION EQUIPMENT NO. OF SESSIONS HOURS PER SESSION Variable Frequency Drives 1 1 X Diesel Engine Driven Generator System 2 4/1 Hydropneumatic Tanks 1 6 X Water Storage Tank Submersible Mixers 1 2 X Self-Contained Control Valves 1 8 X Package Booster Pumping 1 8 X	EQUIPMENT SESSIONS NO. OF SESSION No. OF TO ATTEND NO. OF TO A

END OF SECTION

SECTION 01 91 01

PUMP STATION SHAKEDOWN OPERATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Provide personnel, equipment, supplies and services for verification and shakedown of systems.

1.02 RELATED REQUIREMENTS

- A. Section 01 14 19 Use of Site
- B. Section 01 77 00 Contract Closeout
- C. Section 01 78 23 Operation and Maintenance Data
- D. Section 01 79 01 Manufacturer's Instruction of Owner's Personnel
- E. Section 90 80 00 Plant Process Control Commissioning

1.03 SHAKEDOWN

- A. Not less than number of calendar days scheduled:
 - 1. All major process, maintenance, operations, and monitoring equipment fully functional before and throughout entire scheduled period.
 - 2. If equipment fails during shakedown, required shakedown scheduled period restarted.
 - 3. Once shakedown operations started, Contractor to continue shakedown operations until scheduled shakedown period is achieved.
- B. Prior to the commencement of the Shakedown Operations, the following work must be completed and approved by the Engineer:
 - 1. All equipment must be certified in writing by the manufacturer's representative that the equipment is installed properly, is functioning properly, and is ready for use.
 - 2. Complete all electrical, instrumentation, and controls testing requirements per Section 40 80 00 Plant Process Control Commissioning.
 - 3. Contractor to flush out all new piping and complete all pressure testing on exposed and buried piping, as applicable.
 - 4. Contractor responsible for all damage to any pump from debris left in new piping systems, and for consequential damages, such as, but not limited to, spills.

C. Contractor:

- 1. Supervise operation, operate, maintain, monitor, and adjust all equipment and facilities.
- 2. Notify Engineer and Owner in writing 10 calendar days prior to shakedown.
- 3. Notify Engineer and Owner in writing 30 calendar days prior to needing chemicals to run the process startup and testing.
- 4. Include shakedown operation in Contract time.
- 5. With notice of shakedown, include proposed written schedule of all field instruction which has yet to be provided in accordance with Section 01 79 01 Manufacturer's Instruction of Owner's Personnel, for review by Engineer and Owner; all instruction should be scheduled to facilitate Owner's and Engineer's participation. Revision of proposed schedule may be required to accomplish this objective.
- 6. Where practical for the equipment or system involved, instruction as required by Section 01 79 01 Manufacturer's Instruction of Owner's Personnel, to occur prior to shakedown; all other instruction to occur within first 50 percent of shakedown operations unless specifically approved in writing by Engineer.
- 7. Request and coordinate use of potable water with Owner's representative.
- 8. Provide all labor, equipment, temporary piping, pumping and appurtenances needed for testing.
- 9. Have scheduled component or system manufacturer's field service representatives on-site during system shakedown. Coordinate with Engineer to schedule manufacturer's service representatives to be on-site during system shakedown.
- 10. Operate system making all adjustments to equipment, valves and system requested by Owner's plant staff.
- 11. Provide qualified Contractor employee(s) available to make operational adjustments any time required by Owner's staff.
- 12. Provide equipment manufacturer's recommended maintenance.
- 13. Provide facilities housekeeping and cleaning.
- 14. Deliver required spare parts, lubricants, maintenance tools, and equipment to Owner.
- 15. Have trades and specialists on-site during system shakedown to adjust, trouble shoot, and correct components, systems, and associated facilities as required.
- 16. Verify all system components and systems are fully functioning, calibrated, and ready to be put into service under all operating, emergency and alarms conditions.
- 17. Contractor responsible for all damages resulting from backups, spills and any other regulatory violations during the construction period and shakedown period which are within its control.
- 18. Demonstrate to Engineer and Owner that system components and systems are fully functional, calibrated, and system is ready to be put into service.
- 19. Complete any required training of Owner's staff by equipment manufacturers.
- 20. Continue until scheduled system shakedown time has successfully occurred and substantial completion of system is certified by Engineer.
- 21. Provide electrical power during shakedown testing and up to the date of substantial completion.

22. If Contractor requests Engineer to observe shakedown operations and Engineer must make additional visits because Work is not ready, Owner may charge Contractor for all of Engineer's additional visit time and costs at Engineer's standard billing rated through a credit by Change Order.

D. Owner:

1. Responsible for quality of drinking water during shakedown operations.

1.04 SYSTEM SHAKEDOWN INTERRUPTION

A. Definitions:

- 1. "Level 1 interruption" means:
 - a. Failure of any single system component when system can, and does, continue to operate and be controlled and monitored as intended and failure is remedied within 24-hours.
 - b. Subsequent failure(s) of the same component cannot be classified as a level 1 interruption.
- 2. "Level 2 interruption" means:
 - a. Failure of any single system component which interrupts system functionability, reliability, control, monitoring or operation for less than 8-hours, or
 - b. Concurrent period of time when two system components have failed when system can, and does, continue to operate and be controlled and monitored as intended and failures are remedied within 24-hours of first component failure, or
 - c. Single system component failure which meets the requirements for a level 1 interruption except for being a subsequent failure(s) of the same component, or
 - d. When more than two level 1 interruptions have occurred during the shakedown of a system, or
 - e. Single system failure which would meet the requirements for a level 1 interruption except failure not remedied within 24-hours.
 - f. Subsequent failures(s) of any component causing a level 2 interruption cannot be classified as a level 2 interruption.
- 3. "Level 3 interruption" means:
 - a. Any component or system failure which interrupts system functionability, reliability, control, monitoring or operation for more than 8-hours, or
 - b. When more than two level 2 interruptions have occurred during the shakedown of a system, or
 - c. Component failure(s) which would meet the requirements for a level 2 interruption except for being a subsequent failure of the same component, or
 - d. Single system component failure which would meet the requirements for a level 2 interruption except failure not remedied within 8-hours, or
 - e. Any other failures which are not a level 1 or level 2 interruption.
- 4. Failure includes components not being calibrated.

- B. If level 1 interruption occurs:
 - 1. Continue system shakedown operations.
 - 2. Shakedown time continues to run.

C. If level 2 interruption occurs:

- 1. Continue system shakedown operations.
- 2. Shakedown time suspended until all components and systems are fully functional.
- 3. Verify that components that have failed are fully functional and ready to be put back into service, including related monitoring and control facilities.
- 4. Reimburse Owner for billings by Engineer for Engineer's costs in attending component verification activities.

D. If level 3 interruption occurs:

- 1. Continue shakedown operations.
- 2. Verify that all system components are fully functional, calibrated, and ready to be put back into service under all operating, emergency and alarm conditions.
- 3. Restart shakedown starting at 0 (zero) time.
- 4. Reimburse Owner for billings by Engineer for Engineer's costs in attending component and/or system verification activities.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SHAKEDOWN OPERATIONS

- A. Operate the following systems and continue shakedown operations throughout the scheduled period:
 - 1. Hondo 2 Pump Station and associated pump station systems.

3.02 SCHEDULE

- A. Work Prior to Testing:
 - 1. Line #2 Suction and Line #3 Discharge Water Transmission Lines:
 - a. Successfully completed flushing, pressure testing and disinfection.
 - b. Confirm all isolation valves are open and all air valves are operational.
 - c. Confirm all air has been evacuated from the lines.
 - d. Coordinate with Owner to confirm the Hondo 2 Pump Station, control tank, and control valves are ready for startup testing.

B. Functional Testing:

- 1. Charge the hydropneumatic tank bladders to the correct precharge pressure.
- 2. Fill the pump station piping with water.
- 3. Confirm all piping and appurtenances are watertight.
- 4. Check pressure gauges and instrumentation are reading correctly.
- 5. Check that controls, instrumentation, and SCADA communications are fully functional.

- 6. Operate the hydromatic tank level gauge solenoid valve systems through several cycles to confirm proper operation.
- 7. Bump each booster pump to confirm they rotate in the correct direction, are free of debris, and run without excessive noise or vibration.
- 8. Operate valves to confirm they operate properly.
- 9. Check that the flow meter properly responds to the bump testing.
- 10. Correct all deficiencies noted before performing the Shakedown Test.

C. Shakedown Test:

- 1. Run each booster pump individually for a minimum accumulated time of thirty (30) minutes each pump.
- 2. Run all combinations of two pumps operating simultaneously for a minimum accumulated time of fifteen (15) minutes each combination.
- 3. Record flow, suction and discharge pressures, and ampere draw every 5 minutes during each test.
- 4. Confirm the pumps are delivering water as specified and in accordance with the submitted pump curves.
- 5. Confirm the pumps operate without overheating, excessive noise, or excessive vibration.
- 6. Confirm the pump controls operate properly.
- 7. Confirm the signals from the Hondo 2 Fire Storage Tank properly control pump starts and stops.
- 8. Simulate a power trip with one pump operating, and then with two pumps operating, to confirm proper operation of the hydropneumatic tank.
- 9. Demonstrate proper operation of pump building heating and ventilation systems.
- 10. Correct all deficiencies noted.

3.03 SUBSTANTIAL COMPLETION

- A. Substantial Completion of the project (certified by the Engineer) shall occur and the Owner will accept when:
 - 1. All systems are complete and functional.
 - 2. All required shakedown testing periods have been completed.
 - 3. Utilities, alarms, electrical, area lighting, monitoring, controls, drains, piping paving and related components are in place and completed.
 - 4. Facilities can be put to intended use.
 - 5. Owner is able to use for intended use at no additional cost to Owner.
- B. Contractor's warranty start date for equipment systems will be the date of Substantial Completion accepted by the Owner for that specified equipment system.
- C. After the Engineer and Owner have accepted the Work, or designated portion thereof, Owner will assume responsibility for operation and maintenance of the facilities and equipment, or designated portion thereof.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Payment will be made under:

Bid Item No.	Pay Item	<u>Pay Unit</u>
5.01	Pump System Shakedown Testing	Lump Sum

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Cast-In-Place Concrete
- B. Reinforcing Steel
- C. Forms
- D. Admixtures
- E. Embedments

1.02 ADDITIONAL REQUIREMENTS SPECIFIED ELSEWHERE

A. Section 01 45 23: Testing Laboratory Services.

1.03 SUBMITTALS

- A. Shop Drawings and Product Data:
 - 1. Concrete mix design.
 - 2. Proposed admixtures, per ACI 318.
 - 3. Reinforcing bar lists, fabrication, and placement drawings for structures.
 - 4. Concrete accessories.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Storage:

- 1. Cement and fly ash:
 - a. Store in moisture-proof enclosures.
 - b. Do not use if caked or lumpy.
- 2. Aggregate:
- 3. Store to prevent segregation and inclusion of foreign materials.
- 4. Reinforcing steel: Store on supports which will keep it from contact with the ground.
- 5. Rubber and plastic materials:
 - a. Store in a cool place.
 - b. Do not expose to direct sunlight.

PART 2 PRODUCTS

2.01 MATERIALS

A. Forms:

- 1. The form work shall be designed in accordance with ACI 347.
- 2. Chamfer strips: Clear white pine, surface against concrete planed.
- 3. Form Coating: Industrial lubricants "Nox-crete Form Coating", "L&M Debond", Protex "Pro-Cote", Richmond "Rich Cote", or Engineer reviewed equivalent.
- 4. Form ties: Removable end, permanently embedded body type not requiring auxiliary spreaders, with cones on outer ends, embedded portion 1" minimum back from concrete face. If not provided with threaded ends, constructed for breaking off ends without damage to concrete.
- 5. Earth cuts shall not be used as forms for vertical surfaces, unless indicated on project drawings.

B. Reinforcing Steel:

- 1. Bars: ASTM A615, Grade 60.
- 2. Welded wire fabric: ASTM A185 or A497.
- 3. Bar supports: PS7; CRSI Class B, fabricated from galvanized wire.
- C. Welded Wire Fabric: ASTM A185, furnished in flat sheets.
- D. Fibrous Reinforcement: 100% virgin polypropylene fibrillated fibers specifically manufactured for use as concrete reinforcement and containing no reprocessed olefin material. Fibers shall have a specific gravity of 0.91 and a minimum tensile strength of 70 ksi.

E. Concrete:

- 1. Cement: ASTM C150, Type I or II. Use Type III only with prior written approval of Engineer.
- 2. Fly ash: ASTM C618, Class F, except loss on ignition not more than 5%
- 3. Fine aggregate: Clean, natural sand, ASTM C33.
- 4. Coarse aggregate: Crushed rock, natural gravel or other inert granular material, ASTM C33 except clay and shale particles no more than 1%.
- 5. Water: Clean, fresh and potable.
- 6. Admixtures:
 - a. Retarder: ASTM C494, Type D; Grace "Duratard-HC", Master Builders "Pozzolith 300-R", Protex "Protard", Sika Chemical "Plastiment", or Engineer reviewed equivalent.
 - b. Plasticizer: ASTM C494, Type A; Grace "WRD A-HC", Master Builders "Rheobuild 1000", Sika Chemical "Plastocrete", or Engineer reviewed equivalent.
 - c. Air entraining agent: ASTM C260; Grace "Darex AEA", Master Builders "AE 90", Protex "AES", Sika Chemical "AEK", or Engineer reviewed equivalent.
 - d. Water reducing agent ASTM C494, Type A; Master Builders "Pozzolith 322-N", or Engineer reviewed equivalent.

F. Accessories:

- 1. Polyethylene film: PS17, 6 mil.
- 2. Membrane curing compound and floor sealer: FS TT-C-600, Type 1; chlorinated rubber, minimum 18% solids; Grace "Dekote", Process Solvent "Concrete Treatment ALX-9", Protex "Triple Seal Series CRD-18", TK Product "Tri-Kote TK-18", or Engineer reviewed equivalent.
- 3. Expansion and contraction joint: Elastic
 - a. Rubber: Dumbell, 9" wide, 3/8 thick with 3/4" bead on each end, WR Grace, U.S. Rubber, William or Engineer reviewed equivalent.
 - b. PVC: Ribbed or serrated, 9" wide, 3/8" thick with "U" or "O" bulb closed center section, WR Grace, WR Meadows, Vinylex or Engineer reviewed equivalent.
- 4. Exterior expansion joint material: Asphalt impregnated fiberboard: ASTM D994.
- 5. Bond break joint material: 30 lb. asphalt saturated felt, ASTM D226.
- 6. Interior slab construction joint material: Preformed 20 gage steel or as indicated on Drawings.

2.02 CONCRETE MIX

- A. Comply with ASTM C94.
- B. Water to Cementitious Material Ratio: Maximum 0.50.
- C. Fly Ash: Not less than 10% and not more than 25% of the total cementitious material weight.
- D. Slump: Maximum 4.0", unless otherwise scheduled.
- E. Compressive Strength: 28 days 4000 psi, unless otherwise scheduled or shown on the Drawings.
- F. Volumetric Air Content: 4.5% to 7.5%, air may be omitted for interior slabs to be trowel finished.
- G. Admixtures:
 - 1. Content, batching method, and time of introduction in accordance with the manufacturer's recommendations for compliance with this Specification.
 - 2. Include a water reducing admixture.
 - 3. Calcium chloride shall not be used.
- H. Coarse Aggregate:
 - 1. Maximum nominal dimension:
 - 2. 3/4" for 8" concrete members.
- I. Add fibrous reinforcing (1.5 lbs/cubic yard of concrete) to concrete at batch plant for all concrete where indicated on Drawings.

J. Consistency:

- 1. Suitable for the placement conditions.
- 2. Slump uniform.
- 3. Aggregate floating uniformly throughout the concrete mass.
- 4. Flow sluggishly when vibrated or spaded.
- 5. Adjust mix in field, with Engineer's approval, as required to meet specifications.

2.03 FABRICATION

A. Reinforcing Steel:

- 1. Fabricate in accordance with ACI 315 and 318 except as specified or indicated on Drawings.
- 2. Accurately fabricated.
- 3. Free from loose rust, scale, and contaminants which will reduce bond.

PART 3 EXECUTION

3.01 INSTALLATION

A. Forms:

- 1. In accordance with ACI 347.
- 2. Mortartight.
- 3. Exposed concrete surfaces free from irregularities.
- 4. True to line, grades, and dimensions shown on the Drawings.
- 5. Rigid and properly braced.
- 6. Ties arranged so that metal will not show or discolor concrete surface.
- 7. Bevel or chamfer exterior corners.
- 8. Coat forms with acceptable release material.

B. Reinforcing Steel:

- 1. Remove loose rust, scale, grease or any coating which may impair bond to concrete. Remove all rust that can be wiped off with a cloth.
- 2. Provide supports to provide minimum cover and spacing.
- 3. Provide splice lengths as required by ACI 318.

C. Embedments:

- 1. Accurately placed for the purpose intended.
- 2. Remove loose rust, scale, and other foreign matter before placing concrete. Remove all rust that can be wiped off with a cloth.

D. Concrete:

- 1. Place before initial set has occurred, but in no event after the concrete has contained its water content for more than 30 minutes.
- 2. Place concrete on compacted moist surfaces, free from standing or running water.
- 3. Concrete to be conveyed and placed in an approved manner to prevent segregation of the coarse aggregate.

- 4. Cold weather concreting:
 - a. Comply with ACI 306.
- 5. Hot weather concreting:
 - a. Comply with ACI 305.

E. Expansion and Contraction Joints:

1. Provide as indicated on the Drawings.

F. Finishing:

- 1. Not required on buried surfaces.
- 2. No special concrete or cement mortar topping allowed for slab finish.
- 3. Slabs brought to true and even finish by screeding, floating, and finishing to product a smooth impervious surface, free from blemishes.
- 4. Unless otherwise specified or shown on the Drawings, a steel trowel finish shall be applied.
- 5. Excess water shall not be present when the finish is made.

G. Curing:

1. Cure concrete by approved method which will keep surfaces adequately wet or protected from moisture loss for the curing period.

H. Repairing Defective Concrete:

- 1. Repair defects in formed concrete surfaces within 24 hours.
- 2. Replace defective concrete within 48 hours.
- 3. Cut out and remove to sound concrete honeycombed or otherwise defective concrete.
- 4. Cut edges square to avoid feathering.
- 5. Comply with Chapter 9, ACI 301.
- 6. Perform repair work so as not to interfere with thorough curing of adjacent concrete.
- 7. Adequately cure repair work.

3.02 FIELD QUALITY CONTROL

A. Perform Field Control Test:

- 1. Tests by qualified personnel.
- 2. Make tests in presence of Engineer's representative.
- 3. Provide all equipment, supplies, and the services of one or more employees, as required.
- 4. The test frequencies specified are minimum; perform additional tests as required by the job conditions.
- B. Slump: Perform a test for each load in accordance with ASTM C143.
- C. Air Content: Test one (1) sample from one of each three (3) batches made and from each batch from which test cylinders are made, in accordance with ASTM C231.

D. Compression Tests:

- 1. Make one (1) set of four (4) cylinders from every load or batch or portion thereof.
- 2. Make, cure, store, and deliver cylinders in accordance with ASTM C31.
- 3. Mark or tag each set of test cylinders with the date and time of day the cylinders were made, the location in the work where the concrete represented by the cylinders was placed, the delivery truck or batch number, the air content, and the slump.
- 4. Testing laboratory will:
 - a. Test one (1) cylinder in each set at 7 days.
 - b. Test two (2) cylinders from each set at 28 days.
 - c. If compressive strength does not reach specified compressive strength at 28 days, test remaining cylinder at 56 days.
 - d. Do not test or discard remaining cylinder until so instructed by the Engineer.
 - e. Engineer will evaluate in accordance with ACI 214 and 318.
 - f. Test in accordance with ASTM C39.
- 5. 4" dia. x 8" cylinders may only be used under the following conditions:
 - a. Coarse aggregate size for all mixes used on the project do not exceed 1" maximum size, and
 - b. Test cylinders for all mixes used on the project shall be the same size.
- E. Concrete used solely for blocking of water line valves or fittings will not require testing. It shall, however, be subject to acceptance by the Engineer as to its suitability.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	<u>Pay Item</u>	<u>Pay Unit</u>
1.11, 1.12, 1.14, 2.02, 2.07, 3.01, 3.02, 3.03, 3.12, 3.13, 3.14, 3.16, 4.03, 5.03	Miscellaneous Cast-in-Place Concrete Collars, Blocks, and Encasement	Incidental to Associated Items
4.01, 5.01, 5.02	Cast-in Place Reinforced Concrete	Lump Sum

END OF SECTION

SECTION 03 48 00

PRE-CAST CONCRETE TRIM

PART 1 GENERAL

1.01 SUMMARY

A. Provide pre-cast concrete sills as shown on the Drawings. Include fasteners and anchors as required to complete installation of precast concrete trim items.

1.02 QUALITY ASSURANCE

- A. Perform work in accordance with ACI standards.
- B. Obtain materials from same source throughout the Work.
- C. Single Source Responsibility for Materials: Obtain integral coloring, color hardeners, patina stain, and curing compound materials from one manufacturer.

1.03 SUBMITTALS

- A. Submit color chart for color selection by the A/E.
- B. Samples:
 - Submit two, 6" x 6" x 2" thick samples showing finish using design mix proposed for finished Work.
 - 2. Sample approval will be for color, appearance and finish texture.
 - 3. Resubmit samples until approved.

1.04 DELIVERY, STORAGE AND HANDLING

A. Protect pre-cast items from damage.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cement:

- 1. ASTM Cl50, Type II white cement as necessary if required to achieve the specific color as specified.
- 2. Use only one brand, type, and source of cement for entire Project.

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B. Aggregate:

- 1. General:
 - a. Provide fine and coarse aggregate for each type finish from one source for entire Project.
- 2. Fine aggregate: ASTM C33.
 - a. Manufactured sands from coarse aggregate or dust-free, silt-free, salt-free natural sand.
 - b. Restrict deleterious reactive materials with alkalis in cement per ASTM C33.
 - c. Provide white sand as necessary if required to achieve the specific color as specified.
- 3. Coarse aggregate:
 - a. Normal weight aggregate: ASTM C33.
- C. Water: Clean and potable containing less that 50 ppm of chlorides.
- D. Concrete Color: White.
- E. Finish Color: To be selected by the A/E from Santa Fe County's color palette.
- F. Finish Texture: Smooth
- G. Formwork Materials:
 - 1. Verify that form release agent will not discolor or otherwise have detrimental effects on Architectural concrete.
- H. Form Release Agent: Material that will not stain concrete finish and will not have detrimental effects on application of sealants.
- I. Joint Fillers: Non Asphaltic Joint Fillers: ASTM D1752, Type I.
- J. Sealants: Two-part polyurethane sealants, of grade as required to suit application, meeting ASTM C920, in manufacturer's standard custom colors, and as follows:
 - 1. Urethane NS grade as specified in Section 07 92 00 Elastomeric Sealants.
- K. Curing Compound: Meeting ASTM C309, water-based emulsion.
- L. Concrete Design Mix: Refer to Section 03 30 00 Cast-in-Place Concrete.

2.02 PRECAST CONCRETE WALL CAPS

A. Provide standard masonry sill blocks: 5 5/8" x 7 5/8" x 15 5/8" where shown on the Drawings.

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PART 3 EXECUTION

3.01 PREPARATORY WORK

A. Handle and store pre-cast items to prevent damage and discoloration. Discard damaged items.

3.02 INSTALLATION

- A. Follow generally accepted masonry practices. Install level to each other. Space and grout joints in accordance with design requirements of supporting masonry.
- B. To ensure proper bonding, set in mortar or adhesive suitable for both concrete and wall substrate.

3.03 DEFECTIVE CONCRETE

- A. Modify or replace (at A/E's option) concrete not conforming to required levels, lines, details, elevations, and appearance. Removal and replacement shall not impair the strength or appearance of the structure.
- B. Repair or replace concrete not properly placed with the specified type.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
5.01	Precast Concrete Trim	Lump Sum

END OF SECTION

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SECTION 04200 -CONCRETE MASONRY UNITS

PART 1 - GENERAL

1.01 SUMMARY

- Description of Work: Provide labor, materials, equipment, tools, storage, transportation, and A. services as shown on the drawings and specified herein or required to complete the Concrete Masonry Unit Work as total installations.
- Extent of each type of masonry work is indicated on the drawings. Extent of each type of B. different masonry unit is shown on the drawings.

RELATED DOCUMENTS 1.02

- Drawings and General Provisions of the contract, including Division 1 Specification Sections, apply to the work specified in this Section.
- Related Sections: В.
 - 1. Section 03300 Concrete Work
 - 2. Section 05500 Metal Fabrications
 - 3. Section 07210 Building Insulation
 - 4. Section 07600 Flashing and Sheet Metal
 - 5. Section 07900 Joint Sealers
 - 6. Section 09220 Portland Cement Plaster with Synthetic Finish
 - 7. Section 09260 Gypsum Board Assemblies
 - 8. Section 09900 Painting

1.03 **REFERENCES**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. All publications referenced herein shall be the latest edition.
- B. ACI INTERNATIONAL (ACI)

- ACI SP-66 ACI 1. **Detailing Manual**
- C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1.	ASTM A 82 REV A	Standard Specification for Steel Wire, Plain, for Concrete
		Reinforcement.

- ASTM A 153/A 153M Standard Specification for Zinc Coating (Hot-Dip) on Iron and 2. Steel Hardware
- 3. ASTM A 615/A 615M Standard Specification for Deformed and Plant Billet-Steel Bars for concrete Reinforcement.
- ASTM C 90 Standard Specification for Loadbearing Concrete 4. Masonry Units.

5.	ASTM C 140	Standard Test Methods for Sampling and Testing Concrete Masonry Units.
6.	ASTM C 150	Standard Specification for Portland Cement.
7.	ASTM C 270	Standard Specification for Mortar for Unit Masonry.
8.	ASTM C 476	Standard Specification for Grout for Reinforced and Non-Reinforced Masonry.
9.	ASTM C 780	Standard Test Method for Pre-construction and Construction Evaluation of Mortars for Plan and Reinforced Unit Masonry.
10.	ASTM C 1019	Standard Test Methods for Sampling and Testing Grout.

1.04 CONSTRUCTION TOLERANCES

- A. Variation from Plumb: For vertical lines and surfaces of columns, walls and arises do not exceed 1/4" in 10', or 3/8" in a story height not to exceed 20', nor 1/2" in 40' or more. For external corners, expansion joints, control joints and other conspicuous lines, do not exceed 1/4" in any story or 20' maximum, nor 1/2" in 40' or more.
- B. Variation from Level: For lines of exposed lintels, sills, parapets, horizontal grooves & other conspicuous lines, do not exceed 1/4" in any bay or 20' maximum, nor 3/4" in 40'or more.
- C. Variation of Linear Building Line: For position shown in plan and in related portion of columns, walls and partitions do not exceed 1/2" in any bay or 20' maximum, nor 3/4" in 40' or more.
- D. Variation in Cross-Sectional Dimensions: For columns and thickness of walls, from dimensions shown, do not exceed minus 1/4" nor plus 1/2".

1.05 SUBMITTALS

- A. Product Data: Submit manufacturer's specifications and other data for each type of masonry unit, accessory and other manufactured products, including certifications that each type complies with specified requirements. Include the instructions for handling, storage, installation and protection.
- B. Samples: For verification purposes, submit the following:
 - Colored masonry mortar samples for each color required showing full range of color, which can be expected, in finished work. Label samples to indicate type and the amount of colorant used.
- C. Shop Drawings: Layout showing extent of unit masonry work and types of units.
 - Submit one reproducible set and 2 prints.

1.06 JOB CONDITIONS

- A. Protection of Work: During erection, cover top of walls with heavy waterproof sheeting at end of each day's work. Cover partially completed structures when work is not in progress.
- B. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
- C. Do not apply uniform floor or roof loading for at least 12 hours after building masonry walls or columns.
- D. Do not apply concentrated loads for at least three days after building masonry walls or columns.
- E. Protect sills, ledges, & projections from droppings of mortar.

F. Cold Weather Protection

- 1. Remove any ice or snow formed on masonry bed by carefully applying heat until top surface is dry to the touch.
- 2. Remove all masonry determined to be frozen or damaged by freezing conditions.
- Perform the following construction procedures while the work is progressing.
- 4. When air temperature is from 40 deg F (4 deg C) to 32 deg F (0 deg C), heat the sand or mixing water to produce mortar temperatures between 40 deg F (4 deg C) and 120 deg F (49 deg C).
- 5. When air temperature is from 25 deg F (-4 deg C) to 20 deg F (-7 deg C), heat sand and mixing water to produce mortar temperatures between 40 deg F (4 deg C) and 120 deg F (49 deg C); maintain temperature of mortar on boards above freezing; use salamanders or other heat sources on both sides of walls under construction; use wind breaks when wind is in excess of 15 mph.

1.07 PROTECTION

Perform the following protections for completed masonry and masonry not being worked on.

- A. When the mean daily air temperature is from 40 deg F (4 deg C) to 32 deg F (0 deg C), protect masonry from rain or snow for at least 24 hours by covering with weather-resistive membrane.
- B. When mean daily air temperature is from 32 deg F (0 deg C) to 25 deg F (-4 deg C), completely cover masonry with weather-resistive membrane for at least 24 hours.
- C. When mean daily air temperature is from 25 deg F (-4 deg C) to 20 deg F (-7 deg C), completely cover masonry with insulating blankets or similar protection for at least 24 hours.

PART 2 - PRODUCTS

2.01 MASONRY UNITS, GENERAL

A. Obtain masonry units from one manufacturer, of uniform texture and color for each kind required, for each continuous area & visually related areas.

2.02 CONCRETE MASONRY UNITS (CMU) STANDARD MODULAR MEDIUM WEIGHT

- A. Sizes: 7-5/8" x 7-5/8" x 15-7/8"; 11-5/8" x 7-5/8" x 15-7/8"; and as required to meet all conditions.
- B. Units shall meet ASTM C90, Type I, moisture controlled for hollow load-bearing units.
 - 1. Minimum compressive strength: 1900 psi average net area (f'm = 1500psi).
 - 2. Linear shrinkage may not exceed .045%.
 - 3. Moisture content shall not exceed 25% of total absorption.
 - 4. Manufacturer: as noted on drawings.

C. Aggregate:

 Volcanic scoria or other as required to meet strength requirements and shall meet all other requirements of ASTM C331. Specification for medium weight aggregate for concrete masonry units.

D. Color:

1. Units to be standard gray below grade and when not visible and as specified in the architectural drawings where visible.

E. Types:

1. Standard smooth face for below grade or areas not visible and as specified in the architectural drawings where visible.

2.03 MATERIALS

- A. Hollow Core Standard Units: ASTM C90, Type I, Grade N. The units shall be of integral color as specified by the Architect and shall be of the type of block (split face, smooth face, or burnished) specified by the architect. All units are to be manufactured with water repellent. The water repellent add mixture shall be "Dry Block" by WR Grace & Co. or approved equal.
- B. Mortar: ASTM C270, Type S.
- C. Grout: ASTM C476.
- D. Cell reinforcing: ASTM A615, Grade 60. Comply with Section 03010.
- E. Bond Beam and Lintel Reinforcing: ASTM A615, Grade 60. Comply with Section 03010.
- F. Joint Reinforcing: Standard Truss type by Dur-O-Wal or approved equal.
- G. Control Joint Material: Rubber, neoprene or PVC joint material for use with standard sash block by Dur-O-Wal or approved equal.
- H. Vertical Bar Positioner: Steel or plastic by Dur-O-Wal or approved equal.
- I. Mortar Plasticizer: Easy Spread by American Colloid Company or approved equal.

2.04 MORTAR MATERIALS

- A. Portland Cement: ASTM C150, Type I, except Type III may be used for cold weather construction. Provide natural color or white cement as required to produce required mortar color.
- B. Hydrated Lime: ASTM C207, Type S.
- C. Aggregates: ASTM C144, except for joints less than 1/4" use aggregate graded with 100% passing No. 16 sieve.
 - 1. White Mortar Aggregates: Natural white sand or ground white stone.
 - 2. Color Mortar Aggregates: Ground marble, granite, or other sound stone, as required to match Architect's sample.
- D. Moisture Resistant Mortar Additive: Ammonium Stearate, aluminum tristrearate or calcium stearate.
- E. Water: Clean, free of deleterious materials, which would impair strength or bond.

2.05 MASONRY ACCESSORIES

- A. Individual Wire Ties for Masonry
 - Fabricate from 3/16" cold-drawn steel wire, ASTM A82, unless otherwise indicated, of length required for proper embedment in wythes of masonry.
 - 2. For use with masonry veneer, provide: Dur-O-Wall Dur-O-Eye veneer anchors or approved equal at CMU walls, Dur-O-Wall D/A 213 at steel Stud walls, and DA709 with 4" and 7" triangularties. Space as required by code; unless otherwise indicated 16" o.c. horizontal and vertical.
 - 3. Anchors and Ties: Provide straps, bars, bolts and rods fabricated from not less than 16 ga. sheet metal or 3/8" diameter rod stock, unless otherwise indicated.

B. Welded Wire Joint Reinforcing

- 1. Masonry wall joint reinforcing shall be truss type manufactured from No. 9 side rods and No. 9 cross rods.
- Finish shall be regular mill galvanized conforming to ASTM A641.
- 3. Use prefabricated corner and tee units at corners and intersections.

C. Flashings for Masonry

- 1. Provide concealed flashings, shown to be built into masonry.
- 2. Provide concealed flashings as follows:
 - a. Fabricate through-wall metal flashings with deformations in both directions for integral mechanical mortar bond.

D. Miscellaneous Masonry Accessories

- 1. Reinforcing Bars: Deformed steel, ASTM A615, Grade 60 of the sizes shown.
- 2. Non-Metallic Expansion Joint Strips: Provide premolded compressible, elastic fillers of foam rubber, neoprene, or extruded plastic.
- 3. Bond Breaker Strips: 15-lb. asphalt roofing felt complying with ASTM D226, or 15-lb. coal tar roofing felt complying with ASTM D227.
- Premolded Control Joint Strips: Solid rubber strip with a Shore A durometer hardness of 60 to 80, designed to fit standard sash block and maintain lateral stability in masonry wall, size and configuration as indicated.
- 5. Air Infiltration Barrier (Building Wrap): DuPont Tyvek® Commercial Wrap or approved comparable product. Install at walls with brick veneer.
- 6. Weep Tubes: Polyethylene, color to be specified by Architect.

E. Anchoring Masonry Work

- 1. Provide anchoring devices of type shown as specified. If not shown or specified, provide standard type for facing and backup involved.
- 2. Anchor masonry to structural members where masonry abuts or faces such members to comply with following.
 - Provide an open space not less than 1" in width between masonry and structural members, unless otherwise shown. Keep open space free of mortar or other rigid materials.
 - Anchor masonry to structural members with metal ties embedded in masonry joints and attached to structure. Provide anchors with flexible tie sections, unless otherwise indicated.
 - Space anchors as shown, but not more than 16" on centers vertically and 16" on centers horizontally.

2.06 MORTAR AND GROUT MIXES

- A. Do not lower freezing point of mortar by use of admixtures or antifreeze agents. Do not use calcium chloride in mortar or grout.
- B. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specifications, except limit materials to those specified herein, and limit cement/lime ratio (by volume) as follows.
 - 1. Type M: 1/4 part lime per part of portland cement.

2. Type S: Over 1/4 up to ½ part lime per part of portland cement.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Thickness: Build masonry construction to full thickness shown, except build single wythe walls, if any, to actual thickness of masonry units, using units of nominal thickness shown or specified.
- B. Build chases and recesses as shown and as required for work of other trades. Provide not less than 8" of masonry between chases and recesses.
- C. Cut masonry units with motor-driven saw designed to cut masonry with clean, sharp, unchipped edges. Cut units as required to provide pattern shown and to fit adjoining work neatly. Use full units without cutting wherever possible. Wetting of concrete masonry units is permitted.
- D. Frozen Materials and Work: Do not use frozen materials or materials mixed or coated with ice or frost. For masonry, which is specified to be wetted, comply with BIA recommendations. Do not build on frozen work. Remove and replace masonry work damaged by frost or freezing.
- E. Pattern Bond: Lay exposed masonry in bond pattern shown, or if not shown, lay in running bond vertical joint in each course centered on units in courses above and below Lay concealed masonry with all units in a wythe bonded by lapping not less than 2". Bond and interlock each course of each wythe at corners, unless otherwise shown Match coursing, bonding, color and texture of new masonry work with existing work, where indicated.
- F. Lay out walls in advance for accurate spacing of surface bond patterns, with uniform joint widths and to properly locate openings, movement-type joints, returns and offsets. Avoid use of less than half-size units at corners, jambs and wherever possible at other locations.
- G. Lay up walls plumb and true and with courses level, accurately spaced and coordinated with other work.
- H. Stopping and Resuming Work: Rack back ½ masonry unit length in each course; do not tooth. Clean exposed surfaces of set masonry, wet units lightly (if specified to be wetted), and remove loose masonry units and mortar prior to laying fresh masonry.
- J. Built-In Work: As the work progresses, build in items specified under this & other sections of these specifications. Fill in solidly with masonry around built-in items.
 - 1. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core.

3.02 MORTAR BEDDING AND JOINTING

- A. Use Type M mortar for masonry below grade and in contact with earth, interior and exterior load bearing walls.
- B. Use Type S mortar for exterior above grade load bearing and non-load bearing walls, parapet walls, pavements, and for interior load bearing walls and non-load bearing partitions.

C. Batch Control

- 1. Measure and batch materials either by volume or weight such that the required proportions for mortar can be accurately controlled and maintained. Measurement of sand exclusively by shovel will not be permitted.
- 2. Mix mortars with maximum amount of water consistent with workability to provide maximum tensile bond strength within capacity of mortar.
- 3. Mix mortar ingredients for a minimum of five minutes in a mechanical batch mixer. Use water clean and free of deleterious materials, which would impair work. Do not use mortar, which has begun to set, or if more than 2-1/2 hours has elapsed since initial mixing. Retemper mortar during 2-1/2 hour period as required to restore workability.

- 4. Lay solid masonry units with completely filled bed, head and collar joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not slush head joints.
- D. Joints: Maintain joint widths shown, except for minor variations required to maintain bond alignment. If not otherwise indicated, lay walls with 3/8" joints. Cut joint flush for masonry walls, which are to be concealed or to be covered by other materials. Tool exposed joints slightly concave. Rake out mortar in preparation for application of caulking or sealants where shown. Remove masonry units disturbed after laying; clean and relay in fresh mortar. Do not pound corners at jambs to fit the stretcher units, which have been set in position. If adjustments are required, remove units, clean off mortar, and reset in fresh mortar.

3.03 HORIZONTAL JOINT REINFORCING

- A. Provide continuous horizontal joint reinforcing as shown and specified. Fully embed longitudinal side rods in mortar for their entire length with a minimum cover of 5/8" on exterior side of walls and 1/2" at other locations. Lap reinforcement a minimum of 6" at ends of units. Do not bridge control and expansion joints with reinforcing, unless otherwise indicated. Provide continuity at corners and wall intersections by use of prefabricated "L" and "T" sections. Cut and bend units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures and other special conditions.
- B. Space continuous horizontal reinforcing for single-wythe walls at 16" o.c. vertically unless otherwise specified.
- C. Reinforce masonry openings greater than 1'-0" wide with horizontal joint reinforcing placed in two horizontal joints approximately 8" apart, both immediately above the lintel & below the sill. Extend reinforcing a minimum of 2'-0" beyond jambs of opening, bridging control joints where provided.

3.04 ANCHORING MASONRY WORK

- A. Provide anchoring devices of type shown as specified. If not shown or specified, provide standard type for facing and backup involved.
- B. Anchor masonry to structural members where masonry abuts or faces such members to comply with the following.
 - Provide an open space not less than 1" in width between masonry and structural member, unless otherwise shown. Keep open space free of mortar or other rigid materials.
 - Anchor masonry to structural members with metal ties embedded in masonry joints and attached to structure. Provide anchors with flexible tie sections unless otherwise indicated.
 - 3. Space anchors as shown, but not more than 24" o.c. vertically and 36" o.c. horizontally.

3.05 CONTROL AND EXPANSION JOINTS

A. Provide vertical expansion, control and isolation joints in masonry where shown. Build in related masonry accessory items as masonry work progresses. See Division 7 sections for "Joint Sealers."Build in joint fillers where shown, as specified in Division 7 sections.

3.06 FLASHING OF MASONRY WORK:

- A. Provide concealed flashings in masonry work at or above all shelf angles, lintels, ledges and other obstructions to the downward flow of water in the wall so as to divert such water to the exterior. Prepare masonry surfaces smooth and free from projections which could puncture flashing. Place through-wall flashing on bed of mortar and cover with mortar. Seal penetrations in flashing with mastic before covering with mortar.
- B. Interlock end joints of deformed metal flashings by overlapping deformations not less than 1-1/2" and seal lap with elastic sealant.
- C. Install flashings in accordance with manufacturer's instructions.

D. Install reglets and nailers for flashing and other related work where shown to be built into the masonry work.

3.07 PREPARATION OF CELLS FOR FILLWORK:

- A. Prior to filling, inspect and clean cell spaces. Remove dirt, mortar droppings, loose pieces of masonry and other foreign materials from cellspaces. After final cleaning and inspection, close cleanout holes.
- B. Do not place concrete or insulation until entire height of masonry to be filled has attained sufficient strength to resist displacement of the masonry units and breaking of mortar bond.
- C. Place concrete or insulation by pumping into all cell spaces.
- D. Rod and vibrate each cell pour during pouring operation.

3.08 REPAIR, POINTING, CLEANING

- A. Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.
- B. Pointing: During tooling of joints, enlarge any voids or holes except weep holes, and completely fill with mortar. Point up all joints at corners, openings and adjacent work to provide a neat, uniform appearance, properly prepared for application of caulking or sealant compounds.
- C. Clean exposed CMU masonry by dry brushing at end of each day's work and after final pointing to remove mortar spots and droppings.

PART- 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No. Pay Item Pay Unit
5.01 Concrete Masonry Units Lump Sum

END OF SECTION

SECTION 04 23 00

GLASS UNIT MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Glass Block Units, solid.
- B. Integral Joint Reinforcement.
- C. Mortar.

1.02 RELATED SECTIONS

- A. Section 04 00 00 Unit Masonry.
- B. Section 07 92 00 Elastomeric Sealants.

1.03 REFERENCES

- A. ASTM A153 Class B-2, Spec. Zinc Coating (Hot dip) on iron and steel hardware.
- B. ASTM C144 Spec. for Aggregate for Masonry.
- C. ASTM C150 Spec. for Portland Cement.
- D. ASTM C207 Spec. for Hydrated Lime for Masonry Purposes.
- E. ASTM C270 Spec. for Mortar for Unit Masonry.
- F. ASTM D1227 Type III—Spec. for Emulsified Asphalt (For Porous Surfaces).

1.04 SYSTEM DESCRIPTION

- A. Glass block panels shall not be designed to support structural loads.
- B. Maximum deflection of structural members supporting glass block panels shall not exceed L/600.
- C. Sills of all panels must be painted with a heavy coat of asphalt emulsion and must dry for two hours before first mortar bed is placed.

- D. Provision for expansion and movement must be made at jambs and heads of all panels. Mortar must not bridge expansion spaces.
- E. Mortar should be mixed and applied in accordance with the recommendations of Manufacturer.

1.05 SUBMITTALS

- A. Product Data:
 - 1. Submit manufacturer's product data.
- B. Samples:
 - 1. Submit glass block units of each type specified showing size, color, design, and pattern of faces.
 - 2. Submit representative samples of panel reinforcing, expansion strips, and sealant.

1.06 STORAGE AND PROTECTION

- A. Store unopened cartons of glass block in a clean, cool, dry area.
- B. Protect opened cartons of glass block against windblown rain or water run-off with tarpaulins or plastic covering.

1.07 PROJECT/SITE CONDITIONS

A. Do not install glass block units when temperature is 40°F and falling. Maintain the temperature of glass unit masonry above 40°F for the first 48 hours after construction.

1.08 WARRANTY

A. 5-year warranty which covers replacement of any glass block unit found to be defective.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. The Drawings and Specifications are based on catalog data, specifications, and products of Pittsburgh Corning Corporation and designate the type and quality of work intended under this Section.
- B. Products of other manufacturers proposed as equivalent quality must be submitted for approval by the A/E.
- C. Supporting technical data, samples, published specifications and the like must be submitted for comparison.

D. Contractor shall warrant that proposed substitutions, if accepted, will provide performance equivalent to the materials specified herein.

2.02 GLASS BLOCK UNITS

- A. Solid glass units, nominally 8 inch x 8 inch x 3 inch thick made of clear colorless glass with a polyvinyl butyral edge coating.
 - 1. Pattern type: VISTABRIK® Solid Glass Block.

2.03 ACCESSORIES

- A. Panel Reinforcing: Two parallel 9-gauge wires either 1-5/8 inch or 2 inch on center with electrically butt-welded cross-wires spaced at regular intervals, galvanized after welding.
- B. Panel Anchors: 20 gauge perforated steel strips 24 inches long by 1-3/4 inches wide, hot-dipped galvanized after perforation.
- C. Expansion Strips: Made of polyethylene foam with a thickness of 3/8 inch.
- D. Asphalt Emulsion: A water-based asphalt emulsion, by Karnak Chemical Corp. (Karnak 100, 1-800-526-4236), or equal.
- E. Sealant: Non-staining, waterproof mastic, silicone type.
- F. Packing (Backer Rods): Polyethylene foam, neoprene, fibrous glass or equal as approved by sealant manufacturer.

2.04 MORTAR MATERIALS

- A. Mortar: Type S in accordance with ASTM C270: Mortar shall be 1 part Portland Cement, 1/2 part lime, and sand equal to 2-1/4 to 3 times the amount of cementitious material (cement plus lime), all measures by volume. For exterior glass block panels, an integral type waterproofer shall be added to the mortar mix. No antifreeze compounds or accelerators allowed.
 - 1. Portland Cement: Type 1 in accordance with ASTM C150: If a waterproof Portland Cement is used, the integral type waterproofer shall be omitted. Do not use masonry cement. Color to be selected by the A/E.
 - 2. Lime: Type S, in accordance with ASTM C207 shall be a high-calcium lime, or a pressure-hydrated dolomitic lime, provided that not less than 92% of all the active ingredients are completely hydrated
 - 3. Sand: A clean, white quartzite or silica type, essentially free of iron compounds, for thin joints, in accordance with ASTM C144, not less than 100% passing a No. 8 sieve.

- B. Integral Type Water Repellent: Stearate type by Sonneborn Building Products (Hydrocide Powder, 1-800-243-6739), or equal.
 - 1. Add hydrocide powder to dry mortar mix. Do not add powder to wet mortar mix.
- C. External Type Waterproofer: Water based silane sealer type by Harris Specialty Chemicals, Inc. (ENVIROSEAL 20, 1-800-327-1570).
 - 1. Remove excess sealer from glass surfaces soon after application.

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify that channels, panel anchors have been provided at head and jambs for the purpose of providing panel support within the opening.
- B. Mix all mortar components to a consistency that is drier than mortar for ordinary masonry. Retempering the mortar after it has taken its initial set shall not be permitted. Do not use antifreeze compounds or accelerators.
- C. Freshly mixed mortar may create skin irritation. Avoid direct contact where possible and wash exposed skin areas promptly with water. If any mortar gets into the eyes, rinse immediately with water and get prompt medical attention.

3.02 INSTALLATION

- A. Install per manufacturer's installation instructions.
- B. Cover sill area with a heavy coat of asphalt emulsion. Allow emulsion to dry at least 2 hours before placing mortar.
- C. Adhere expansion strips to jambs and head. Make certain expansion strip extends to sill.
- D. Set a full mortar bed joint, applied to sill.
- E. Set lower course of block. Maintain a uniform joint width of 1/4 to 3/8 inch plus or minus 1/8 inch. All mortar joints must be full and not furrowed. Steel tools must not be used to tap block into position. (Place a rubber crutch tip on end of trowel to tap block into position.) Do not realign, tap, or otherwise move block after initial placement.
- F. For VISTABRIK[®] Solid Glass Block, typical mortar joint is 3/8 inch. It may be necessary to use wedges in the mortar joints of the lower courses to prevent the mortar from being "squeezed" out.

- G. Install panel reinforcing every 16 inches o.c. maximum in the horizontal mortar joint, and in joints immediately above and below all openings within panels.
 - 1. Where panel anchors are used at jambs and heads, in lieu of channel or chase surrounds, install panel anchors in the same joints (16 inches o.c. maximum) as the panel reinforcing.
 - 2. At panel corners, anchors shall be placed in each mortar joint, both at the jamb and head, 24 inches on each side of the corner.
 - 3. Install panel anchors across head joint spaced 16 inches o.c. maximum.
 - 4. Run reinforcing continuously from end to end of panels.
 - 5. Lap reinforcing not less than 6 inches whenever it is necessary to use more than one length.
 - 6. For VISTABRIK® Solid Glass Block, use 1-5/8" wide reinforcing. Do not bridge expansion joints with reinforcing.
- H. Install Reinforcing as Follows:
 - 1. Place lower half of mortar in bed joint. Do not furrow.
 - 2. Press panel reinforcing into place.
 - 3. Cover panel reinforcing with upper half of mortar bed and trowel smooth. Do not furrow.
- I. Place full mortar bed for joints not requiring panel reinforcing. Do not furrow. Maintain uniform joint width.
- J. Set succeeding courses of block. Space at head of panel and jambs must remain free of mortar for caulking with sealant.
- K. Use only wooden or rubber tipped tools when tapping glass blocks in place.
- L. Strike joints smooth while mortar is still plastic and before final set.
 - 1. Remove surplus mortar from faces of glass blocks and wipe dry.
 - 2. Tool joints smooth and concave before mortar takes final set.
 - 3. Remove wedges from lower courses of VISTABRIK® Solid Glass Blocks and point the voids with mortar.
 - 4. At this time, remove and clean out all excess mortar from jamb, head and other expansion joint locations.
- M. After final mortar set (approximately 24 hours), install packing tightly between glass block panel and jamb and head locations. Leave space for sealing.
- N. Apply sealant evenly to the full depth of recesses as indicated on the Drawings and in accordance with the manufacturer's application manual and instructions.
- O. All exterior glass block panels shall be well sealed to prevent water entry.

3.03 CLEANING

- A. Remove surplus mortar from the faces of the glass block at the time joints are struck or tooled. Mortar should be removed while it is still plastic using a clean, wet sponge or an ordinary household scrub brush having stiff bristles.
- B. Do not use harsh cleaners, acids of any strength, abrasives or alkaline materials while cleaning glass block. Never use steel wool or wire brush to remove mortar from glass block surfaces.
- C. Final mortar removal is accomplished with a clean, wet sponge or cloth. Rinse sponge or cloth frequently in clean water to remove abrasive particles that could scratch glass surfaces. Allow any remaining film on the block to dry to a powder.
- D. After all organic sealants, caulking, etc., have been applied, remove excess caulking materials with commercial solvents such as xylene, toluene, mineral spirits or naptha and follow with normal wash and rinse. Do not damage caulking with application of strong solvents. Comply with solvent manufacturer's directions on label for toxicity and flammability warnings.
- E. Final cleaning of glass block panels is accomplished after they are completely installed.
 - 1. Wait until panels are not exposed to direct sunlight.
 - 2. Start at the top of the panel and wash with generous amounts of clean water.
 - 3. Dry all water from the glass block surface.
 - 4. Change cloth frequently to eliminate dried mortar particles or aggregate that could scratch the glass surface.
 - 5. Remove dry powder from the glass surfaces, with a clean, dry, soft cloth.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	<u>Pay Unit</u>
5.01	Glass Unit Masonry	Lump Sum

END OF SECTION

SECTION 05 50 01

ANCHOR BOLTS AND CHEMICAL ANCHORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cast-in anchor bolts for structural connections and to secure equipment.
- B. Bolts, threaded rods, and deformed rods to be placed in holes drilled into hardened concrete or masonry and secured by chemical grouts.

1.02 SUBMITTALS

- A. Section 01 33 23: Shop Drawings, Product Data, and Samples
- B. Product Data

1.03 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver anchor bolts and templates in time to permit setting when structural concrete is placed.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Bolts:
 - 1. Carbon steel: ASTM A 307
 - 2. Galvanized steel: Carbon steel, hot-dip galvanized, ASTM A 153; or zinc plated, ASTM A 164, type GS
 - 3. Stainless steel: ASTM F 593
- B. Nuts:
 - 1. Same material as bolts.
 - 2. Carbon steel: ASTM A 563, Grade B heavy hexagonal
 - 3. Stainless steel: ASTM F 594
 - 4. Self-locking: Prevailing torque, IFI-100, Grade A
- C. Washers:
 - 1. Same material as bolts.
 - 2. Flat: ASTM F 436
 - 3. Locking: Spring type ANSI B27.1
- D. Sleeves:
 - 1. Pipe: ASTM A 53, galvanized
 - 2. Bearing plates: ASTM A 36, galvanized

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E. Chemical Anchor Systems:

- 1. Fastener or connector: Bolt, threaded rod or deformed rod as shown on Drawings, material as indicated on Drawings or specified.
- 2. Screen sleeves: For attachment to hollow masonry walls, provide stainless steel screen sleeves specifically manufactured for the purpose and approved by the manufacturer of the adhesive to be used.
- 3. Chemical adhesive: Two component system to be mixed at the site and placed into predrilled holes.
- 4. Acceptable products: Subject to compliance with the requirements of these specifications, products which may be used in the work include, but are not limited to, the following:
 - a. Epcon Epoxy Injection System as manufactured by ITW Ramset/Red Head.
 - b. HIT Renovation Anchor System as manufactured by the HILTI Corporation.
 - c. Molly PARAFAST Resin Mortar as manufactured by the Molly Fastening Systems Group of Emhart Corporation.

2.02 FABRICATION AND MANUFACTURE

A. Anchor Bolts:

- 1. 3/4" minimum, except as indicated on the Drawings.
- 2. Type:
 - a. General use: L-shaped hook type.
 - b. Where indicated on Drawings or specified:
 - 1) Straight bolt with square head.
 - 2) Straight bolt with square plate welded to bolt and nut welded to plate and bolt.
 - 3) Through-bolt with sleeve and square plate assembly.
 - 4) Coupled bolt with sleeve welded to square plate and bolt.

PART 3 EXECUTION

3.01 INSPECTION

A. Verify that holes for anchor bolts in forms and templates match applicable equipment shop drawings.

3.02 INSTALLATION

A. Anchor Bolts:

- 1. Where installed in cast-in-place concrete, install a nut on the concrete side of the form or supporting template.
- 2. Provide 3 nuts for each equipment anchor bolt for which a lock nut is indicated, 2 for others.
- 3. Sleeved anchor bolts:
 - a. Centered in pipe sleeve.
 - b. Sleeve ID: Approximately 2-1/2 times bolt OD.

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- c. Sleeve length: Approximately 8 times bolt OD.
- d. Bearing plate minimum thickness: 1/2 times bolt OD.
- 4. Through bolts:
 - a. Sleeved with bearing plates.
 - b. Bearing plates welded to bolt and plate welded to sleeve.
 - c. Dimension: As specified for sleeved anchor bolts.
- B. Chemical Anchor Systems:
 - 1. Install in conformity with the manufacturer's instructions.

3.03 SCHEDULE

- A. Anchor bolts to be Type 316 stainless steel unless noted otherwise on Drawings.
- B. All sleeves and plates galvanized unless noted otherwise on Drawings.
- C. Wedge anchors not acceptable unless noted otherwise on Drawings.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	<u>Pay Item</u>	Pay Unit
1.25, 3.23, 4.01, 4.02,	Anchor Bolts and	Lump Sum
4.03, 5.01, 5.04	Chemical Anchors	

END OF SECTION

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SECTION 06 10 00

ROUGH CARPENTRY

PART 1 GENERAL

1.01 SUMMARY

- A. Contractor shall provide miscellaneous lumber and/or plywood for:
 - 1. Framing with dimension lumber and engineered wood products.
 - 2. Rooftop equipment bases and support curbs.
 - 3. Wood blocking and nailers.
 - 4. Wood furring.
 - 5. Wood sleepers.
 - 6. Utility shelving.
 - 7. Plywood backing panels.

B. Related Sections:

1. Section 09 22 00 – Gypsum Board Assemblies

1.02 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product indicated.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that materials comply with requirements.
- B. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses.
- C. Research/Evaluation Reports: For the following:
 - 1. Treated wood.
 - 2. Engineered wood products.
 - 3. Power-driven fasteners.
 - 4. Powder-actuated fasteners.
 - 5. Expansion anchors.

1.03 QUALITY ASSURANCE

A. Each piece of lumber or plywood shall bear official GRADE STAMP of Association under whose rules it is graded or may be accompanied by certificate of inspection issued by that Association.

1.04 REFERENCES

A. NFPA National Forest Products Association National Design Specification for Stress Grade Lumber and Its Fastening.

- B. Western Wood Products Association Grading Rules.
- C. American Plywood Association Product Standard.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect lumber from dampness both during and after delivery at site.
- B. Immediately pile stacks in such a manner as to provide air circulation around all surfaces of each piece to insure thorough air seasoning.
- C. Locate stacks on well-drained areas, supported at least 6-inches above grade and covered adequately to protect from driving rain.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where Paragraph titles below introduce lists, the following requirements apply for product selection:
- B. Available Manufacturers: Subject to compliance with requirement.

2.02 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. For exposed lumber indicated to receive stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
 - 3. Provide dressed lumber, S4S, unless otherwise indicated.
 - 4. Provide dry lumber with 19% maximum moisture content at time of dressing for 2-inch nominal thickness or less, unless otherwise indicated.
- B. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
 - 1. Allowable Design Stresses: Meet or exceed those indicated per manufacturer's published values determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

C. Wood Structural Panels:

- 1. Plywood: Either DOC PS 1 or DOC PS 2, unless otherwise indicated.
- 2. Oriented Strand Board: DOC PS 2.
- 3. Comply with "Code Plus" provisions in APA Form No. E30K, "APA Design/Construction Guide: Residential & Commercial."

2.03 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWPA C2 (lumber) and AWPA C9 (plywood), except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWPA C31 with inorganic boron (SBX).
- B. Kiln-dry material after treatment to maximum moisture content of 19% for lumber and 15% for plywood.
- C. Mark each treated item with treatment quality mark of an inspection agency approved by the American Lumber Standards Committee Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:
 - 1. Blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - 2. Blocking and similar concealed members in contact with masonry or concrete.
 - 3. Wood framing members less than 18 inches above grade.
 - 4. Wood floor plates that are installed over concrete slabs directly in contact with earth.

2.04 DIMENSION LUMBER

- A. General: Of grades indicated according to the American Lumber Standards
 Committee National Grading Rule provisions of the grading agency indicated. Must
 match existing wood at the existing building. Architect will approve wood used.
- B. Framing Other Than Non-Load-Bearing Partitions: Construction or No. 2 grade and any of the following species:
 - 1. Hem-fir or Hem-fir (north); NLGA, WCLIB, or WWPA.
 - 2. Southern pine; SPIB.
 - 3. Spruce-pine-fir (south) or Spruce-pine-fir; NELMA, NLGA, WCLIB, or WWPA.
- C. Framing Other Than Non-Load-Bearing Partitions: Any species of machine stress-rated dimension lumber with a grade of not less than 2100f-1.8E.
- D. Exposed Framing: Hand select material for uniformity of appearance and freedom from characteristics that would impair finish appearance.
 - 1. Species and Grade: As indicated above for load-bearing construction of same type.
 - 2. Species and Grade: Hem-fir or Hem-fir (north), Select Structural grade; NLGA, WCLIB, or WWPA.
 - 3. Species and Grade: Southern pine, No. 1 grade; SPIB.
 - 4. Species and Grade: Spruce-pine-fir or Spruce-pine-fir (south), No. 1 grade; NELMA, NLGA, WCLIB, or WWPA.

2.05 TIMBER AND MISCELLANEOUS LUMBER

- A. For timbers of 5-inch nominal size and thicker, provide material complying with the following requirements:
 - 1. Species and Grade: Douglas fir-larch, Douglas fir-larch (north), or Douglas fir-south; No. 1 grade; NLGA, WCLIB, or WWPA.
 - 2. Species and Grade: Eastern hemlock, Eastern hemlock-tamarack, or Eastern hemlock-tamarack (north); No. 1 grade; NELMA or NLGA.
 - 3. Species and Grade: Southern pine, No. 1 grade; SPIB.
- B. Provide miscellaneous lumber for support or attachment of other construction, including Blocking.
- C. For items of dimension lumber size, provide No. 2 grade lumber with 19% maximum moisture content of any species.
- D. For concealed boards, provide lumber with 19% maximum moisture content and any of the following species and grades:
 - 1. Mixed southern pine, No. 2 grade; SPIB.
 - 2. Eastern softwoods, No. 2grade; NELMA.
 - 3. Northern species, No. 2grade; NLGA.
 - 4. Western woods, No. 2 Common grade; WCLIB or WWPA.

2.06 ENGINEERED WOOD PRODUCTS

- A. Laminated-Veneer Lumber: Composite of wood veneers with grain primarily parallel to member lengths, manufactured with exterior-type adhesive complying with ASTM D2559. Allowable design values determined according to ASTM D5456.
 - 1. Manufacturers:
 - a. Boise Cascade Corporation.
 - b. Georgia-Pacific Corporation.
 - c. Louisiana-Pacific Corporation.
 - d. Pacific Woodtech Corp.
 - e. Trus Joist MacMillan.
 - f. Union Camp Corp.; Building Products Division.
 - g. Willamette Industries, Inc.
 - 2. Extreme Fiber Stress in Bending, Edgewise: 2500 psi for 12 inch nominal-depth members.
 - 3. Modulus of Elasticity, Edgewise: 1,800,000 psi.
- B. Rim Boards: Performance-rated product complying with APA PRR-401.
 - 1. Material: composite panels.
 - 2. Thickness and Grade: 1-inch rim board.
 - 3. Trademark: Factory mark with APA trademark indicating thickness, grade, and compliance with APA standard.

2.07 PLYWOOD BACKING PANELS

A. Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2 inch thick.

2.08 MISCELLANEOUS MATERIALS

A. Fasteners:

- 1. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.
- 2. Power-Driven Fasteners: CABO NER-272.
- 3. Bolts: Steel bolts complying with ASTM A307, Grade A; with ASTM A563 hex nuts and, where indicated, flat washers.
- B. Metal Framing Anchors: Made from hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 coating designation.
 - 1. Manufacturers: Alpine Engineered Products, Inc.
 - a. Cleveland Steel Specialty Co.
 - b. Harlen Metal Products, Inc.
 - c. KC Metals Products, Inc.
 - d. Silver Metal Products, Inc.
 - e. Simpson Strong-Tie Company, Inc.
 - f. Southeastern Metals Manufacturing Co., Inc.
 - g. United Steel Products Company, Inc.
 - 2. Research/Evaluation Reports: Provide products acceptable to authorities having jurisdiction and for which model code research/evaluation reports exist that show compliance of metal framing anchors, for application indicated, with building code in effect for Project.
 - 3. Allowable Design Loads: Meet or exceed those indicated per manufacturer's published values determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.
- C. Building Paper: Asphalt-saturated organic felt complying with ASTM D226, Type I (No. 15 asphalt felt), unperforated.

PART 3 EXECUTION

3.01 INSTALLATION

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate blocking and similar supports to comply with requirements for attaching other construction.

- B. Apply field treatment complying with AWPA M4 to cut surfaces of preservative treated lumber and plywood.
- C. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. CABO NER-272 for power-driven fasteners.
 - 2. Published requirements of metal framing anchor manufacturer.
 - 3. Tables in the IBC
- D. Use finishing nails for exposed work, unless otherwise indicated. Countersink nail heads and fill holes with wood filler.
- E. Framing Standard: Comply with AFPA's "Manual for Wood Frame Construction," unless otherwise indicated.
- F. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
- G. Comply with applicable recommendations contained in APA Form No. E30K, "APA Design/Construction Guide: Residential & Commercial," for types of structural-use panels and applications indicated.
- H. Comply with "Code Plus" provisions in above-referenced guide.
- I. Fastening Methods:
 - 1. Combination Subfloor-Underlayment: Glue and nail to wood framing.
 - 2. Subflooring: Glue and nail to wood framing.
 - 3. Sheathing: Nail or staple to wood framing.
 - 4. Underlayment: ail or staple to subflooring.
 - 5. Plywood Backing Panels: Nail or screw to supports.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
5.01	Rough Carpentry	Lump Sum

END OF SECTION

SECTION 06 1920 METAL-PLATE-CONNECTED WOOD TRUSSES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Triangular-pitched roof trusses.
 - 2. Truss accessories.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 6 Section "Rough Carpentry" for roof and floor sheathing of structural-use panels and dimension lumber for supplementary framing and permanent bracing.

1.03 DEFINITIONS

A. Metal-plate-connected wood trusses include planar structural units consisting of metal-plate-connected members fabricated from dimension lumber and cut and assembled before delivery to Project site.

1.04 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Engineer, fabricate, and erect metal-plate-connected wood trusses to withstand design loads within limits and under conditions required.
 - 1. Design Loads: As indicated.
 - 2. Design trusses to withstand design loads without deflections greater than the following:
 - a. Roof Trusses: Vertical deflection of 1/240 of span due to total load.
 - b.. Roof Trusses: Horizontal deflection at reactions of 1-1/4 inches due to total load.
 - c. Floor Trusses Vertical deflection of 1/360 of span due to live load.
- B. Engineering Responsibility: Engage a fabricator who uses a qualified professional engineer to prepare calculations, Shop Drawings, and other structural data for metal-plate-connected wood trusses.

1.05 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

- B. Product Data for lumber, metal-plate connectors, metal framing connectors, bolts, and fasteners.
- C. Shop Drawings detailing location, pitch, span, camber, configuration, and spacing for each type of truss required; species, sizes, and stress grades of lumber to be used; splice details; type, size, material, finish, design values, and orientation and location of metal connector plates; and bearing details.
 - To the extent truss design considerations are indicated as fabricator's responsibility, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 2. Include truss Shop Drawings signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Product certificates signed by officer of truss fabricating firm certifying that metal-plate-connected wood trusses supplied for Project comply with specified requirements and Shop Drawings.
- E. Qualification data for firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- F. Material test reports from a qualified independent testing agency indicating and interpreting test results relative to compliance of fire-retardant-treated wood products with requirements indicated.
- G. Material certificates for dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the American Lumber Standards Committee (ALSC) Board of Review.
- H. Research or evaluation reports of the model code organization acceptable to authorities having jurisdiction that evidence the following products' compliance with building code in effect for Project.
 - 1. Metal-plate connectors.
 - 2. Metal framing connectors.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has completed wood truss installation similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Fabricator's Qualifications: Engage a firm that complies with the following requirements for quality control and is experienced in fabricating metal-plate-connected wood trusses similar to those indicated for this Project and with a record of successful in-service performance:
 - Fabricator participates in a recognized quality-assurance program that involves inspection by SPIB; Timber Products Inspection, Inc.; Truss Plate Institute (TPI); or other independent inspecting and testing agency acceptable to Architect and authorities having jurisdiction.
- C. Comply with applicable requirements and recommendations of the following publications:

- 1. ANSI/TP1 1, "National Design Standard for Metal-Plate-Connected Wood Truss Construction."
- 2. TPI HIB "Commentary and Recommendations for Handling Installing & Bracing Metal Plate Connected Wood Trusses."
- 3. TPI DSB "Recommended Design Specification for Temporary Bracing of Metal Plate Connected Wood Trusses."
- D. Metal-Plate Connector Manufacturer's Qualifications: A manufacturer that is a member of TPI and that complies with TPI quality-control procedures for manufacture of connector plates published in ANSI/TPI 1.
- E. Single-Source Responsibility for Connector Plates: Provide metal connector plates from one source and by a single manufacturer.
- F. Wood Structural Design Standard: Comply with applicable requirements of AFPA's "National Design Specification for Wood Construction" and its "Supplement."
- G. Single-Source Engineering Responsibility: Provide trusses engineered by metal-plate connector manufacturer to support superimposed dead and live loads indicated, with design approved and certified by a qualified professional engineer.
- H. Professional Engineer Qualifications: A professional engineer who is legally authorized to practice in the jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated that have resulted in installing metal-plate-connected wood trusses similar to those indicated for this Project and with a record of successful in-service performance.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Handle and store trusses with care and comply with manufacturer's written instructions and TPI recommendations to avoid damage and lateral bending.
- B. Inspect trusses showing discoloration, corrosion, or other evidence of deterioration. Discard and replace trusses that are damaged or defective.

1.08 SEQUENCING AND SCHEDULING

A. Time delivery and erection of trusses to avoid extended on-site storage and to avoid delaying progress of other trades whose work must follow erection of trusses.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - Metal Connector Plates:

- a. Alpine Engineered Products, Inc.
- b. Computrus, Inc.
- c. Mitek Industries, Inc.
- d. Robbins Manufacturing Company.
- e. Tee-Lok Corporation.
- f. Truswal Systems Corporation.
- 2. Metal Framing Anchors:
 - a. Cleveland Steel Specialty Co.
 - b. Harlen Metal Products, Inc.
 - c. Silver Metal Products, Inc.
 - d. Simpson Strong-Tie Company, Inc.
 - e. Southeastern Metals Manufacturing Co., Inc.
 - f. United Steel Products Co.

2.02 DIMENSION LUMBER

- A. Lumber Standards: Comply with DOC PS 20, "American Softwood Lumber Standard," and with applicable grading rules of inspection agencies certified by ALSC's Board of Review.
- B. Inspection Agencies: Inspection agencies, and the abbreviations used to reference them, include the following:
 - 1. NELMA Northeastern Lumber Manufacturers Association.
 - 2. NLGA National Lumber Grades Authority (Canadian).
 - 3. SPIB Southern Pine Inspection Bureau.
 - 4. WCLIB West Coast Lumber Inspection Bureau.
 - WWPA Western Wood Products Association.
- C. Grade Stamps: Provide lumber with each piece factory marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.
- D. Provide dressed lumber, S4S, manufactured to actual sizes required by DOC PS 20 for moisture content specified, to comply with requirements indicated below:
 - 1. Provide dry lumber with 19 percent maximum moisture content at time of dressing.
- E. Grade and Species: Provide dimension lumber of any species for truss chord and web members, graded visually or mechanically, and capable of supporting required loads without exceeding allowable design values according to AFPA's "National Design Specification for Wood Construction" and its "Supplement."

2.03 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. General: Where lumber is indicated as preservative treated or is specified to be treated, comply with applicable requirements of AWPA C2 (lumber). Mark each treated item with the Quality Mark Requirements of an inspection agency approved by ALSC's Board of Review.
- B. Pressure treat aboveground items with waterborne preservatives to a minimum retention of 0.25 lb/cu. ft.. After treatment, kiln-dry lumber to a maximum moisture content of 19 percent.

C. Complete fabrication of treated items before treatment, where possible. If cut after treatment, apply field treatment complying with AWPA M4 to cut surfaces. Inspect each piece of lumber after drying and discard damaged or defective pieces.

2.04 METAL CONNECTOR PLATES

- A. General: Fabricate connector plates from metal complying with requirements indicated below.
- B. Hot-Dip Galvanized Steel Sheet: Structural-quality steel sheet, zinc coated by hot-dip process complying with ASTM A 653, G60 coating designation; Grade 33 and not less than 0.0359 inch thick.
- C. Electrolytic Zinc-Coated Steel Sheet: ASTM A 591, structural-(physical) quality steel sheet, zinc coated by electrodeposition; 33,000-psi minimum yield strength, coating class C, and not less than 0.0474 inch thick.
- D. Aluminum-Zinc Alloy-Coated Steel Sheet: Structural-(physical) quality steel sheet, aluminum-zinc alloy-coated by hot-dip process complying with ASTM A 792, AZ50 coating designation; Grade 33 and not less than 0.0359 inch thick.
- E. Stainless-Steel Sheet: ASTM A 666, Type 304 or 316, chromium nickel steel sheet; 33,000-psi minimum yield strength and not less than 0.035 inch thick.

2.05 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified below for material and manufacture.
 - 1. Where truss members are exposed to weather or to high relative humidities, provide fasteners with a hot-dip zinc coating per ASTM A 153 or of stainless steel, Type 304 or 316.
- B. Nails, Wire, Brads, and Staples: FS FF-N-105.
- C. Power-Driven Fasteners: CABO NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Lag Bolts and Screws: ASME B18.2.1.
- F. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

2.06 METAL FRAMING ANCHORS

- A. General: Provide metal framing anchors of structural capacity, type, size, metal, and finish indicated that comply with requirements specified, including the following:
 - 1. Research or Evaluation Reports: Provide products for which model code research or evaluation reports exist that are acceptable to authorities having jurisdiction and that evidence compliance of metal framing anchors for application indicated with building code in effect for this Project.

- Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis, and demonstrated by comprehensive testing performed by a qualified independent testing agency.
- B. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653, G60 coating designation; structural, commercial, or lock-forming quality, as standard with manufacturer for type of anchor indicated.
- C. Stainless-Steel Sheet: ASTM A 666, Type 304 or 316, chromium nickel steel sheet; 33,000-psi minimum yield strength.

2.07 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.
- B. Protective Coatings: Provide one of the following coating systems:
 - 1. SSPC-Paint 22, epoxy-polyamide primer.
 - 2. SSPC-Paint 16, coal-tar epoxy-polyamide black or dark red paint.
 - 3. SSPC-Paint 27 and SSPC-Paint 12, basic zinc chromate-vinyl butyral wash primer and cold-applied asphalt mastic.

2.08 FABRICATION

- A. Cut truss members to accurate lengths, angles, and sizes to produce close-fitting joints.
- B. Fabricate metal connector plates to size, configuration, thickness, and anchorage details required to withstand design loadings for types of joint designs indicated.
- C. Assemble truss members in design configuration indicated using jigs or other means to ensure uniformity and accuracy of assembly with joints closely fitted to comply with tolerances of ANSI/TPI 1. Position members to produce design camber indicated.
 - 1. Fabricate wood trusses within manufacturing tolerances of ANSI/TPI 1.
- D. Connect truss members by metal connector plates located and securely embedded simultaneously into both sides of wood members by air or hydraulic press.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Do not install wood trusses until supporting construction is in place and is braced and secured.
- B. Before installing, splice trusses delivered to Project site in more than one piece.
- C. Hoist trusses in place by lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.
- D. Install and brace trusses according to recommendations of TPI and as indicated.

- E. Install trusses plumb, square, and true to line and securely fasten to supporting construction.
- F. Space, adjust, and align trusses in location before permanently fastening and as follows:
 - 1. Truss Spacing: As indicated.
- G. Anchor trusses securely at all bearing points using metal framing anchors. Install fasteners through each fastener hole in metal framing anchor according to manufacturer's fastening schedules and written instructions.
- H. Securely connect each truss ply required for forming built-up girder trusses.
 - 1. Anchor trusses to girder trusses as indicated.
- I. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.
 - Install and fasten strongback bracing vertically against vertical web of parallel-chord floor trusses at centers indicated.
- J. Install wood trusses within installation tolerances of ANSI/TPI 1.
- K. Do not cut or remove truss members.
- L. Return wood trusses that are damaged or do not meet requirements to fabricator and replace with trusses that do meet requirements.
 - 1. Do not alter trusses in the field.

3.02 REPAIRS AND PROTECTION

- A. Repair damaged galvanized coatings on exposed surfaces with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Protective Coating: Clean and prepare exposed surfaces of embedded-metal connector plates. Brush apply primer, when part of coating system, and one coat of protective coating.
 - 1. Apply materials to provide minimum dry film thickness recommended by manufacturer of coating system.

PART 4 - PAYMENT

4.01 PAYMENT ITEMS

Bid Item No. Pay Item Pay Unit
5.01 Wood Trusses Lump Sum

END OF SECTION

SECTION 07 20 00

INSULATION

PART 1 GENERAL

1.01 WORK INCLUDED

- A. This section specifies thermal insulation for buildings
- B. Related Sections: Division 6.
 - 1. Wood Deck.
 - 2. Wood Roof Trusses.

1.02 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - 1. ASTM C553: Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - 2. ASTM E84: Surface Burning Characteristics of Building Materials.
 - 3. ASTM E970: Standard Test Method for Critical Radiant Flux of Exposed Attic Floor Insulation Using a Radiant Heat Energy Source.

1.03 SUBMITTALS

- A. Product Data for each type of insulation used.
- B. Manufacturer's Installation Instructions.
- C. Certificates: Stating the type, thickness and "R" value (thermal resistance) of the insulation to be installed.

1.04 QUALITY ASSURANCE

- A. Insulation Installed in Concealed Locations Surface Burning Characteristics:
 - 1. Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
 - 2. Where such materials are installed in Construction Type III, Type IV, and Type V, the flame spread and smoke developed limitations do not apply to facings that are installed behind and in substantial contact with the unexposed surface of the ceiling wall or floor finish.

- B. Insulation Installed in Exposed Locations Surface Burning Characteristics:
 - 1. Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
 - 2. Attic Floor Insulation (directly above ceiling): Minimum 0.12 watt per sq cm critical radiant flux when tested in accordance with ASTM E970.

1.05 STORAGE AND HANDLING

- A. Store insulation materials in weathertight enclosure.
- B. Protect insulation from damage from handling, weather, and construction operations before, during, and after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Owens Corning.
- B. Products by other manufacturers when products submitted meet the requirements of this Specification.

2.02 MATERIALS

- A. Insulation General:
 - 1. Where thermal resistance ("R" value) is specified or shown for insulation, the thickness shown on the drawings is nominal. Use only insulation with actual thickness that is not less than that required to provide the thermal resistance specified.
 - 2. Where "R" value is not specified for insulation, use the thickness shown on the Drawings.
- B. Exterior Roof/Ceiling:
 - 1. Where framing is not faced with gypsum board and insulation is exposed to space provide Flame Spread 25 Insulation.
 - 2. Type: FRK (foil) walls or PSK (white) ceilings, faced glass fiber thermal insulation complying with ASTM C 665, Type III for FRK (foil) and Type II for PSK (white), Class A.
 - 3. Where wood framing is faced with gypsum board provide fiberglass building insulation with vapor barrier which complies with ASTM C 665; preformed glass fiber batt insulation, Section 7.4, Water Vapor Permeance and ASTM E 96, Class A or 1 Fire Resistance rating.
 - 4. R-Value: As indicated on Drawings.
- C. Expanding Insulating Foam Sealant for filling gaps around sealing around windows and doors.

- D. Separate Vapor and Air Barrier: Translucent polyethylene film, Type 1, Class 1; 6 mil thick.
- E. Nails or Staples: Steel wire, electroplated or galvanized; type and size to suit application.
- F. Tape: As recommended by insulation manufacturer.

G. Fasteners:

- 1. Staples or Nails: ASTM F1667, zinc-coated, size, and type best suited for purpose.
- 2. Screws: ASTM C954 or C1002, size and length best suited for purpose with washer not less than 50 mm (two inches) in diameter.
- 3. Impaling Pins: Steel pins with head not less than 50 mm (two inches) in diameter with adhesive for anchorage to substrate. Provide impaling pins of length to extend beyond insulation and retain cap washer when washer is placed on the pin.
- 4. As recommended by the manufacturer of the insulation.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Exterior Framing Thermal Batt Insulation:
 - 1. Install separate vapor/air barrier on warm side of insulation when noted on the Drawings.
 - 2. Install faced insulation with the vapor retarder facing the heated side, unless specified otherwise. Tape seal tears or cuts in vapor retarder. Extend vapor retarder tight to full perimeter of adjacent window and door frames and other items interrupting plane of membrane. Tape seal in place.
 - 3. Install batt or blanket insulation in exterior walls, roof, and ceiling spaces from wall-to-wall without gaps or voids with tight joints and filling framing void.
 - 4. Roof Rafter Insulation: Place mineral fiber blankets between framing to provide not less than a two inch air space between insulation and roof sheathing.
 - 5. Retain roof batt insulation in place with wire mesh secured to framing members. Tape seal tears or cuts in barrier.
- B. Pack or install foam insulation around door frames and windows and in building expansion joints, door soffits and other voids. Pack or install foam behind outlets around pipes, ducts, and services encased in walls. Open voids are not permitted. Hold insulation in place with pressure sensitive tape.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.Pay ItemPay Unit5.01InsulationLump Sum

END OF SECTION

SECTION 07 21 19

FOAMED-IN-PLACE MASONRY FOAM INSULATION

PART 1 GENERAL

1.01 WORK INCLUDED

- A. This Section specifies masonry foam thermal insulation for concrete unit masonry cores of buildings.
- B. Related Sections:
 - 1. Division 4:
 - a. Unit Masonry.

1.02 REFERENCES

- A. The publications listed below form a part of this Specification to the extent referenced. The publications are referenced in the text by basic designation only.
 - 1. ASTM E-84: "Standard Test Method for Surface Burning Characteristics of Building Materials."
 - 2. ASTM C-518: "Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus."
 - 3. NFPA 259: "Standard Test Method for Potential Heat of Building Materials."

1.03 SUBMITTALS

- A. Product Data for each type of insulation used.
- B. Manufacturer's Installation Instructions.
- C. Certificates: Stating the type, thickness and "R" value (thermal resistance) of the insulation to be installed.

1.04 QUALITY ASSURANCE

- A. Manufacturing Standards: Provide insulation produced by a single and approved manufacturer. The product must come from the manufacturer pre-mixed to ensure consistency.
- B. Installer Qualifications for Foamed-In-Place Masonry Insulation: Engage an experienced dealer/applicator who has been trained and licensed by the product manufacturer and which has not less than three years direct experience in the installation of the product used.

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- C. Warranty: Upon request, a one year product and installation warranty will be issued by both the manufacturer and installer.
- D. Fire Performance Characteristics: Provide insulation materials which are identical to those whose fire performance characteristics, as listed for each material or assembly of which insulation is a part, have been determined by testing, per methods indicated below, by a testing agency acceptable to authorities having jurisdiction
 - 1. Product must be classified by Underwriters Laboratory ("UL") as to Surface Burning Characteristics.
 - 2. Surface Burning Characteristics: ASTM E-84.

1.05 STORAGE AND HANDLING

- A. Store insulation materials in weathertight enclosure.
- B. Protect insulation from damage from handling, weather, and construction operations before, during, and after installation.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Masonry Foam Insulation:
 - 1. Surface Burning Characteristics: Maximum flame spread, smoke developed, and fuel contributed of 0, 5 and 0 respectively.
 - 2. Combustion Characteristics: Must be noncombustible, Class A building material.
 - 3. Thermal Values: "R" Value of 4.91/inch @ 32°F mean; ASTM C-177.
 - 4. Sound Abatement: Minimum Sound Transmission Class ("STC") rating of 53 and a minimum Outdoor Indoor Transmission Class ("OITC") rating of 44 for 8" wall assembly ASTM E90-90).

PART 3 EXECUTION

3.01 INSPECTION AND PREPARATION

- A. Application Assemblies:
 - 1. CMU Walls in thickness locations as indicated on the Drawings.
- B. Select the best location(s) to inject foam:
 - 1. Drill 5/8"-7/8" holes in masonry joints or directly through CMU face walls.

3.02 INSTALLATION OF FOAMED-IN-PLACE INSULATION

A. General: Install foamed-in-place insulation from interior, or as specified, prior to installation of interior finish work and after all masonry and structural concrete work is in place; comply with manufacturer's instructions.

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B. Installation:

- 1. Fill all open cells and voids in hollow concrete masonry walls where shown on Drawings.
- 2. The foam insulation shall be pressure injected through a series of 5/8" to 7/8" holes drilled into every vertical column of block cells (every 8" on center) beginning at an approximate height of four (4) feet from finished floor level.
- 3. Repeat this procedure at an approximate height of ten (10) feet above the first horizontal row of holes (or as needed) until the void is completely filled.
- 4. Patch holes with mortar and score to resemble existing surface.

3.03 PROTECTION

- A. Protect product from excess moisture during initial 24-hour curing period after installation. A minimum 72-hour curing period is required prior to painting.
- B. Do not expose Foam to surfaces over 190°F for sustained periods of time.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
5.01	Masonry Insulation	Lump Sum

END OF SECTION

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SECTION 07 41 00

METAL ROOFING

PART 1 GENERAL

1.01 SUMMARY

- A. This Section includes the following:
 - 1. Trapezoidal-rib, snap joint, standing seam metal roof panels, with related metal trim and accessories.
 - 2. Metal Panel Underlayment for installation over Wood Roof Deck.
- B. Related Sections included in other Sections:
 - 1. Division 6 Section "Wood Sheathing" for roof deck.
 - 2. Division 6 Section "Wood Trusses" for roof framing.
 - 3. Division 7 Section "Sheet Metal Flashing and Trim" for metal flashing and trim not part of this Work.
 - 4. Division 7 Section "Joint Sealants" for field-applied sealants.

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. A653-00 Standard Specification for Steel Sheet, Zinc-Coated (galvanized), or Zinc-Iron Alloy-Coated (galvannealed) by the Hot-Dip process.
 - 2. A792-99 Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy Coated by the Hot Dip process.
- B. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
 - 1. 1993 Edition Architectural Sheet Metal, 5th Edition.
- C. National Roofing Contractor Association (NRCA):
 - 1. Roofing and Waterproofing Manual, 5th Edition.
- D. Single Ply Roofing Institute (SPRI):
 - 1. 1994 Edition Wind Design for Use with Low Slope Roofing.

1.03 PERFORMANCE REQUIREMENTS

A. General: Provide manufactured roof and wall panel assemblies complying with performance requirements indicated and capable of withstanding structural movement, thermally induced movement, and exposure to weather without failure or infiltration of water into the building interior.

- B. Air Infiltration: Provide manufactured roof panel assemblies with permanent resistance to air leakage through assembly of not more than 0.09 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a static-air pressure difference of 4.0 lb./sq. ft.
- C. Water Penetration: Provide manufactured roof panel assemblies with no water penetration as defined in the test method when tested according to ASTM E 331 at a minimum of differential pressure of 20 percent of inward acting, wind-load design pressure of not less than 6.24 lb./.sq. ft. and not more than 12.0 lf/sq. ft.
- D. Wind Uplift Resistance: Provide roof panel system assemblies including clips, meeting requirements. The minimum design uplift-resistance capacities for the specific roof area and building identified are as follows

Zone 1 (roof area field):
 Zone 2 (roof area perimeter):
 31.1 pounds per square foot
 36.4 pounds per square foot

3. Zone 3 (roof area corners): 36.4 pounds per square foot

- E. Structural Performance: Provide manufactured roof and wall panel assemblies capable of withstanding design wind loads indicated under in-service conditions with deflection no greater than the following, based on testing manufacturer's standard units according to ASTM E 1592 and ASTM E 330 by a qualified independent testing and inspecting agency.
 - 1. Maximum Deflection: 1/180 of the span.

1.04 SUBMITTALS

- A. Product Data: Include manufacturer's product specifications, standard details, certified product test results, and general recommendations, as applicable to material and finishes for each component and for total panel assemblies.
- B. Shop Drawings: Details of edge and corner conditions, joints, panel profiles, supports, anchorage, trim, flashings, underlayment, closures, and special details. Distinguish between factory and field-assembled work.
- C. For installed products indicated to comply with certain design loadings, include structural analysis data signed by the qualified professional engineer responsible for their preparation.
- D. Samples for Initial Selection: Manufacturer's color charts or chips showing the full range of colors available for roof and wall panels with factory-applied finishes.
- E. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of Architects and Owners, and other information specified.

- F. Product Test Reports: Indicate compliance of manufactured roof and wall panel assemblies and materials with performance and other requirements based on comprehensive testing of current products.
- G. Maintenance Manual at Project Closeout including Warranties.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer shall have a minimum of ten years experience in manufacturing metal components for the roofing industry. Panels and accessories specified in this Section shall be manufactured at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing.
- B. Installer Qualifications: Engage an experienced installer (minimum of 5 years) who has completed metal roof, soffit and wall panel projects similar in material, design, and extent to that indicated for this Project and with a record of success in service performance. Installation Contractor must be an approved and certified applicator by the specified metal roof manufacturer a minimum of 10 days prior to bid date. Contractor must supply A/E with a copy of this certification.
- C. Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated without delaying the Work, as documented according to ASTM E 699.
- D. Coordination: Prior to ordering materials, a pre-roofing meeting will be held with the metal roof manufacturer, approved applicator, general contractor, owner, and the A/E to discuss the specified roofing system and its proper application.
 - 1. Coordinate application of the roofing system with other trades in such a manner that the complete installation is weather-tight and in accordance with all approved details and warranty requirements.
- E. Inspections: After the metal roof installation is complete, the manufacturer shall inspect the work and inform (by written report) the A/E, Contractor, and the installer of defective/incomplete work to be remedied. Those areas indicated shall be corrected to the full satisfaction of the Architect, Owner, and manufacturer. The manufacturer shall submit written acceptance of the Project to the architect prior to issuance of the weather-tightness warranty.
 - Inspections shall be performed at each transition of roof detail encountered for each phase of roofing for the duration of the Project. Each inspection must be conducted by an experienced, full-time employee of the manufacturer with experience in similar inspections over the past two years.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver panels and other components so they will not be damaged or deformed. Package panels for protection against damage during transportation or handling.

- B. Handling: Exercise care in unloading, storing, and erecting wall panels to prevent bending, warping, twisting, and surface damage.
- C. Stack materials on platforms or pallets, covered with a tarpaulin or other suitable weather-tight and ventilated covering. Store panels to ensure dryness. Do not store panels in contact with other material that might cause staining, denting, or other surface damage.

1.07 PROJECT CONDITIONS

- A. Field Measurements: Verify location of structural members and openings in substrates by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the work.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the work, either establish opening dimensions and proceed with fabricating roof, soffit, and wall panels without field measurements or allow for trimming panel units. Coordinate roof and wall construction to ensure actual locations of structural members and to ensure opening dimensions correspond to established dimensions.

1.08 WARRANTY

- A. General Warranty: Special warranties specified in this article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Finish Warranty: Submit a written warranty, signed by manufacturer, covering failure of the factory-applied exterior finish on metal panels within the specified warranty period and agreeing to repair or replace roof and wall panels that show evidence of finish deterioration. Deterioration of finish includes, but is not limited to color fade, chalking, cracking, peeling, and loss of integrity.
- C. Finish Warranty Period: 20 years from date of Substantial Completion.
- D. Special Roof Weather-Tight Warranty: Submit a written warranty executed by the manufacturer agreeing to repair or replace metal roof panel assemblies that fail to remain weather-tight within the specified warranty period. A weather-tight warranty is only available on systems installed by approved applicators, certified by the manufacturer.
- E. Roof Weather-Tight Warranty Period: 20 years from date of Substantial Completion.
- F. Roofing Installer Warranty: Installer shall provide a written warranty for five years from date of final completion and acceptance, guaranteeing materials, workmanship and weathertightness of the roof system, without any cost to the building Owner or manufacturer.

G. Flashing and Trim:

- 1. The Contractor shall provide the Owner with a notarized written warranty assuring that all sheet metal work including caulking and fasteners to be watertight and secure for a period of three years from the date of final acceptance of the building.
- 2. Warranty shall include all materials and workmanship required to repair any leaks that develop.
- 3. Installing Contractor shall be responsible for the installation of the coping system in general accordance with the membrane manufacturer's recommendations.
- 4. Installing Contractor shall certify that the coping system has been installed per the manufacturer's printed details and specifications.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Basis of Design: MBCI Metal Roof and Wall Systems, Division of NCI Group, Inc.; Houston TX. Tel: (877)713-6224; Email: info@mbci.com; Web: www.mbci.com.
- B. Products by other manufacturer's which meet the requirements of this Specification are acceptable.

2.02 PANEL METALS AND FINISHES

- A. Metallic-Coated Steel Sheet Pre-painted with Coil Coating: Steel sheet metallic coated by the hot-dip process and pre-painted by the coil-coating process to comply with ASTM A755 (ASTM A755M) and the following requirements.
 - 1. Steel Sheet: ASTM A653, Steel sheet, G-90 Zinc-coated (galvanized) by the hot dip process; structural quality.
 - 2. Thickness: 24 Gauge thick, unless otherwise indicated.
 - 3. Finish: Apply the following organic coating in thickness indicated. Furnish appropriate air-drying spray finish in matching color for touchup.
 - 4. Fluoropolymer 2-Coat Coating System: Manufacturer's standard 2-coat, thermocured system composed of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70% polyvinylidene fluoride resin by weight with a total minimum dry film thickness of 0.9 mil (0.023 mm) and 30% reflective gloss when tested according to ASTM D523.
 - 5. Color: To be selected by the A/E

2.03 METAL ROOF PANELS

A. Snap Joint, Concealed Fastener, Trapezoidal Seam Metal Roof Panels: Structural metal roof panel consisting of formed metal sheet with raised trapezoidal ribs at panel

edges, installed by lapping and interlocking edges of adjacent panels, and mechanically attaching panels to supports using concealed clips and fasteners in a weathertight installation.

- 1. Basis of Design: MBCI, Ultra-Dek, www.mbci.com/ultradek.html.
- 2. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 92/A 792M, structural quality, Grade 50, Coating Class AZ50, prepainted by the coil-coating process per ASTM A755/A755M.
- 3. Nominal Coated Thickness: 24 gage.
- 4. Panel Surface: Smooth with minor ribs in pan.
- 5. Exterior Finish: Fluoropolymer Two-Coat System: 0.2 0.3 mil primer with 0.7 0.8 mil 70% PVDF fluoropolymer color coat, AAMA 621.
- 6. Concealed Finish: 0.5 mil total dry film thickness consisting of primer coat and wash coat of manufacturer's standard light-colored acrylic or polyester backer finish.
- 7. Color: As selected by Architect from manufacturer's standard colors.
- 8. Panel Width: 24 inches.
- 9. Panel Seam Height: 3 inch.
- 10. Joint Type: Snap joint.

2.04 METAL ROOF PANEL ACCESSORIES

- A. General: Provide complete metal roof panel assembly incorporating trim, fasciae, and miscellaneous flashings, in manufacturer's standard profiles
- B. Provide required fasteners, closure strips, thermal spacers, splice plates, support plates, and sealants as indicated in manufacturer's written instructions.
- C. Flashing and Trim: Match material, thickness, and finish of metal panel face sheet.
- D. Panel Clips: Provide panel clip of type specified, at spacing indicated on approved Shop Drawings.
 - 1. Two-piece Floating: ASTM C645, with ASTM A653/A653M, G90 hot-dip galvanized zinc coating, configured for concealment in panel joints, and identical to clips utilized in tests demonstrating compliance with performance requirements.
 - 2. Single-Piece Fixed: ASTM A980 with zinc electroplated galvanized coating.
- E. Panel Fasteners: Self-tapping screws and other acceptable corrosion-resistant fasteners recommended by roof panel manufacturer. Where exposed fasteners cannot be avoided, supply fasteners with EPDM or neoprene gaskets and heads matching color of metal panels by means of factory-applied coating.
- F. Joint Sealers: Manufacturer's standard or recommended liquid and preformed sealers and tapes, and as follows:
 - 1. Factory-Applied Seam Sealant: Manufacturer's standard hot-melt type.
 - 2. Tape Sealers: Manufacturer's standard non-curing butyl tape, AAMA 809.2.

2.05 FABRICATION

- A. General: Provide factory fabricated and finished metal panels and accessories meeting performance requirements, indicated profiles, and structural requirements.
- B. Fabricate metal panel joints configured to accept factory-applied sealant providing weathertight seal and preventing metal-to-metal contact and minimizing noise resulting from thermal movement.
- C. Form panels in continuous lengths for full length of detailed runs, except where otherwise indicated on approved Shop Drawings.
- D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's written instructions, approved Shop Drawings, and Project Drawings. Form from materials matching metal panel substrate and finish.

2.06 PANEL UNDERLAYMENT

- A. Roof: Ice and Water Barrier recommended by the primary roofing manufacturer:
 - 1. Manufacturer: Imetco's Drydek, basis of design.
 - 2. Self-adhering.
 - 3. Provides protection against freeze/thaw cycles, wind driven rain.
 - 4. 100% SBS modified.
 - 5. Polyester and fiberglass reinforced scrim engineered to tolerate extremely high temperatures (260°F) and withstand thermal expansion and contraction of deck.
 - 6. Meet ASTM D1970 Standards.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements indicated for conditions affecting performance of metal panels.
- B. Panel Supports and Anchorage: Examine substrate to verify that decking, angles, and other secondary structural panel support members and anchorage have been installed to meet requirements of panel manufacturer.
- C. Do not proceed with panel installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Coordinate metal roof panels with all other work; including flashing, trim, and construction of decks, parapets, wall, and other adjoining work to provide a leak proof, secure, and non-corrosive installation.

B. Promptly remove protective film, if any, from exposed surfaces of metal panels. Strip with care to avoid damage to finish.

3.03 PANEL INSTALLATION

- A. General: Comply with panel manufacturer's written instructions and recommendations for installation, as applicable to Project conditions and supporting substrates. Anchor panels and other components of the Work securely in place, with provisions for thermal and structural movement.
- B. Install underlayment under metal panels, unless otherwise recommended by panel manufacturer. Use adhesive for temporary anchorage, where possible to minimize the use of mechanical fasteners under metal panels. Apply from eave to ridge in shingle fashion and lap joints a minimum of 2 inches (50 mm).
- C. Snap-Joint, Trapezoidal Standing Seam Metal Roof Panels: Install weathertight metal panel system in accordance with manufacturer's written instructions, approved Shop Drawings, and Project Drawings. Install metal roof panels in orientation, sizes, and locations indicated, free of waves, warps, buckles, fastening stresses, and distortions. Anchor panels and other components securely in place. Provide for thermal and structural movement.
- D. Attach panels to supports using clips, screws, fasteners, and sealants recommended by manufacturer and indicated on approved Shop Drawings.
 - 1. Fasten metal panels to supports with concealed clips at each location indicated on approved Shop Drawings, with spacing and fasteners recommended by manufacturer.
 - 2. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
 - 3. Provide weatherproof jacks for pipe and conduit penetrating metal panels of types recommended by manufacturer.
 - 4. Dissimilar Materials: Where elements of metal panel system will come into contact with dissimilar materials, treat faces, and edges in contact with dissimilar materials as recommended by manufacturer.

3.04 ACCESSORY INSTALLATION

- A. General: Install metal panel trim, flashing, and accessories using recommended fasteners and joint sealers, with positive anchorage to building, and with weather tight mounting. Provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete metal panel assembly, including trim, copings, flashings, sealants, closure strips, and similar items.
 - 2. Comply with details of assemblies utilized to establish compliance with performance requirements and manufacturer's written installation instructions.
 - 3. Provide concealed fasteners except where noted on approved Shop Drawings.

- 4. Set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently weather resistant.
- B. Joint Sealers: Install joint sealers where indicated and where required for weathertight performance of metal panel assemblies, in accordance with manufacturer's written instructions.
 - 1. Prepare joints and apply sealants per requirements of Division 07 Section "Joint Sealants."

3.05 CLEANING AND PROTECTING

- A. Damaged Units: Replace panels and other components of the Work that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.
- B. Cleaning: Remove temporary protective coverings and strippable films, if any, as soon as each panel is installed. On completion of panel installation, clean finished surfaces as recommended by panel manufacturer and maintain in a clean condition during construction.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit	
5.01	Metal Roofing	Lump Sum	

END OF SECTION

SECTION 07 62 00

SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Flashings, sheet metal work, and related items including, but not limited to:
 - 1. Metal counterflashing at vertical surfaces.
 - 2. Flashing at roof penetrations.
- B. Extent of each type of flashing and sheet metal work is indicated on Drawings and by provisions of this Section.
- C. Finished sheet metalwork will form a weathertight construction without waves, warps, buckles, fastening stresses or distortion, which allows for expansion and contraction. Sheet metal mechanic shall be responsible for cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate the work of other trades. Coordinate installation of sheet metal items used in conjunction with roofing with roofing work to permit continuous roofing operations.
- D. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this Section.
- E. Roofing accessories which are installed integral with roofing membrane are specified in roofing system sections as roofing work.

1.02 RELATED WORK

A. Division 7 - Roofing Systems.

1.03 SUBMITTALS

- A. Product Data, Flashing, Sheet Metal, Accessories: Submit manufacturer's product data, installation instructions, and general recommendations for each specified sheet material, and fabricated product.
- B. Shop Drawings, Flashing, Sheet Metal, Accessories: Submit Shop Drawings showing layout, joining, profiles, and anchorages of fabricated work, including major counter flashings, trim/fascia units, gutters, downspouts, scuppers, and expansion joint systems; layouts at 1/4" scale, details at 3" scale.

1.04 QUALITY ASSURANCE

A. Standards:

- 1. Comply with design and installation methods of SMACNA Architectural Sheet Metal Manual.
- 2. Comply with The NRCA Roofing and Waterproofing Manual installation details.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Packing and Shipping: Deliver materials to site in Manufacturer's original unopened packaging with labels intact.
- B. Storage: Adequately protect against damage while stored at the site.
- C. Handling: Comply with Manufacturer's instructions.

1.06 JOB CONDITIONS

A. Coordinate work of this Section with interfacing and adjoining work for proper sequencing of each installation. Ensure best possible weather resistance and durability of the work and protection of materials and finishes.

PART 2 PRODUCTS

2.01 FLASHING AND SHEET METAL MATERIALS

- A. Sheet Metal Flashing/Trim:
 - 1. Zinc-Coated Steel: Commercial quality with 0.20% copper, ASTM A525 except ASTM A527 for lock-forming, G90 hot-dip galvanized, mill phosphatized where indicated for painting; 0.0359" thick (24 gage) except as otherwise indicated.
 - 2. 24 ga Kynar 500 coated galvanized steel.

2.02 MISCELLANEOUS MATERIALS AND ACCESSORIES

- A. Solder: For use with steel or copper, provide 50 50 tin/lead solder (ASTM B32), with rosin flux.
- B. Fasteners: Same metal as flashing/sheet metal or, other noncorrosive metal as recommended by sheet manufacturer. Match finish of exposed heads with material being fastened.
- C. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.

- D. Elastomeric Sealant: Generic type recommended by manufacturer of metal and fabricator of components being sealed; comply with FS TT-S-0027, TT-S-00230, or TT-S-001543.
- E. Epoxy Seam Sealer: 2-part noncorrosive metal seam cementing compound, recommended by metal manufacturer for exterior/interior nonmoving joints including riveted joints.
- F. Adhesives: Type recommended by flashing sheet manufacturer for waterproof/weather-resistant seaming and adhesive application of flashing sheet.
- G. Metal Accessories: Provide sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of work, matching or compatible with material being installed, noncorrosive, size, and gage required for performance.

2.03 FABRICATION

- A. General Metal Fabrication: Shop-fabricate work to greatest extent possible. Comply with details shown, and with applicable requirements of SMACNA "Architectural Sheet Metal Manual" and other recognized industry practices. Fabricate for waterproof and weather-resistant performance; with expansion provisions for running work, sufficient to permanently prevent leakage, damage or deterioration of the work. Form work to fit substrates. Comply with material manufacturer instructions and recommendations for forming material. Form exposed sheet metal work without excessive oil-canning, buckling, and tool marks, true to line and levels indicated, with exposed edges folded back to form hems.
- B. Seams: Fabricate nonmoving seams in sheet metal with flat-lock seams. For metal other than aluminum, tin edges to be seamed, form seams, and solder. Form aluminum seams with epoxy seam sealer; rivet joints for additional strength where required.
- C. Expansion Provisions: Where lapped or bayonet-type expansion provisions in work cannot be used, or would not be sufficiently water/weatherproof, form expansion joints of intermeshing hooked flanges, not less than 1" deep, filled with mastic sealant (concealed within joints).
- D. Sealant Joints: Where movable, non-expansive type joints are indicated or required for proper performance of work, form metal to provide for proper installation of elastomeric sealant, in compliance with SMACNA standards.
- E. Separations: Provide for separation of metal from noncompatible metal or corrosive substrates by coating concealed surfaces at locations of contact, with bituminous coating or other permanent separation as recommended by manufacturer/fabricator.

PART 3 EXECUTION

3.01 INSTALLATION REQUIREMENTS

A. General: Except as otherwise indicated, comply with manufacturer's installation instructions and recommendations, and with SMACNA "Architectural Sheet Metal Manual." Anchor units of work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams which will be permanently watertight and weatherproof.

B. Eave and Gable Flashings:

- 1. One piece in width, applied in 8 to 10 foot lengths. Provide a 3/4 inch continuous fold in the upper edge of the sheet to engage cleats spaced not more than 10 inch on center.
- 2. Locate the upper edge of flashing not less than 18 inches from the outside face of the building, measured along the roof slope.
- 3. Fold lower edge of the flashing over and loose-lock into a continuous edge strip on the fascia.

C. Flashing at Roof Penetrations and Equipment Supports:

1. Provide metal flashing for all pipes, ducts, and conduits projecting through the roof surface and for equipment supports, guy wire anchors, and similar items supported by or attached to the roof deck.

3.02 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces, removing substrates which might cause corrosion of metal or deterioration of finishes.
- B. Protection: Protect flashings and sheet metal work during construction from damage or deterioration, other than natural weathering, at time of substantial completion.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	<u>Pay Unit</u>
5.01	Sheet Metal Flashing and Trim	Lump Sum

END OF SECTION

SECTION 07 92 00

ELASTOMERIC SEALANTS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Provide elastomeric joint sealants, joint fillers and joint backer materials for complete and durable seal at all locations scheduled herein and as indicated on the Drawings.

1.02 RELATED WORK

- A. Included Elsewhere to be Performed in Compliance with this Section:
 - 1. Division 03: Concrete.
 - 2. Division 04: Masonry.
 - 3. Division 05: Metals.
 - 4. Division 08: Openings.
 - 5. Division 11: Equipment.
 - 6. Division 26: Electrical.
 - 7. Division 32: Exterior Improvements.
- B. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1.03 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM C510 Standard Test Method for Staining and Color Change of Single or Multi-component Joint Sealants.
 - 2. ASTM C719 Standard Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants under Cyclic Movement (Hockman Cycle).
 - 3. ASTM C794 Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants.
 - 4. ASTM C920 Standard Specification for Elastomeric Joint Sealants.
 - 5. ASTM C1087 Standard Test Method for Determining Compatibility of Liquid- Applied Sealants with Accessories Used in Structural Glazing Systems.
 - 6. ASTM C1193 Standard Guide for Use of Joint Sealants.
 - 7. ASTM C1248 Standard Test Method for Staining of Porous Substrate by Joint Sealants.
 - 8. ASTM D412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers Tension.
 - 9. ASTM D679 Methods of Testing and Tolerances for Certain Fine Staple Cotton Gray Goods.
 - 10. ASTM D816 Standard Test Methods for Rubber Cements.

- 11. ASTM D1002 Standard Test Method for Apparent Shear Strength of Single-Lap-Joint Adhesively Bonded Metal Specimens by Tension Loading (Metal-to-Metal).
- 12. ASTM D2203 Standard Test Method for Staining from Sealants.
- 13. ASTM D2240 Standard Test Method for Rubber Property Durometer Hardness

1.04 SUBMITTALS

- A. Comply with pertinent provisions of SUBMITTALS SECTION.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.

C. Test Reports:

- 1. Submit results of laboratory pre-construction testing.
- 2. Submit results of field pre-construction testing.
- 3. Submit manufacturer's recommendations for joint preparation, priming, and joint accessory materials based on test results.
- 4. Submit manufacturer's recommended installation procedure modifications resulting from field adhesion tests.
- D. Selection Samples: For each finish product specified, two complete sets of color charts for each sealant type for initial selection.
- E. Verification Samples: For each finish product specified, two samples, standard cured color samples for each sealant type illustrating selected colors.

F. Manufacturer's Certificate:

- 1. Certify products are suitable for intended use and products meet or exceed specified requirements.
- 2. Certify applicator is approved by manufacturer.

G. Qualifications Data:

1. Submit applicator's qualifications, including reference projects of similar scope and complexity, with current phone numbers and contact names of architects and owners for verification.

H. Manufacturer's Field Reports:

- 1. Indicate time present at Project site.
- 2. Include observations; indicate compliance with manufacturer's installation instructions, and supplemental instructions provided to installers.

I. Operation and Maintenance Data:

- 1. Submit recommended inspection intervals.
- 2. Submit instructions for repairing and replacing failed sealant joints.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company regularly engaged in manufacturing and marketing of products specified in this Section.

B. Applicator Qualifications:

Applicator shall have at least three years' experience in installing materials of types specified and shall have successfully completed at least three projects of similar scope and complexity.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.
- B. Store primers and sealants in cool dry location with ambient temperature range of 60° to 80°F (15° to 27°C).
- C. Handling: Handle materials to avoid damage.

1.07 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.
- B. Optimal application temperature is 32°F (0°C) and rising.
 - 1. Maintain sealant at room temperature before applying. If temperatures are below 32°F (0°C) contact manufacturer's customer service for application guidelines.

1.08 SEQUENCING

- A. Schedule work so waterproofing, water repellents, and preservative finishes are installed after sealants, unless sealant manufacturer approves otherwise in writing.
- B. Ensure sealants are cured before covering with other materials.
- C. Ensure that Work of this Section are supplied to affected trades in time to prevent interruption of construction progress.

1.09 WARRANTY

- A. Provide Manufacturer's signed Standard Limited Warranty, against adhesive and cohesive failure of sealant and against infiltration of water and air through sealed joint for period of 1 year from date of completion.
 - 1. Manufacturer's Standard Warranty covering sealant materials.

2. Defective work shall include, but not be restricted to, joint leakage, cracking, crumbling, melting, running, loss of adhesion, loss of cohesion, or staining of adjoining or adjacent work or surfaces.

PART 2 PRODUCTS

2.01 POLYETHER SEALANTS

- A. Concrete Masonry Sealant for sealing of vertical joints/cracks with a one-component, gun-grade, elastomeric adhesive/sealant.
 - 1. ASTM C920, Type S, Grade NS, Class 35, Use T1, NT, M, A, G and O.
 - 2. Federal Specification TT-S-00230C, Type II, Class B.
 - 3. Conforms to USDA requirements for Non-food Contact.
 - 4. VOC Content: Less than 24 grams / liter ASTM D2369 EPA Method 24 (tested at 240°F / 115°C).
 - 5. Performance Requirements:
 - a. Initial Cure (ASTM D679): 60 minutes
 - b. Properties (ASTM D412) at 21 days: Tensile Stress 145-psi minimum. Elongation at Break 445%.
 - c. Shore A Hardness (ASTM D2240) at 21 days: 21.
 - d. Service Range: -40° to 200° F (-40° to 93° C).
 - e. The sealant shall be non-staining.
- B. Self-Leveling Construction Sealant for sealing of horizontal concrete, curb, and pavement joints. Materials include one-component, low modulus, self-leveling, elastomeric Polyether sealants.
 - 1. ASTM C920, Type S, Grade P, Class 25, Use T2, NT, M.
 - 2. Conforms to USDA requirements for Non-food Contact.
 - 3. VOC Content: Less than 24 grams / liter ASTM D2369 EPA Method 24 (tested at 240°F / 115°C).
 - 4. Performance Requirements:
 - a. Initial Cure (ASTM D679): 120 minutes
 - b. Properties (ASTM D412) at 21 days: Tensile Strength at break: Minimum 120 psi. Elongation at Break Minimum 350%.
 - c. Shore A Hardness (ASTM D2240) at 21 days: 15 +/- 3.
 - d. Adhesion in Peel (ASTM C794).
 - e. Service Range: -40° to 200° F (-40° to 93° C).
 - f. The sealant shall be non-staining. Final Cure: 7 to 10 days.
- C. Moisture curing, polyether sealant designed for application in damp, dry, or cold climates curing in wet or dry climate conditions and at low temperatures (32°F, 0°C). Designed for application on dissimilar materials such as glass, aluminum, steel, masonry, and many engineering plastics such as polycarbonate, vinyl (PVC) and fiberglass (FRP). Recommended for precast concrete, block and masonry, window and door frames, siding and weather sealing.
 - 1. ASTM C920, Type S, Grade NS, Class 25; Uses NT, T2, M, G, A and O.
 - 2. Federal Specification TT-S-00230-C Type II, Class B.

- 3. Corps of Engineers CRD-C-541, Type II, Class B.
- 4. Conforms to USDA Requirements for Non-food Contact.
- 5. VOC Content: Less than 14 grams / liter ASTM D2369 EPA Method 24 (tested at 240°F / 115°C).
- 6. Performance Requirements:
 - a. Initial Cure/Tack Free (ASTM D679): 20 +/- 10 minutes.
 - b. Shrinkage: No visible shrinkage after 14 days.
 - c. Low Temperature Flex (ASTM D816): Pass -10°F (-23°) 1/4 inch (6.4 mm) mandrel.
 - d. Shear Strength (ASTM D1002): 200 psi.
 - e. Properties (ASTM D412) at 21 days: Tensile Strength: 230 psi. Elongation at Break Minimum 400%.
 - f. Shore A Hardness (ASTM D2240) at 21 days: 14 +/- 2.
 - g. Service Range: -40° to 200°F (-40° to 93°C).
 - h. Optimal application temperature 32°F (0°C) and rising. Maintain sealant at room temperature before applying. If temperatures are below 32° F (0°C) contact manufacturer's customer service for application guidelines.

2.02 SILICONE SEALANTS

- A. Single component neutral cure (RTV) silicone, adhesive sealant specifically formulated for applications on metal roofs, gutters, downspouts, and other metal architectural surfaces such as walls, windows, doors and fixtures.
 - 1. ASTM C920, Type S, Grade NS, Class 50; Uses NT, T2, M, G, A and O.
 - 2. Federal Specification TT-S-00230-C Type II, Class A.
 - 3. Corps of Engineers CRD-C-541, Type II, Class A.
 - 4. Conforms to USDA Requirements for Non-food Contact.
 - 5. VOC Content: Less than 33 grams / liter ASTM D2369 EPA Method 24 (tested at 240°F / 115°C).
 - 6. Performance Requirements:
 - a. Initial Cure/Tack Free (ASTM D679): 10 +/- 5 minutes.
 - b. Shrinkage: No visible shrinkage after 14 days.
 - c. Low Temperature Flex (ASTM D816): Pass -10°F (-23°C) 1/4 inch (6.4 mm) mandrel.
 - d. Shear Strength (ASTM D1002): 75 +/-5 psi.
 - e. Properties (ASTM D412) at 21 days: Tensile Strength: 135 psi. Elongation at Break Minimum 600%.
 - f. Shore A Hardness (ASTM D2240) at 21 days: 10 +/- 3.
 - g. Service Range: -80° to 400°F (-62° to 204°C).

2.03 ACCESSORIES

- A. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- B. Primer: Non-staining type, recommended by sealant manufacturer to suit application.

- C. Joint Backing: Round foam rod compatible with sealant; oversized 25 to 50% larger than joint width; recommended by sealant manufacturer to suit application
- D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.
- E. Masking Tape: Non-staining, non-absorbent tape product compatible with joint sealants and adjacent joint surfaces.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify substrate surfaces and joint openings are ready to receive work.
 - 1. Verify joint surfaces are clean and dry.
 - 2. Ensure concrete surfaces are fully cured.
- B. Report unsatisfactory conditions in writing to the Architect.
- C. Do not proceed until unsatisfactory conditions are corrected.

3.02 PREPARATION

- A. Prepare joints in accordance with ASTM C1193 and manufacturer's instructions.
- B. Clean joint surfaces to remove dirt, dust, oils, wax, paints, and other contamination capable of affecting primer and sealant bond.
 - 1. Clean concrete joint surfaces to remove curing agents and form release agents.
- C. Protect elements surrounding the Work of this section from damage or disfiguration. Apply masking tape to adjacent surfaces when required to prevent damage to finishes from sealant installation.

3.03 SEALANT INSTALLATION

- A. Install primer and sealants in accordance with ASTM C1193 and manufacturer's instructions.
- B. Optimal application temperature 32°F and rising. Maintain sealant at room temperature before applying. If temperatures are below 32°F contact manufacturer's customer service for application guidelines.
- C. Install joint backing to maintain the following joint ratios:
 - 1. Joints up to 1/2 inch Wide: 1:1 width to depth ratio.
 - 2. Joints Greater than 1/2 inch Wide: 2:1 width to depth ratio; maximum 1/2 inch joint depth.
- D. Install bond breaker where joint backing is not used.

- E. Apply primer where required for sealant adhesion.
- F. Install sealants immediately after joint preparation.
- G. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- H. Tool exposed joint surface flat.

3.04 UNACCEPTABLE SEALANT USE

- A. Do not install sealants in lieu of other required building enclosure weatherproofing components such as flashing, drainage components, and joint closure accessories; or to close gaps between walls, floors, roofs, windows and doors that exceed acceptable installation tolerances; or to fill gaps where materials have been misfit such as where door frames meet wall base and flooring, around switch plate, and receptacle covers, around light fixture back plates.
- B. Remove sealants that have been applied in an unacceptable manner and correct building enclosure deficiencies.

3.05 CLEANING

A. Remove masking tape. Clean adjacent surfaces soiled by sealant installation.

3.06 INSTALLATION SCHEDULE

- A. Exterior Sealant Joint Applications:
 - 1. Control and expansion joints in cast-in-place concrete.
 - 2. Joints between architectural and structural precast concrete units.
 - 3. Control and expansion joints in unit masonry.
 - 4. Butt joints between metal panels.
 - 5. Joints between different materials listed above.
 - 6. Perimeter joints between materials listed above and frames of doors, windows, storefronts, louvers, and similar openings.
 - 7. Control and expansion joints in overhead surfaces.
 - 8. Other exterior joints in vertical surfaces and non-traffic horizontal surfaces for which no other sealant is specified.
- B. Exterior Sealant Joint Applications:
 - 1. Metal roofs, gutters, downspouts, and other metal architectural surfaces.
- C. Interior Sealant Joint Applications:
 - 1. Control and expansion joints on exposed interior surfaces of exterior walls.
 - 2. Perimeter joints on exposed interior surfaces of exterior openings.
 - 3. Joints on precast beams and planks.
 - 4. Perimeter joints between interior wall surfaces and frames of interior doors, windows, storefronts, louvers, elevator entrances, and similar openings.

- 5. Other interior joints in vertical surfaces and non-traffic horizontal surfaces subject to movement for which no other sealant is specified.
- D. Traffic Sealant Joint Applications:
 - 1. Control, expansion and isolation joints in cast-in-place concrete.
 - 2. Control, expansion and isolation joints in structural precast concrete units.
 - 3. Joints between architectural precast concrete paving units.
 - 4. Joints between different materials listed above.
 - 5. Other interior and exterior traffic bearing joints in horizontal and sloped traffic surfaces
- E. Concealed Bedding Sealant Joint Applications:
 - 1. Bedding joints under metal thresholds and saddles.
 - 2. Bedding joints between sheet metal flashing and other materials.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
5.01	Elastomeric Sealants	Lump Sum

END OF SECTION

SECTION 08 11 00

METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish metal doors and frames as specified and shown on plans and schedules for Flush Design Steel Doors

1.02 RELATED WORK

- A. Division 07: Elastomeric Sealants
- B. Division 08:
 - 1. Section 08 71 00 Finish Hardware
- C. Division 09: Painting

1.03 REFERENCE STANDARDS

A. SDI Standards:

- 1. SDI-106-1999 Recommended Standard Door Type Nomenclature
- 2. SDI-108-1999 Recommended Selection and Usage Guide for Standard Steel Doors
- 3. SDI-111-2000 Recommended Details and Guidelines for Standard Steel Doors, Frames, and Accessories
- 4. SDI-112-1997 Zinc-Coated (Galvanized/Galvannealed) Standard Steel Doors and Frames
- 5. SDI-117-2000 Manufacturing Tolerances for Standard Steel Doors and Frames
- 6. SDI-118-2002 Basic Fire Door Requirements
- 7. SDI-124-1998 Maintenance of Standard Steel Doors and Frames

B. ANSI Standards:

- 1. ANSI/UL 1784-2001 Air Leakage Test of Door Assemblies
- 2. ANSI/SDI A250.3-1999 Test Procedure and Acceptance Criteria for Factory Applied Finish Painted Steel Surfaces for Steel Doors and Frames
- 3. ANSI/SDI A250.4-2001 Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frame Anchors and Hardware Reinforcings
- 4. ANSI/SDI A250.6-1997 Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames
- 5. ANSI/SDI A250.7-1997 Nomenclature for Standard Steel Doors and Steel Frames
- 6. ANSI/SDI A250.10-1998 Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames

- 7. ANSI/SDI A250.11-2001 Recommended Erection Instructions for Steel Frames (Formerly SDI-105)
- 8. A115 Hardware Preparation in Steel Doors and Steel Frames
- 9. A115.IG Installation Guide for Doors and Hardware

C. ASTM Standards:

- 1. ASTM A1008-2003 Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
- 2. ASTM A568-2003 Standard Specification for Steel Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for
- 3. ASTM A1011-2001 Standard Specification for Steel Sheet and Strip, Hot-Rolled, Car-bon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
- 4. ASTM A591-1998 Standard Specification for Steel Sheet, Electrolytic Zinc-Coated, for Light Coating Weight [Mass] Applications
- 5. ASTM A653-2002 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
- 6. ASTM A924-1999 Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

1.04 QUALITY ASSURANCE

- A. Manufacturer shall meet or exceed all standards as noted in Materials Section 2.01 references.
- B. No product shall be manufactured prior to receipt of approved hardware schedule and templates.

1.05 SUBMITTALS

- A. Submit shop drawings indicating each type of:
 - 1. Door
 - 2. Frame
 - 3. Core material
 - 4. Material thickness
 - 5. Mortises
 - 6. Reinforcements
 - 7. Anchorages
 - 8. Locations of exposed fasteners
 - 9. Arrangement of standard hardware

B. Submit Schedule:

- 1. Identify each unit with door and window marks and numbers.
- 2. Relate numbers to Architect's door and window schedules.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Products shall be marked with architects opening number on all doors, frames, misc. parts and cartons.
- B. All doors and frames shall be stored vertically under cover. The units shall be placed on at least 4" high wood sills or in a manner that will prevent rust or damage.
- C. ANSI/SDI A250.8-200317The use of non-vented plastic or canvas shelters that can create a humidity chamber shall be avoided.
- D. A 1/4" space between the doors shall be provided to promote air circulation. If the wrapper on the door becomes wet, it must be removed immediately.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Steels used to manufacture doors, frames, anchors, and accessories shall meet at least one or more of the following requirements:
 - 1. Cold rolled steel shall conform to ASTM designations A1008, "Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability" and A568, "Standard Specification for Steel Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for."
 - 2. Hot rolled, pickled and oiled steel shall comply with ASTM designations A1011, "Standard Specification for Steel Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability" and A568, "Standard Specification for Steel Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for."
 - 3. Hot dipped zinc coated steel shall be of the alloyed type and comply with ASTM designations A924, "Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process" and A653, "Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process."
- B. Thermal-Rated Insulating Assemblies: Provide at exterior locations and elsewhere as scheduled on Drawings, assembly with u-factor of 0.70 max.

2.02 FRAMES

- A. Exterior frames shall be 16 gauge full profile welded type construction.
- B. Finish: Factory primed, for field finishing.

- C. Provide frames with a minimum of three anchors per jamb suitable for the adjoining wall construction. Provide anchors of not less than 0.042" in thickness or 0.167" diameter wire. Frames over 7'-6" shall be provided with an additional anchor per jamb.
- D. Base anchors shall be provided with minimum thickness of 0.042".
- E. Welding shall conform to ANSI/AWS-101-94: Welded joints shall be ground to a smooth uniform finish.
- F. Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.

2.03 DOORS

- A. Doors shall be of types indicated on the Drawings.
- B. Full Flush Door Faces: Each door face shall be formed from a single sheet of steel with no visible seams on the surface to the faces. A full height vertical seam shall be permitted on the door edges.
- C. Exterior Doors: Level 3, Extra Heavy Duty, 16 gauge, 1-3/4" thick, model 1, full flush design
- D. Core: Mineral fiberboard.
- E. Door construction per ANSI/SDI A250.8-200319E
- F. End closure: The top and bottom of the doors shall be closed with inverted channels or closures. The channels or closures shall have a minimum material thickness of 0.042"
- G. Door edge design: shall be in accordance with ANSI/SDI A250.8, "SDI-100, Recommended Specifications for Standard Steel Doors and Frames", Section 2.3.1.3.

2.04 HARDWARE PREPARATION

- A. Mortise, reinforce drill and tap doors and frames as required for mortised hardware furnished under Division 08 Sections, Finish Hardware in accordance with a final approved hardware schedule and templates provided by the hardware supplier.
- B. Minimum hardware reinforcing gages shall comply with Table 4 of ANSI/SDI A250.8, "SDI-100, Recommended Specifications for Standard Steel Doors and Frames".
- C. Follow SDI 127C for Frame cutout limits.
- D. Obtain templates from hardware and security suppliers.

E. Drilling and tapping for surface door closers, door closer brackets, and adjusters shall be done in the field by the installer.

2.05 FINISH

- A. Doors and frames shall be leveled and ground smooth.
- B. Apply mineral filler to eliminate weld scars and other blemishes
- C. Prime Finish:
 - 1. Doors and frames shall be thoroughly cleaned, and chemically treated to insure maximum paint adhesion.
 - 2. All surfaces of the door and frame exposed to view shall receive a factory applied coat of rust inhibiting primer, either air-dried or baked-on.
 - 3. The finish shall meet the requirements for acceptance stated in ANSI/SDI A250.10 "Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames."

2.06 DESIGN CLEARANCES

- A. The clearance between the door and frame head and jambs shall be 1/8" in the case of both single swing and pairs of doors.
- B. The clearance between the meeting edges of pairs of doors shall be 1/8" to 1/4" for fire rated doors 1/8" $\pm 1/16$ ".
- C. The clearance at the bottom shall be 3/4".
- D. The clearance between the face of the door and door stop shall be 1/16" to 1/8".
- E. All clearances shall be, unless otherwise specified, subject to a tolerance of $\pm 1/32$ ".

PART 3 EXECUTION

3.01 INSTALLATION

- A. Verify that rough openings are no less than 3/16" larger on all three sides than the intended overall frame size.
- B. Frames shall be installed plumb, level, rigid and in true alignment as recommended in ANSI/SDI A250.11, "Recommended Erection Instructions for Steel Frames" and A115.IG, "Installation Guide for Doors and Hardware".
- C. Frames shall be fastened to the adjacent structure so as to retain their position and stability. Dry-wall slip-on frames shall be installed in prepared wall openings in accordance with manufacturer's instructions.
- D. Anchor bottoms of frames with expansion bolts or powder-actuated fasteners. Build in or secure wall anchors to adjoining construction.

- E. Doors shall be adjusted to maintain perimeter clearances as specified. Shimming shall be performed by the installer as needed to assure the proper clearances are achieved.
- F. Installation of hardware items shall be in accordance with the hardware manufacturer's recommendations and templates. A115.IG, "Installation Guide for Doors and Hardware" and ANSI/SDI A250.6, "Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames" shall be consulted for other pertinent information.
- G. Contractor shall seal around frames in place with tested and approved elastomeric sealant per Section 07 92 00 Elastomeric Sealants.

3.02 PRIME COAT TOUCH-UP

- A. Immediately after erection, areas where prime coat has been damaged shall be sanded smooth and touched up with same primer as applied at shop.
- B. Remove rust before above specified touch-up is applied.
- C. Touch-up shall not be obvious.

3.03 PROTECTION

A. Protect installed work against damage from other construction work.

3.04 SCHEDULE

A. As indicated on Drawings.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
5.01	Metal Doors and Frames	Lump Sum

END OF SECTION

SECTION 08 31 13

ACCESS DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnishing and installing factory-fabricated architectural grade access doors for walls and ceilings.

1.02 SUBMITTALS

- A. Product Data: Submit manufacturer's product data.
- B. Shop Drawings:
 - 1. Door and panel units: Show types, thickness of metals, full size profiles of door members.
 - 2. Hardware: Show materials, finishes, locations of fasteners, types of fasteners, locations, and types of operating hardware, and details of installation.
 - 3. General: Show connections of units and hardware to other Work.
- C. Warranty: Submit executed copy of Manufacturer's Standard Warranty.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle door and frame unit in a manner to prevent damage and deterioration.
- B. Follow special storage and handling requirements of the manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with requirements manufacturers whose products may be incorporated into the work include, but are not limited to, the following:
 - 1. Acudoor Products, Inc.
 - 2. Milcor Incorporated.
 - 3. JL Industries.
 - 4. Nystrom.

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2.02 MATERIALS

- A. Wall/ceiling access door and frame unit shall be: Non-Rated General Purpose Access Door.
 - 1. Face of door flush with frame: With concealed flange for gypsum board installation and concealed hinge.
 - 2. 16 ga steel mounting frame with drywall bead.
 - 3. 16 ga. steel door flush to edge of frame.
 - 4. Locations: Gypsum Board Ceiling.
 - 5. Door Size: 24" x 24".
 - 6. Finish: Paintable White; powder-coat.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

3.03 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
5.01	Access Doors and Frames	Lump Sum

END OF SECTION

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SECTION 08 33 23

OVERHEAD COILING DOORS

PART 1 GENERAL

1.01 SUMMARY

- A. The work of this Section includes rolling doors.
- B. Related Sections: Other Specification Sections which directly relate to the work of this Section include, but are not limited to, the following:
 - 1. Division 8: Finish Hardware; key cylinders for locks.

1.02 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each type of rolling door. Include both published data and any specific data prepared for this Project.
- B. Shop Drawings: Submit Shop Drawing for approval prior to fabrication. Include detailed plans, elevations, and details of framing members, required clearances, anchors, and accessories. Include relationship with adjacent materials.
- C. Samples: Manufacturer's standard range of finish colors from which A/E will make a selection.

1.03 QUALITY ASSURANCE

- A. Manufacturer: Rolling doors shall be manufactured by a firm with a minimum of five years' experience in the fabrication and installation of rolling doors.
- B. Installer: Installation of rolling doors shall be performed by the authorized representative of the manufacturer.
- C. Single-Source Responsibility: Provide doors, guides, motors, and related primary components from one manufacturer for each type of door. Provide secondary components from source acceptable to manufacturer of primary components.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials and products in labeled protective packages.
- B. Store and handle in strict compliance with manufacturers instructions and recommendations.

C. Protect from damage from weather, excessive temperatures, and construction operations.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers': Subject to compliance with requirements, manufacturer's offering products which may be incorporated in the work include, but are not limited to, those listed.
 - 1. The Cookson Company, Inc.; 2417 S. 50th Avenue, Phoenix, Arizona 85043; Telephone: 602-272-4244; Fax: 866-448-6798.
 - 2. Overhead Door Corporation, Dallas, Texas; Telephone 800-887-3667 or 972-233-6611; Fax 972-233-0367.
 - 3. McKeon Rolling Steel Door Company, Inc; 95 29th Street, Brooklyn, New York Telephone 800-266-9392 or 718-965-0700; Fax 718-768-3406.

2.02 ROLLING DOORS

- A. Insulated heavy-duty rolling doors for maximum standard openings up to 30' width x 28' height:
 - 1. Curtain: Interlocking roll-formed flat slats as specified following. Endlocks shall be attached to each end of alternate slats to prevent lateral movement.
 - a. Fabricate front slat of 22 gauge galvanized steel. Back slat shall be 24 gauge galvanized steel.
 - b. Cavity shall be filled with CFC-free foamed-in-place, polyurethane insulation.
 - 2. Weatherseals: Vinyl bottom seal, exterior guide, and internal hood seals.

B. Finish:

- 1. Non-galvanized exposed ferrous surfaces shall receive one coat of rust-inhibitive primer.
- 2. Galvanized Steel: Slats and hood shall be galvanized steel in accordance with ASTM A653 and receive rust-inhibitive, roll coating process, including:
 - a. 0.2 mils thick baked-on prime paint with powder coated finish in color as selected by A/E from manufacturer's standard colors.
- C. Windload Design: 20 PSF.
- D. Bottom Bar: Two galvanized steel angles not less than 1" x 1" x 1/8" thick bolted back to back to reinforce curtain in the guides.
- E. Guides: Three structural steel angles with minimum thickness of 3/16":
 - 1. Guides shall be weatherstripped with a vinyl weather seal at each jamb, on the exterior curtain side and interior curtain side.
- F. Brackets: Steel plate to support counterbalance, curtain, and hood.

- G. Counterbalance: Helical torsion spring type housed in a steel tube or pipe barrel, supporting the curtain with deflection limited to 0.03" per foot of span. Counterbalance shall be adjustable by means of an adjusting tension wheel.
- H. Hood: Galvanized steel, 24 gauge with intermediate supports as required.
 - 1. Hood shall be equipped with internal baffle weatherseal.

2.03 OPERATION

- A. Manual Operation:
 - 1. Manual push up chain hoist for doors up to 100 sq.ft.
 - 2. Chain hoist crank operation for doors over 100 sq.ft.
- B. Locking:
 - 1. Interior bottom bar slide bolt.
 - 2. Chain keeper locks for chain hoist operation.
- C. Wall Mounting Condition: As detailed on the Drawings.

PART 3 EXECUTION

3.01 PREPARATION

A. Take field dimension and examine conditions of substrates, supports, and other conditions under which this work is to be performed. Do not proceed with work until unsatisfactory conditions are corrected.

3.02 INSTALLATION

- A. Strictly comply with manufacturer's installation instructions and recommendations. Coordinate installation with adjacent work to ensure proper clearances and allow for maintenance.
- B. Instruct Owners personnel in proper operating procedures and maintenance schedule.

3.03 ADJUSTING AND CLEANING

- A. Test rolling doors for proper operation and adjust as necessary to provide proper operation without binding or distortion.
- B. Touch-up damaged coatings, finishes, and repair minor damage. Clean exposed surfaces using non-abrasive materials and methods recommended by manufacturer of material or product being cleaned.

3.04 SCHEDULE

A. As shown on Drawings.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
5.01	Overhead Coiling Doors	Lump Sum

END OF SECTION

SECTION 08 71 00

DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY:

- A. Section Includes: Finish Hardware for door openings, except as otherwise specified herein.
 - Door hardware for steel (hollow metal) doors.
 - 2. Keyed cylinders as indicated.
- B. Related Sections:
 - 1. Division 4: Concrete Masonry.
 - 2. Division 8: Hollow Metal Doors and Frames.
- C. References: Comply with applicable requirements of the following standards. Where these standards conflict with other specific requirements, the most restrictive shall govern.
 - 1. Builders Hardware Manufacturing Association (BHMA)
 - 2. NFPA 101 Life Safety Code
 - 3. ANSI-A156.xx- Various Performance Standards for Finish Hardware
 - 4. DHI /ANSI A115.IG Installation Guide for Doors and Hardware
 - 5. ICC International Building Code

D. Intent of Hardware Groups

- 1. Should items of hardware not definitely specified be required for completion of the Work, furnish such items of type and quality comparable to adjacent hardware and appropriate for service required.
- Where items of hardware aren't definitely or correctly specified, are required for completion of the Work, a written statement of such omission, error, or other discrepancy to be submitted to Architect, prior to date specified for receipt of bids for clarification by addendum; or, furnish such items in the type and quality established by this specification, and appropriate to the service intended.

1.2 SUBSTITUTIONS:

A. Comply with Division 1.

1.3 SUBMITTALS:

- A. Comply with Division 1.
- B. Special Submittal Requirements: Combine submittals of this Section with Sections listed below to ensure the "design intent" of the system/assembly is understood and can be reviewed together.

- C. Product Data: Manufacturer's specifications and technical data including the following:
 - 1. Detailed specification of construction and fabrication.
 - 2. Manufacturer's installation instructions.
 - 3. Submit catalog cuts with hardware schedule.
- D. Shop Drawings Hardware Schedule: Submit 6 complete reproducible copy of detailed hardware schedule in a vertical format.
 - 1. List groups and suffixes in proper sequence.
 - 2. Completely describe door and list architectural door number.
 - 3. Manufacturer, product name, and catalog number.
 - 4. Function, type, and style.
 - 5. Size and finish of each item.
 - 6. Mounting heights.
 - 7. Explanation of abbreviations and symbols used within schedule.
- E. Templates: Submit templates and "reviewed Hardware Schedule" to door and frame supplier and others as applicable to enable proper and accurate sizing and locations of cutouts and reinforcing.
 - 1. Templates, wiring diagrams and "reviewed Hardware Schedule" of electrical terms to electrical for coordination and verification of voltages and locations.
- F. Samples: (If requested by the Architect)
 - 1. 1 sample of Lever and Rose/Escutcheon design, (pair).
 - 2. 3 samples of metal finishes
- G. Contract Closeout Submittals: Comply with Division 1 including specific requirements indicated.
 - Operating and maintenance manuals: Submit sets containing the following.
 - a. Complete information in care, maintenance, and adjustment, and data on repair and replacement parts, and information on preservation of finishes.
 - b. Catalog pages for each product.
 - c. Name, address, and phone number of local representative for each manufacturer.
 - d. Parts list for each product.
 - 2. Copy of final hardware schedule, edited to reflect, "As installed".
 - 3. Copy of final keying schedule
 - One set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

1.4 QUALITY ASSURANCE

- A. Comply with Division 1.
 - 1. Statement of qualification for distributor and installers.
 - 2. Statement of compliance with regulatory requirements and single source responsibility.

- 3. Distributor's Qualifications: Firm with 3 years experience in the distribution of commercial hardware.
 - a. Distributor to employ full time Architectural Hardware Consultants (AHC) for the purpose of scheduling and coordinating hardware and establishing keying schedule.
 - b. Hardware Schedule shall be prepared and signed by an AHC.
- 4. Installer's Qualifications: Firm with 3 years experienced in installation of similar hardware to that required for this Project, including specific requirements indicated.
- 5. Regulatory Label Requirements: Provide testing agency label or stamp on hardware for labeled openings.
- 6. Single Source Responsibility: Except where specified in hardware schedule, furnish products of only one manufacturer for each type of hardware.
- B. Review Project for extent of finish hardware required to complete the Work. Where there is a conflict between these Specifications and the existing hardware, notify the Architect in writing and furnish hardware in compliance with the Specification unless otherwise directed in writing by the Architect.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packing and Shipping: Comply with Division 1.
 - 1. Deliver products in original unopened packaging with legible manufacturer's identification.
 - 2. Package hardware to prevent damage during transit and storage.
 - 3. Mark hardware to correspond with "reviewed hardware schedule".
 - 4. Deliver hardware to door and frame manufacturer upon request.
- B. Storage and Protection: Comply with manufacturer's recommendations.

1.6 PROJECT CONDITIONS:

- A. Coordinate hardware with other work. Furnish hardware items of proper design for use on doors and frames of the thickness, profile, swing, security and similar requirements indicated, as necessary for the proper installation and function, regardless of omissions or conflicts in the information on the Contract Documents.
- B. Review Shop Drawings for doors and entrances to confirm that adequate provisions will be made for the proper installation of hardware.

1.7 WARRANTY:

- A. Refer to Conditions of the Contract
- B. Manufacturer's Warranty:

1. Closers: 10 Years

2. Exit Devices: Lifetime

3. Locksets & Cylinders: Lifetime

4. All other Hardware: Two years.

1.8 OWNER'S INSTRUCTION:

A. Instruct Owner's personnel in operation and maintenance of hardware units.

1.9 MAINTENANCE:

- A. Extra Service Materials: Deliver to Owner extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Division 1 Closeout Submittals Section.
 - 1. Special Tools: Provide special wrenches and tools applicable to each different or special hardware component.
 - 2. Maintenance Tools: Provide maintenance tools and accessories supplied by hardware component manufacturer.
 - 3. Delivery, Storage and Protection: Comply with Owner's requirements for delivery, storage and protection of extra service materials.
- B. Maintenance Service: Submit for Owner's consideration maintenance service agreement for electronic products installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. The following manufacturers are approved subject to compliance with requirements of the Contract Documents. Approval of manufacturers other than those listed shall be in accordance with Division 1.

<u>ltem</u> :	Scheduled Manufacturer:	<u>Approved</u> :
Hinges	Stanley	Bommer, McKinney, Hager
Continuous Hinges	Stanley	Select, ABH
Locksets	Stanley	Best, Sargent, Schlage
Cylinders	Best	No Substitution
Closers	Stanley	Norton, Sargent
Protection Plates	Trimco	Hager, Burns
Overhead Stops	ABH	Rixson, Glynn Johnson
Door Stops	Trimco	Hager, Burns
Flush Bolts	Trimco	ABH, Burns
Coordinator & Brackets	Trimco	ABH, Burns
Threshold & Gasketing	National Guard	Zero, Reese, Pemko

2.2 MATERIALS:

- A. Hinges: Shall be Five Knuckle Ball bearing hinges
 - 1. Template screw hole locations
 - 2. Bearings are to be fully hardened.
 - 3. Bearing shell is to be consistent shape with barrel.
 - 4. Minimum of 2 permanently lubricated non-detachable bearings on standard weight hinge and 4 permanently lubricated bearing on heavy weight hinges.
 - 5. Equip with easily seated, non-rising pins.
 - 6. Non Removable Pin screws shall be slotted stainless steel screws.
 - 7. Hinges shall be full polished, front, back and barrel.
 - 8. Hinge pin is to be fully plated.
 - 9. Bearing assembly is to be installed after plating.
 - 10. Sufficient size to allow 180-degree swing of door
 - 11. Furnish five knuckles with flush ball bearings
 - 12. Provide hinge type as listed in schedule.

- 13. Furnish 3 hinges per leaf to 7 foot 6 inch height. Add one for each additional 30 inches in height or fraction thereof.
- 14. Tested and approved by BHMA for all applicable ANSI Standards for type, size, function and finish
- 15. UL10C listed for Fire rated doors.

B. Cylindrical Type Locks and Latchsets:

- 1. Tested and approved by BHMA for ANSI A156.2, Series 4000, Operational Grade 1, Extra-Heavy Duty, and be UL10C listed.
- 2. Provide 9001-Quality Management and 14001-Environmental Management.
- 3. Fit modified ANSI A115.2 door preparation.
- Locksets and cores to be of the same manufacturer to maintain complete lockset warranty
- 5. Locksets to have anti-rotational studs that are thru-bolted
- 6. Keyed lever shall not have exposed "keeper" hole
- 7. Each lever to have independent spring mechanism controlling it
- 8. 2-3/4 inch (70 mm) backset
- 9. 9/16 inch (14 mm) throw latchbolt
- 10. Provide sufficient curved strike lip to protect door trim
- 11. Outside lever sleeve to be seamless, of one-piece construction made of a hardened steel allov
- 12. Keyed lever to be removable only after core is removed, by authorized control key
- 13. Provide locksets with 7-pin removable and interchangeable core cylinders
- 14. Hub, side plate, shrouded rose, locking pin to be a one-piece casting with a shrouded locking lug.
- 15. Locksets outside locked lever must withstand minimum 1400 inch pounds of torque. In excess of that, a replaceable part will shear. Key from outside and inside lever will still operate lockset.
- 16. Core face must be the same finish as the lockset.
- 17. Functions and design as indicated in the hardware groups.

C. Cylinders:

- 1. Provide the necessary cylinder housings, collars, rings & springs as recommended by the manufacturer for proper installation.
- 2. Provide the proper cylinder cams or tail piece as required to operate all locksets and other keyed hardware items listed in the hardware sets.
- 3. Coordinate and provide as required for related sections.

D. Door Closers shall:

- 1. Tested and approved by BHMA for ANSI 156.4, Grade 1
- 2. UL10C certified
- 3. Provide 9001-Quality Management and 14001-Environmental Management.
- 4. Closer shall have extra-duty arms and knuckles
- 5. Conform to ANSI 117.1
- 6. Maximum 2 7/16 inch case projection with non-ferrous cover
- 7. Separate adjusting valves for closing and latching speed, and backcheck
- 8. Provide adapter plates, shim spacers and blade stop spacers as required by frame and door conditions
- 9. Full rack and pinion type closer with 1½" minimum bore
- 10. Mount closers on non-public side of door, unless otherwise noted in specification
- 11. Closers shall be non-handed, non-sized and multi-sized.

- E. Door Stops: Provide a dome floor or wall stop for every opening as listed in the hardware sets.
 - 1. Wall stop and floor stop shall be wrought bronze, brass or stainless steel.
 - 2. Provide fastener suitable for wall construction.
 - 3. Coordinate reinforcement of walls where wall stop is specified.
 - 4. Provide dome stops where wall stops are not practical. Provide spacers or carpet riser for floor conditions encountered
- F. Over Head Stops: Provide a Surface mounted or concealed overhead when a floor or wall stop cannot be used or when listed in the hardware set.
 - Concealed overhead stops shall be heavy duty bronze or stainless steel.
 - 2. Surface overhead stops shall be heavy duty bronze or stainless steel.
- G. Kickplates: Provide with four beveled edges ANSI J102, 10 inches high by width less 2 inches on single doors and 1 inch on pairs of doors. Furnish oval-head countersunk screws to match finish.
- H. Door Bolts: Flush bolts for wood or metal doors.
 - Provide a set of Automatic bolts, Certified ANSI/BHMA 156.3 Type 25 for hollow metal label doors.
 - Provide a set of Automatic bolts, Certified ANSI/BHMA 156.3 Type 27 at wood label doors.
 - 3. Manual flush bolts, Certified ANSI/BHMA 156.16 at openings where allowed local authority.
 - 4. Provide Dust Proof Strike, Certified ANSI/BHMA 156.16 at doors with flush bolts without thresholds.
- I. Coordinator and Brackets: Provide a surface mounted coordinator when automatic bolts are used in the hardware set.
 - 1. Coordinator, Certified ANSI/BHMA A1156.3 Type 21A for full width of the opening.
 - 2. Provide mounting brackets for soffit applied hardware.
 - 3. Provide hardware preparation (cutouts) for latches as necessary.
- J. Seals: All seals shall be finished to match adjacent frame color. Seals shall be furnished as listed in schedule. Material shall be UL listed for labeled openings.
- K. Weatherstripping: Provide at head and jambs only those units where resilient or flexible seal strip is easily replaceable. Where bar-type weatherstrip is used with parallel arm mounted closers install weatherstrip first.
 - Weatherstrip shall be resilient seal of (Neoprene, Polyurethane, Vinyl, Pile, Nylon Brush, Silicone).
 - 2. UL10C Positive Pressure rated seal set when required.
- Door Bottoms/Sweeps: Surface mounted or concealed door bottom where listed in the hardware sets.
 - 1. Door seal shall be resilient seal of (Neoprene, Polyurethane, Nylon Brush, Silicone)
 - 2. UL10C Positive Pressure rated seal set when required.

M. Thresholds: Thresholds shall be aluminum beveled type with maximum height of 1/2" for conformance with ADA requirements. Furnish as specified and per details. Provide fasteners and screws suitable for floor conditions.

2.3 FINISH:

- A. Designations used in Schedule of Finish Hardware 3.05, and elsewhere to indicate hardware finishes are those listed in ANSI/BHMA A156.18 including coordination with traditional U.S. finishes shown by certain manufacturers for their products
- B. Powder coat door closers to match other hardware, unless otherwise noted.
- C. Aluminum items shall be finished to match predominant adjacent material. Seals to coordinate with frame color.

2.4 KEYS AND KEYING:

- A. Provide keyed brass construction cores and keys during the construction period. Construction control and operating keys and core shall not be part of the Owner's permanent keying system or furnished in the same keyway (or key section) as the Owner's permanent keying system. Permanent cores and keys (prepared according to the accepted keying schedule) will be furnished to the Owner.
- B. Cylinders, removable and interchangeable core system: Patented 7-pin.
- C. Permanent keys and cores: Stamped with the applicable key mark for identification. These visual key control marks or codes will not include the actual key cuts. Permanent keys will also be stamped "Do Not Duplicate."
- D. Transmit Grand Masterkeys, Masterkeys and other Security keys to Owner by Registered Mail, return receipt requested.
- E. Furnish keys in the following quantities:
 - 1. 1 each Grand Masterkeys
 - 2. 4 each Masterkeys
 - 3. 2 each Change keys each keyed core
 - 4. 15 each Construction masterkeys
 - 5. 1 each Control keys
- F. The Owner, or the Owner's agent, will install permanent cores and return the construction cores to the Hardware Supplier. Construction cores and keys remain the property of the Hardware Supplier.
- G. Keying Schedule: Arrange for a keying meeting, and programming meeting with Architect Owner and hardware supplier, and other involved parties to ensure locksets and locking hardware, are functionally correct and keying and programming complies with project requirements. Furnish 3 typed copies of keying and programming schedule to Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of conditions: Examine doors, frames, related items and conditions under which Work is to be performed and identify conditions detrimental to proper and or timely completion.
 - 1. Do not proceed until unsatisfactory conditions have been corrected.

3.2 HARDWARE LOCATIONS:

- A. Mount hardware units at heights indicated in the following publications except as specifically indicated or required to comply with the governing regulations.
 - 1. Recommended Locations for Builder's Hardware for Standard Steel Doors and Frames, by the Door and Hardware Institute (DHI).
 - 2. Recommended locations for Architectural Hardware for flush wood doors (DHI).
 - 3. WDMA Industry Standard I.S.-1A-04, Industry Standard for Architectural wood flush doors.

3.3 INSTALLATION:

- A. Install each hardware item per manufacturer's instructions and recommendations. Do not install surface mounted items until finishes have been completed on the substrate. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- B. Conform to local governing agency security ordinance.
- C. Install Conforming to ICC/ANSI A117.1 Accessible and Usable Building and Facilities.
 - 1. Adjust door closer sweep periods so that from the open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the landing side of the door.
- D. Installed hardware using the manufacturers fasteners provided. Drill and tap all screw holes located in metallic materials. Do not use "Riv-Nuts" or similar products.

3.4 FIELD QUALITY CONTROL AND FINAL ADJUSTMENT

- A. Contractor/Installers, Field Services: After installation is complete, contractor shall inspect the completed door openings on site to verify installation of hardware is complete and properly adjusted, in accordance with both the Contract Documents and final shop drawings.
 - 1. Check and adjust closers to ensure proper operation.
 - 2. Check latchset, lockset, and exit devices are properly installed and adjusted to ensure proper operation.
 - a. Verify levers are free from binding.
 - b. Ensure latchbolts and dead bolts are engaged into strike and hardware is functioning.
 - 3. Report findings, in writing, to architect indicating that all hardware is installed and functioning properly. Include recommendations outlining corrective actions for improperly functioning hardware if required.

Manufacturer List

<u>Code</u>	<u>Name</u>
NA	National Guard
SD	Stanley Door Closers
SH	Stanley Commercial Hardware
ST	Stanley
TR	Trimco

Finish List

Code	<u>Description</u>
AL	Aluminum
PC	Prime Coat
PCA	Powder Coat Aluminum
626	Satin Chromium Plated
628	Satin Aluminum, Clear Anodized
630	Satin Stainless Steel
689	Aluminum Painted
BLACK	Black
US32D	Stainless Steel, Dull

Option List

Code	<u>Description</u>
BF	BF Keyway (SFIC)
M5	Galvanized Steel Chain
FS4	2 3/4 BS - 3/4" Throw - Sq.Crn.
LBR	Less Bottom Rod
478S	4 7/8" ANSI Strike
CSK	Counter Sunk Screw Holes

Hardware Sets

SET #1

Doors: #101

Hinges	FBB191 4 1/2 X 4 1/2 NRP	US32D	ST
Set Auto Flush Bolts	3810 X 3810	626	TR
Lockset	QCL171 E 478S BF FS4	626	SH
Coordinator	3094B2	PC	TR
Door Closer Cush Stop	CLD-4551 CS AVB SRI	PCA	SD
Kick Plate	KO050 10" X 1"LDW B4E CSK	630	TR
Mounting Bracket	3095	BLACK	TR
	158NA x Door Height		NA
Gasketing Set	160VA Head & Jambs		NA
Drip Cap	16A x 4" ODW		NA
Door Sweep	200NA x Door Width		NA
Handicap Threshold	513A x Opening Width	AL	Ν
	Hinges Set Auto Flush Bolts Lockset Coordinator Door Closer Cush Stop Kick Plate Mounting Bracket Astragal Gasketing Set Drip Cap Door Sweep Handicap Threshold	Set Auto Flush Bolts Lockset QCL171 E 478S BF FS4 Coordinator 3094B2 Door Closer Cush Stop Kick Plate KO050 10" X 1"LDW B4E CSK Mounting Bracket Astragal Gasketing Set Drip Cap Door Sweep 3810 X 3810 QCL171 E 478S BF FS4 CCLD-4551 CS AVB SRI KO050 10" X 1"LDW B4E CSK MOUNTING Bracket 158NA x Door Height 160VA Head & Jambs 160 X 4" ODW 200NA x Door Width	Set Auto Flush Bolts 3810 X 3810 626 Lockset QCL171 E 478S BF FS4 626 Coordinator 3094B2 PC Door Closer Cush Stop CLD-4551 CS AVB SRI PCA Kick Plate KO050 10" X 1"LDW B4E CSK 630 Mounting Bracket 3095 BLACK Astragal 158NA x Door Height Gasketing Set 160VA Head & Jambs Drip Cap 16A x 4" ODW Door Sweep 200NA x Door Width

SET #2

Doors: #102

1 Padlock 41B-722L PATD M5 626 BE

PART 4 - PAYMENT

4.1 PAYMENT ITEMS

Bid Item No.Pay ItemPay Unit5.01Finish HardwareLump Sum

END OF SECTION

SECTION 09 22 00

GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. Section includes Gypsum Board and joint treatment for ceiling installation on wood truss cords.

B. Related Sections:

- 1. Division 6:
 - a. Rough Carpentry.
 - b. Wood Trusses.
- 2. Division 7 Batt Insulation: Acoustic and Thermal Insulation.

1.02 REFERENCES

A. ASTM International:

- 1. ASTM C475 Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
- 2. ASTM C514 Standard Specification for Nails for the Application of Gypsum Board.
- 3. ASTM C557 Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing.
- 4. ASTM C840 Standard Specification for Application and Finishing of Gypsum Board.
- 5. ASTM C1280 Standard Specification for Application of Gypsum Sheathing.
- 6. ASTM C1396 Standard Specification for Gypsum Board.
- 7. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.

B. Gypsum Association:

- 1. GA 214 Recommended Levels of Gypsum Board Finish.
- 2. GA 216 Application and Finishing of Gypsum Board.
- 3. UL 723 Tests for Surface Burning Characteristics of Building Materials.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's product specifications and installation instructions for systems required.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original packages, containers or bundles bearing brand name and identification of manufacturer or supplier.

- B. Store materials inside under cover and in manner to keep them dry, protected from weather, direct sunlight, surface contamination, corrosion and damage from construction traffic and other causes. Neatly stack gypsum boards flat to prevent sagging.
- C. Handle materials to prevent damage to edges, ends or surfaces. Protect metal corner beads and trim from being bent or damaged.

1.05 PROJECT CONDITIONS

- A. Environmental Requirements, General: Comply with requirements of referenced gypsum board application standards and recommendations of gypsum board manufacturer, for environmental conditions before, during, and after application of gypsum board.
- B. Cold Weather Protection: When ambient outdoor temperatures are below 55°F (13°C), maintain continuous, uniform, comfortable building working temperatures of not less than 55°F (13°C) for a minimum period of 48 hours prior to, during, and following application of gypsum board and joint treatment materials or bonding of adhesives.
- C. Ventilation: Ventilate building spaces as required to remove water in excess of that required for drying of joint treatment material immediately after its application. Avoid drafts during dry, hot weather to prevent too rapid dry.

PART 2 PRODUCTS

2.01 BOARD MATERIALS

- A. Fire Rated Water-Resistant Gypsum Board:
 - 1. ASTM C1396, Type X.
 - 2. Gypsum core panel with enhanced fire-resistance and water resistance core.
 - 3. 5/8 inch thick, maximum available length.
 - 4. Ends square cut, tapered edges.

2.02 TRIM ACCESSORIES

- A. Provide trim shapes as required to cover and make neat edges.
- B. Paper Faced Metal Bead and Trim: ASTM C1047, electro-galvanized steel with paper face and flanges, USG Beadex specified for type and quality.
 - 1. Outside corner beads.
 - 2. L-type edge trims.
- C. Metal Trim Shapes: ASTM C1047.

2.03 JOINT TREATMENT MATERIALS

- A. General: ASTM C475; type recommended by the manufacturer for the application indicated, except as otherwise indicated.
- B. Joint Tape:
 - 1. Paper reinforcing tape for gypsum board.
 - 2. 2" wide 10x10 glass mesh tape for glass backer board.
- C. Water-Resistant Joint Compound: Special water-resistant type for treatment of joints, fastener heads and cut edges of water-resistant backing board.
 - 1. Product: Subject to compliance with requirements, provide Sheetrock Brand W/R Compound; United States Gypsum Company.

2.04 MISCELLANEOUS MATERIALS

- A. General: Provide auxiliary materials for gypsum drywall work of the type and grade recommended by the manufacturer of the gypsum board.
- B. Fasteners
 - 1. Screws conforming to ASTM C1002. Bugle or pan head, and lengths as required for securing materials in place.
 - a. Wood Framing and Backing: Type W.
- C. Water: Provide clean, fresh, and potable water.

PART 3 EXECUTION

3.01 INSTALLATION OF GYPSUM BOARD

- A. Gypsum Board Application and Finishing Standards: ASTM C840 and GA216.
- B. Locate exposed end-butt joints as far from center of walls and ceilings as possible, and stagger not less than 1'-0" in alternate courses of board.
- C. Install ceiling boards in the direction and manner which will minimize the number of end-butt joints, and which will avoid end joints in the central area of each ceiling. Stagger end joints at least 1'-0".
- D. Install exposed gypsum board with face side out. Do not install imperfect, damaged, or damp boards. Butt boards together for a light contact at edges and ends with not more than 1/16" open space between boards. Do not force into place.
- E. Locate either edge or end joints over supports, except in horizontal applications or where intermediate supports or gypsum board back-blocking is provided behind end joints. Position boards so that like edges abut, tapered edges against tapered edges and mill-cut or field-cut ends against mill-cut or field-cut ends. Do not place tapered

- edges against cut edges or ends. Stagger vertical joints over different studs on opposite sides of partitions
- F. Attach gypsum board to supplementary framing and blocking provided for additional support at openings and cutouts.

3.02 INSTALLATION OF CONTROL JOINTS

- A. Install expansion and contraction joints in ceilings and walls in accordance with ASTM C840, System XIII or GA216, Section 4.2:
 - 1. Control joints shall be either manufactured devices designed for this purpose or field fabricated from suitable materials.
 - 2. Full height door frames shall be considered equivalent to a control joint.
 - 3. Control joints shall be installed as follows unless otherwise indicated on the Drawings:
 - a. Control joints in the gypsum panel products shall be installed where a partition, wall, or ceiling traverses a construction joint (expansion, seismic, or building control element) in the base building structure.
 - b. Control joints shall be installed where a wall or partition runs in an uninterrupted straight plane exceeding 30 linear feet.
 - c. Control joints in interior ceilings with perimeter relief shall be installed so that linear dimensions between control joints do not exceed 50 ft.
 - d. Control joints in interior ceilings without perimeter relief shall be installed so that linear dimensions between control joints do not exceed 30 ft.
 - e. Control joints in exterior ceilings and soffits shall be installed so that linear dimensions between control joints do not exceed 30 ft.
 - f. A control joint or intermediate blocking shall be installed where ceiling framing members change direction.
 - g. Control joints shall be installed where specified by the Architect or Designer as a design accent or architectural feature.
 - h. Where a control joint occurs in an acoustical or fire-rated system, blocking shall be provided behind the control joint by using a backing material such as 5/8" type X gypsum panel products, mineral fiber, or other tested equivalent. See the Gypsum Association's Fire Resistance Design Manual, GA-600, or Special Recommendations: Control Joints for Fire-Resistance Rated Systems, GA-234.
- B. Space fasteners in gypsum boards in accordance with referenced standards and manufacturer's recommendations, except as otherwise indicated

3.03 INSTALLATION OF DRYWALL TRIM ACCESSORIES

A. General: Where feasible, use the same fasteners to anchor trim accessory flanges as required to fasten gypsum board to the supports. Otherwise, fasten flanges by screwing or stapling in accordance with manufacturer's instructions and recommendations.

- B. Install metal edge trim whenever edge of gypsum board would otherwise be exposed or semi-exposed. Provide type with face flange to receive joint compound.
 - 1. Install L-type trim where work is tightly abutted to other work.

3.04 FINISHING OF GYPSUM BOARD

- A. Refer to Gypsum Board Finishing Standards: ASTM C840, GA 214 and GA216.
- B. General: Apply treatment at gypsum board joints (both directions), flanges of trim accessories, penetrations, fastener heads, surface defects, and elsewhere as required to prepare work for decoration. Prefill open joints and rounded or beveled edges, if any, using type of compound recommended by manufacturer.
- C. Apply joint tape at joints between gypsum boards, except where a trim accessory is indicated.

D. Level 1 Finish:

- 1. Apply in plenum areas above ceilings, in attics, in areas where the assembly is concealed; however, in areas where fire-resistance rating is required for the gypsum board assembly, details of finish must be in accordance with reports of fire tests of assemblies that have met the fire-rating requirements.
- 2. Apply the first embedding coat of joint compound to joint and to inside corners.

E. Level 2 Finish:

- 1. Apply where water-resistant gypsum backing board is used as a substrate for tile; in garages, warehouse storage and similar areas where surface appearance is not a primary concern.
- 2. Apply the first embedding coat and second fill coat of joint compound to inside corners and one coat of joint compound over all fasteners, metal bead and trim.

3.05 PATCHING

A. Patch surface defects in gypsum board to a smooth, uniform appearance, ready to receive finishes.

3.06 PROTECTION OF WORK

A. Provide final protection and maintain conditions, in a manner suitable to installer, which ensures gypsum drywall work being without damage or deterioration at times of substantial completion.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
5.01	Gypsum Board Assemblies	Lump Sum

END OF SECTION

SECTION 09 24 00

STUCCO SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Provide labor, materials and equipment necessary to install fiber reinforced, one-coat stucco assembly over CMU.

B. RELATED SECTIONS

- C. Section 04 20 00 Glass Unit Masonry.
- D. Section 07 92 00 Elastomeric Sealants.

1.02 REFERENCES

A. ASTM

- 1. Standard Specification for Aggregate for Masonry Mortar.
- 2. ASTM C897: Standard Specification for Aggregate for Job-Mixed Portland Cement-Based Plaster.
- 3. ASTM B117: Test Method for Salt Spray (Fog) Testing.
- 4. ASTM E331: Test Method for Water Penetration by Uniform Static Air Pressure Difference.
- 5. ASTM E695: Method for Measuring Relative Resistance to Impact Loading.
- 6. ASTM G155: Accelerated Weathering for Exposure of Nonmetallic Materials.

1.03 ASSEMBLY DESCRIPTION

A. One-Coat Stucco Assembly: Pre-mixed stucco base coat and either an acrylic or elastomeric based finish coat.

B. Stucco Functional Criteria:

- 1. General: Stucco application shall be to vertical substrates or to substrates sloped for positive drainage. Substrates sloped for drainage shall have additional protection from weather exposure that might be harmful to coating performance.
- 2. Testing to meet International Code Council Acceptance Criteria AC11.

3. Performance Requirements of Stucco Assembly Warranty indicating Single:

Criteria	Test	Method	Results
Accelerated Weathering	ASTM G153	2000 Hours	No deleterious effect
Freeze-Thaw Resistance	ICC AC 11	10 cycles	Pass
Transverse Wind Load Resistance	ASTM E330	Meet Design Loads	Refer to ICC-ES ESR-2564
Fire Resistance	ASTM E119	One hour fire	Refer to ICC-ES ESR-2564
Drainage	ICC AC 11	90 %	Refer to ICC-ES ESR-2564

- 4. Substrate materials and construction shall conform to the building code having jurisdiction.
- 5. Substrates shall be sound, dry and free of dust, dirt, laitance, efflorescence, and other harmful contaminants.
- C. Expansion and Control Joints: Continuous expansion and control joints shall be installed at locations in accordance with ASTM C1063 and ASTM C926.
 - 1. For direct application to concrete or masonry, stucco joints are required only at control/expansion joints in the underlaying concrete or masonry.

1.04 SUBMITTALS

- A. Samples: Submit samples for approval. Samples shall be of materials specified and of suitable size as required to accurately represent each color and texture used on Project. Prepare each sample using same tools and techniques for actual project application. Maintain and make available, at job site, approved samples.
- B. Manufacturer's Warranty: Submit sample copies of Manufacturer's Warranty indicating Single Source Responsibility for stucco assembly materials.

1.05 QUALITY ASSURANCE

A. Qualifications:

- 1. Manufacturer: Shall have marketed stucco assemblies in United States for at least ten years and shall have completed projects of same general scope and complexity.
- 2. Applicator: Shall be experienced and competent in installation of stucco materials, and shall provide evidence of a minimum of five years experience in work similar to that required by this section.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver assembly materials in original packaging with manufacturer's identification.

B. Storage: Store assembly materials in a dry location, out of direct sunlight, off the ground, and protected from moisture.

1.07 PROJECT / SITE CONDITIONS

- A. Substrate Temperature: Do not apply stucco assembly materials to substrates whose temperature are below 40°F or contain frost or ice.
- B. Inclement Weather: Do not apply stucco assembly materials during inclement weather, unless appropriate protection is employed.
- C. Sunlight Exposure: Avoid, when possible, installation of the stucco assembly materials in direct sunlight. Application of finishes in direct sunlight in hot weather may adversely affect aesthetics.
- D. Do not apply stucco base coats or finishes if ambient temperature falls below 40°F (4°C) within 24 hours of application. Protect stucco materials from uneven and excessive evaporation during dry weather and strong blasts of dry air.
- E. Prior to installation, the substrate shall be inspected for surface contamination, or other conditions that may adversely affect the performance of the stucco assembly materials, and shall be free of residual moisture.

1.08 COORDINATION AND SCHEDULING:

A. Coordinate Stucco System installation with other construction operations.

1.09 WARRANTY

A. Provide Manufacturer's Standard Limited Warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Parex USA, Inc., 4125 E. La Palma Ave., Suite 250, Anaheim, CA 92807 Contact: Architectural Sales (866-516-0061) or Technical Support (800-226-2424).
- B. No substitutions or additions of other materials are permitted without prior written permission from primary stucco manufacturer for this Project.

2.02 MATERIALS

A. Base Coat: 121 Base Coat: 100% acrylic polymer base, requiring the addition of Portland cement, min 1/2" per coat.

- B. Reinforcing Mesh: Parex USA 355 Standard Mesh: Weight 4.5 oz. per sq. yd; coated for protection against alkali.
- C. Finish: DPR Optimum Finish: Factory blended, 100% acrylic polymer based finish, integrally colored. Finish type, texture and color as selected by A/E.
- D. Water: Clean, potable water.
- E. Portland Cement: ASTM C150, Type I or Type I-II.

2.03 RELATED MATERIALS AND ACCESSORIES

- A. Substrate Materials: Concrete Masonry Units (CMU): Non-painted (uncoated).
- B. Flashing: Refer to Division 7 Flashing Section for flashing materials.
- C. Sealant System:
 - 1. Sealants shall conform to ASTM C 920, Grade NS.
 - 2. Sealant backer rod shall be closed-cell polyethylene foam.
 - 3. Color and texture shall be as selected by A/E.
 - 4. Joint design, surface preparation, and sealant primer shall be based on sealant manufacturer's recommendations and project conditions.

2.04 SOURCE QUALITY CONTROL

A. Provide products specified herein from a single source.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Compliance: Comply with manufacturer's instructions for installation of coatings.
- B. Substrate Examination: Examine prior to Base Coat installation as follows:
 - 1. Substrate shall be free of dust, dirt, laitance, efflorescence, and other harmful contaminants.
 - 2. Substrate construction in accordance with substrate material manufacturer's specifications and applicable building codes.
 - 3. Substrate shall be cured concrete (28 days minimum).
 - 4. Substrate shall have no irregularities greater than 1/4" (6.4 mm), and shall be sound and free of foreign substances, including paint, bond breakers, form oils, laitance, scaling, and flaking.
 - 5. Unsatisfactory conditions shall be corrected before the application of the coatings.
 - 6. Painted surfaces shall have paint removed to achieve a substrate with 90% or more of the surface free of paint.

- 7. Sanding surfaces shall be eliminated mechanically, then washed with clear water.
- 8. Remove efflorescence using mechanical removal and/or a diluted acid solution followed by complete rinsing.
- C. Concrete surfaces shall be level and free of voids over 1/8" (3 mm) across. Glossy surfaces shall be dulled by chemical or mechanical means. Thoroughly remove all residues.
- D. Advise Contractor of discrepancies preventing installation of the Stucco System. Do not proceed with the Stucco System work until unsatisfactory conditions are corrected.

3.02 PREPARATION

- A. Protection: Protect surrounding material surfaces and areas during installation of system.
- B. Clean surfaces thoroughly prior to installation.
- C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the Project conditions.

3.03 MIXING

A. Mix proprietary products in accordance with manufacturer's instructions.

3.04 APPLICATION

- A. General: Installation shall conform to this Specification and manufacturer's written instructions and Drawing details.
- B. Base coat:
 - 1. If leveling is required, apply any Base Coat. Base Coat may be applied up to 3/8" and up to 1/2 in. thick in a single pass when used as a leveler.
 - 2. Apply base coat and fully embed mesh if applicable in base coat.
- C. Finish Coat: Apply finish coat to match specified finish type, texture, and color. Do not apply finish coat to surfaces to receive sealant. Keep finish out of sealant joint gaps.

3.05 CURING

- A. Keep stucco base coat moist for at least 48 hours (longer in dry weather) by lightly fogging walls. Start light fogging after initial set of 1–2 hours. Follow cure times set on Armourwall datasheet, depending on primer and finish.
- B. Air dry acrylic based and elastomeric finish coats only, do not wet cure.

3.06 CLEAN-UP

- A. Removal: Remove and legally dispose of component debris material from job site.
- B. Clean surfaces and work area of foreign materials resulting from operations.

3.07 PROTECTION

- A. Provide protection of installed materials from water infiltration into or behind them.
- B. Provide protection of installed stucco from dust, dirt, precipitation, and freezing during installation.
- C. Provide protection of installed finish from dust, dirt, precipitation, freezing, and continuous high humidity until fully cured and dry.
- D. Clean exposed surfaces using materials and methods recommended by the manufacturer of the material or product being cleaned. Remove and replace work that cannot be cleaned to the satisfaction of the A/E.

3.08 SCHEDULE

A. Refer to Drawings

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	<u>Pay Unit</u>
5.01	Stucco Systems	Lump Sum

END OF SECTION

SECTION 09 90 00

PAINTING AND COATING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes surface preparation and field application of paints, stains, varnishes, and other coatings.
 - 1. "Paint" as used herein means all coating systems materials, including primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats.
- B. Extent of painting work is indicated on Drawings and Schedules, and as herein specified.
- C. Work includes painting and finishing of interior and exterior exposed items and surfaces throughout Project, except as otherwise indicated.
- D. Surfaces to be painted: Except where natural finish of material is specifically noted as a surface not to be painted, paint exposed surfaces, whether or not colors are designated in "schedules". Where items or surfaces are not specifically mentioned, paint the same as similar adjacent materials or areas. If color or finish is not designated, Architect will select these from standard colors or finishes available.
- E. Following categories of work are not included as part of field-applied finish work:
 - 1. Prefinished Items: Unless otherwise indicated, do not include painting when factory-finishing or installer-finishing is specified for such items as (but not limited to) metal toilet enclosures, prefinished partition systems, architectural casework, and finished mechanical and electrical equipment, including light fixtures, switchgear, and distribution cabinets.
 - 2. Concealed Surfaces: Unless otherwise indicated, painting is not required on surfaces such as walls or ceilings in concealed areas and generally inaccessible areas.
 - 3. Finished Metal Surfaces: Unless otherwise indicated, metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze, and similar finished materials will not require finish painting.
 - 4. Operating Parts: Unless otherwise indicated, moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sinkages, sensing devices, motor, and fan shafts will not require finish painting.

- F. Following categories of work are included under other Sections of these Specifications:
 - 1. Shop Primers: Unless otherwise specified, shop priming of ferrous metal items is included under various Sections for structural steel, metal fabrications, hollow metalwork, and similar items.
- G. Do not paint over any code-required labels, such as Underwriters' Laboratories and Factory Mutual, or any equipment identification, performance rating, or nomenclature plates.

1.02 REFERENCES

- A. ASTM International:
 - 1. ASTM D16 Standard Terminology Relating to Paint, Varnish, Lacquer, and Related Products.
 - 2. ASTM D4442 Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials.
 - 3. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. National Fire Protection Association:
 - 1. NFPA 255 Standard Method of Test of Surface Burning Characteristics of Building Materials.
- C. Painting and Decorating Contractors of America:
 - 1. PDCA Architectural Painting Specification Manual.
- D. SSPC: The Society for Protective Coatings:
 - 1. SSPC Steel Structures Painting Manual.
- E. Underwriters Laboratories Inc.:
 - 1. UL 723 Tests for Surface Burning Characteristics of Building Materials.
- F. National Association of Corrosion Engineers NACE International.

1.03 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Samples:
 - 1. For initial color selection.
 - 2. For each color and sheen after selection of colors is made.

- C. Coating Maintenance Manual: Upon completion of project, furnish coating maintenance manual. Basis of Design: Sherwin Williams "Custodian Project Color and Product Information" report or equal.
 - 1. Manual shall include an Area Summary with finish schedule, Area Detailing designating where each product/color/finish was used, product data pages, SDS Sheets, care and cleaning instructions, touchup procedures, and color samples of each color and finish used.

1.04 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide primers and other undercoat paint produced by same manufacturer as finish coats. Use only thinners approved by paint manufacturer, and use only within recommended limits.
- B. Coordination of Work: Review other Sections of these Specifications in which prime paints are to be provided to ensure compatibility of total coatings system for various substrates. Upon request from other trades, furnish information or characteristics of finish materials provided for use, to ensure compatible prime coats are used.

1.05 PRE-INSTALLATION MEETING

A. Schedule pre-installation meeting with Owner and A/E one week minimum prior to commencing work of this Section.

1.06 DELIVERY AND STORAGE

- A. Delivery: Deliver materials to job site in original, new, and unopened packages and containers bearing manufacturer's name and label and following information:
 - 1. Name or title of material.
 - 2. Fed. Spec. number, if applicable.
 - 3. Manufacturer's stock number and date of manufacture.
 - 4. Manufacturer's name.
 - 5. Contents by volume, for major pigment and vehicle constituents.
 - 6. Thinning instructions.
 - 7. Application instructions.
 - 8. Cleaning instructions.
 - 9. Color name and number.

B. Storage:

- 1. Store materials not in actual use in tightly covered containers.
- 2. Maintain containers used in storage of paint in a clean condition, free of foreign materials and residue.
- 3. Protect from freezing where necessary.
- 4. Keep storage area neat and orderly.
- 5. Remove oily rags and waste daily.
- 6. Take all precautions to ensure that workmen and work areas are adequately protected from fire hazards and health hazards resulting from handling, mixing and application of paints.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. Apply water-based paints only when temperature of surfaces to be painted and surrounding air temperatures are between 50°F (10°C) and 90°F (32°C), unless otherwise permitted by paint manufacturer's printed instructions.
- B. Apply solvent-thinned paints only when temperature of surfaces to be painted and surrounding air temperatures are between 45°F (7°C) and 95°F (35°C), unless otherwise permitted by paint manufacturer's printed instructions.
- C. Do not paint in snow, rain, fog or mist, or when relative humidity exceeds 85%, or to damp or wet surfaces, unless otherwise permitted by paint manufacturer's printed instructions.
- D. Painting may be continued during inclement weather if areas and surfaces to be painted are enclosed and heated within temperature limits specified by paint manufacturer during application and drying periods.

1.08 EXTRA MATERIALS

- A. Supply 1 gallon of each color, and type; store where directed.
- B. Label each container with color, room locations, and date in addition to manufacturer's label.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Sherwin Williams Paints (Listed in Schedule)
- B. Products by the following manufacturers may be substituted for scheduled products when equivalent in performance:
 - 1. Dunn Edwards Paint Company.
 - 2. Benjamin Moore.
 - 3. Kwal-Howells.
 - 4. ICI Paints.

2.02 COMPONENTS

- A. Coatings: Ready-mixed, except field catalyzed coatings. Prepare coatings:
 - 1. To soft paste consistency, capable of being readily and uniformly dispersed to homogeneous coating.
 - 2. For good flow and brushing properties.
 - 3. Capable of drying or curing free of streaks or sags.

2.03 MATERIALS

- A. Material Quality:
 - 1. Provide best quality grade of various types of coatings regularly manufactured by listed manufacturers.
 - 2. Materials not displaying manufacturer's identification as a standard, best-grade product will not be acceptable.
- B. Color Pigments: Pure, no-fading, applicable types to suit substrates and service indicated.

PART 3 EXECUTION

3.01 INSPECTION

- A. Applicator must examine areas and conditions under which painting work is to be applied and notify Contractor in writing of conditions detrimental to proper and timely completion of work.
- B. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Applicator.
- C. Starting of painting work will be construed as Applicator's acceptance of surfaces and conditions within any particular area.
- D. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to formation of a durable paint film.

3.02 GENERAL PREPARATION

- A. Product label directions must be read and followed.
- B. Perform preparation and cleaning procedures in accordance with paint manufacturer's instructions and as herein specified, for each particular substrate condition. Clean surfaces before applying paint or surface treatments.
 - 1. Program cleaning and painting so that contaminants from cleaning process will not fall onto wet, newly painted surfaces.
- C. When using a commercially available solvent or cleaner, observe recommended precautions:
 - 1. Follow all manufacturers' specifications for product use and preparation.
 - 2. Test cleaning materials on an isolated or hidden area to determine that the desired result is achieved and that no damage or discoloration occurs as a result of the product's use.
 - 3. Do not mix chemical compounds. Some cleaners may react with other solutions, creating toxic or poisonous vapors.
 - 4. Remove cleaners thoroughly.

- 5. When working with toxic or caustic substances, wear protective clothing and gear as recommended by the substance manufacturer.
- 6. Use the proper tools for the cleaning job at hand, and use these tools in a safe and proper manner.
- D. Surface Appurtenances: Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
- E. Surfaces must be dry and in sound condition. Remove oil, dust, dirt, loose rust, peeling paint or other contamination to ensure good adhesion.
 - 1. Provide barrier coats over incompatible primers or remove and reprime as required. Notify A/E in writing of any anticipated problems in using specified coating systems with substrates primed by others.
- F. Remove mildew before painting by washing with a solution of 1 part liquid household bleach and 3 parts of warm water. Apply the solution and scrub the mildewed area. Allow the solution to remain on the surface for 10 minutes. Rinse thoroughly with clean water and allow the surface to dry 48 hours before painting. Wear protective glasses or goggles, waterproof gloves, and protective clothing, and follow all precautions as listed on the cleaning product label. Quickly wash off any of the mixture that comes in contact with skin. Do not add detergents or ammonia to the bleach/water solution.
- G. Remove hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place that are not to be finish-painted, or provide surface-applied protection prior to surface preparation and painting operations. Following completion of painting of each space or area, reinstall removed items.

3.03 SUBSTRATE PREPARATION

- A. Follow the required preparation method identified in the manufacturer's product data sheet and the recommended SSPC surface preparation method.
- B. Aluminum: Remove all oil, grease, dirt, oxide and other foreign material by cleaning per SSPC-SP1, Solvent Cleaning.
- C. CMU: Remove all loose mortar and foreign material. Surface must be free of laitance, concrete dust, dirt, form release agents, moisture curing membranes, loose cement, and hardeners. Cure concrete and mortar at least 30 days at 75°F. The pH of the surface should be between 6 and 9. On tilt-up and poured-in-place concrete, commercial detergents and abrasive blasting may be necessary to prepare the surface. Fill bug holes, air pockets, and other voids with a cement-patching compound.
- D. Concrete: SSPC-SP13 or NACE 6. This standard gives requirements for surface preparation of concrete by mechanical, chemical, or thermal methods prior to the application of bonded protective coating or lining systems. The requirements of this standard are applicable to all types of cementitious surfaces, including cast-in-place concrete floors and walls, precast slabs, masonry walls and shotcrete surfaces. An

- acceptable prepared concrete surface should be free of contaminants, laitance, loosely adhering concrete, and dust, and should provide a sound, uniform substrate suitable for the application of protective coating or lining systems.
- E. Drywall—Interior and Exterior: Must be clean and dry. Set and spackle nail heads. Tape and cover joints with a joint compound. Sand spackled nail heads and tape joints smooth, and remove dust prior to painting. Spackle exterior surfaces with exterior grade compounds.
- F. Galvanized Metal: First, Solvent Clean per SSPC-SP1 and apply a test area, priming as required. Allow the coating to dry at least one week before testing. If adhesion is poor, Brush Blast per SSPC-SP7 is necessary to remove these treatments.
- G. Previously Coated Surfaces: Maintenance painting will frequently not permit or require complete removal of all old coatings prior to repainting. However, remove all surface contamination such as oil, grease, loose paint, mill scale dirt, foreign matter, rust, mold, mildew, mortar, efflorescence, and sealers to assure sound bonding to the tightly adhering old paint. Clean and dull glossy surfaces of old paint films before repainting. Fill and sand surface irregularities smooth. Thoroughly wash with an abrasive cleanser to clean and dull in one operation, or, wash thoroughly and dull by sanding. Spot prime any bare areas with an appropriate primer. Check for compatibility by applying a test patch of the recommended coating system, covering at least 2 to 3 square feet. Allow to dry one week before testing adhesion per ASTM D3359. If the coating system is incompatible, complete removal is required (per ASTM 4259, see Concrete).
- H. Stucco: Clean and remove loose stucco. If recommended procedures for applying stucco are followed and normal drying conditions prevail, the surface may be painted in 30 days. The pH of the surface should be between 6 and 9.
- I. Wood—Exterior: Must be clean and dry. Prime and paint as soon as possible. Scrape, sand, and spot-prime knots and pitch streaks before full priming coat is applied. Patch all nail holes and imperfections with a wood filler or putty and sand smooth. Apply caulk after priming.
- J. Wood—Interior: Store finishing lumber and flooring in dry, warm rooms to prevent absorption of moisture, shrinkage, and roughening of the wood. Sand surfaces smooth with the grain, never across it. Correct surface blemishes and clean area of dust before coating.

3.04 MATERIALS PREPARATION

- A. Mix and prepare painting materials in accordance with manufacturer's directions.
- B. Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials and residue.

- C. Stir materials before application to produce a mixture of uniform density, and stir as required during application.
 - 1. Do not stir surface film into material.
 - 2. Remove film and, if necessary, strain material before using.

3.05 APPLICATION

A. General:

- 1. Apply paint in accordance with manufacturer's directions.
- 2. Use applicators and techniques best suited for substrate and type of material being applied.
- 3. Provide finish coats which are compatible with prime paints used.
- 4. Apply additional coats when undercoats, stains, or other conditions show through final coat of paint, until paint film is of uniform finish, color, and appearance.
 - a. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners, receive a dry film thickness equivalent to that of flat surfaces.
- 5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Do not paint surfaces behind permanently-fixed equipment or furniture.
- 6. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, not-specular black paint.
- 7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
- 8. Finish exterior doors on tops, bottoms, and side edges same as exterior faces, unless otherwise indicated.
- 9. Sand lightly between each succeeding enamel or varnish coat.
- 10. Omit first coat (primer) on metal surfaces which have been shop-primed and touch-up painted, unless otherwise indicated.

B. Scheduling Painting:

- 1. Apply first-coat material to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
- 2. Allow sufficient time between successive coatings to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

C. Minimum Coating Thickness:

1. Apply materials at not less than manufacturer's recommended spreading rate, to establish a total dry film thickness as recommended by coating manufacturer.

D. Prime Coats:

1. Apply prime coat of material which is required to be painted or finished, and which has not been prime coated by others.

2. Recoat primed and sealed surfaces where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.

E. Pigmented (Opaque) Finishes:

- 1. Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage.
- 2. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

F. Transparent (Clear) Finish:

- 1. Use multiple coats to produce glass-smooth surface film of even luster.
- 2. Provide a finish free of laps, cloudiness, color irregularity, runs, brush marks, orange peel, nail holes, or other surface imperfections.
- 3. Provide satin finish for final coats.

G. Completed Work:

- 1. Match approved samples for color, texture, and coverage.
- 2. Remove, refinish, or repaint work not in compliance with specified requirements.

3.06 CLEAN-UP AND PROTECTION

A. Clean-Up:

- 1. During progress of work, remove from site discarded paint materials, rubbish, cans, and rags at end of each work day.
- 2. Upon completion of painting work, clean window glass and other paint-spattered surfaces.
 - a. Remove spattered paint by proper methods of washing and scraping.
 - b. Use care not to scratch or otherwise damage finished surfaces.

B. Protection:

- 1. Protect work of other trades, whether to be painted or not, against damage by painting and finishing work.
- 2. Correct any damage by cleaning, repairing or replacing, and repainting, as acceptable to Architect.
- 3. Provide "Wet Paint" signs as required to protect newly-painted finishes.
- 4. Remove temporary protective wrappings provided by others for protection of their work, after completion of painting operations.
- 5. At completion of work of other trades, touch-up and restore all damaged or defaced painted surfaces.

3.07 EXTERIOR PAINT SCHEDULE

- A. Metal Non-Ferrous, Galvanized or Shop-Primed Ferrous:
 - 1. 1st Coat: S-W A-100 Exterior Latex Gloss, A8 Series
 - 2. 2nd Coat: S-W A-100 Exterior Latex Gloss, A8 Series (4 mils wet, 1.4 mils dry per coat)

B. Metal – Ferrous:

- 1. 1st Coat: S-W Kem Kromik Universal Primer, B50Z Series (6 mils wet, 3 mils dry).
- 2. 2nd Coat: S-W A-100 Exterior Latex Gloss, A8 Series.
- 3. 3rd Coat: S-W A-100 Exterior Latex Gloss, A8 Series (4 mils wet, 1.4 mils dry per coat).

C. Wood: Painted Finish:

- 1. 1st Coat: S-W A-100 Exterior Latex Wood Primer, B42W41 (4 mils wet, 1.4 mils dry) (if Tannin Bleeding is likely, use A-100 Exterior Wood Primer, Y24W20).
- 2. 2nd Coat: S-W A-100 Exterior Latex Gloss, A8 Series.
- 3. 3rd Coat: S-W A-100 Exterior Latex Gloss, A8 Series (4 mils wet, 1.4 mils dry per coat).

3.08 INTERIOR PAINT SCHEDULE

- A. Concrete Concrete Floors:
 - 1. 1st Coat: ArmorSeal Floor-Plex 7100 Primer (2.0 mils dry).
 - 2. 2nd Coat.: ArmorSeal® Floor-Plex® 7100 WB Epoxy, B70-400 Series (2.0 mils dry).
- B. Concrete and Masonry Walls and Ceilings, CMU, Poured-in-Place Concrete, Precast Concrete: Semi-Gloss Latex Finish
 - 1. 1st Coat: S-W PrepRite Masonry Primer, B28W300 (7 mils wet, 3 mils dry) or S-W PrepRite Block Filler, B25W25 (75-125 sq ft/gal).
 - 2. 2nd Coat: S-W ProMar 200 Latex Semi-Gloss, B31W200 Series.
 - 3. 3rd Coat: S-W ProMar 200 Latex Semi-Gloss, B31W200 Series (4 mils wet, 1.3 mils dry per coat).
- E. Metal Aluminum: Latex Semi-Gloss Finish:
 - 1. 1st Coat: S-W ProMar 200 Latex Semi-Gloss, B31W200 Series.
 - 2. 2nd Coat: S-W ProMar 200 Latex Semi-Gloss, B31W200 Series (4 mils wet, 1.3 mils dry per coat).
- F. Metal Galvanized: Latex Semi-Gloss Finish:
 - 1. 1st Coat: S-W ProMar 200 Latex Semi-Gloss, B31W200 Series.
 - 2. 2nd Coat: S-W ProMar 200 Latex Semi-Gloss, B31W200 Series (4 mils wet, 1.3 mils dry per coat).

- G. Metal Structural Steel Columns, Joists, Trusses, Beams, Miscellaneous, and Ornamental Iron, Sashes, Doors, Partitions, Cabinets, Lockers, Radiators, Pumps, Motors, Machines, Convectors, Ducts, Elevator Cabs, Copper, Non-Galvanized Metal: Industrial Zero VOC Semi-Gloss Finish.
 - 1. Zero VOC Topcoat:
 - a. 1st Coat: S-W Pro Industrial Pro-Cryl® Primer, B66-310 Series (2-4 mils dry).
 - b. 2nd Coat: S-W Pro Industrial Zero VOC Semi-Gloss Acrylic B66W651 Series
 - c. 3rd Coat: S-W Pro Industrial Zero VOC Semi-Gloss Acrylic B66W651 Series (2.5 4.0 mils dry per coat).

H. Wood: Painted Finish:

- 1. 1st Coat: S-W PrepRite Classic Primer, B28W101 (4 mils wet, 1.6 mils dry).
- 2. 2nd Coat: S-W ProMar 200 Latex Semi-Gloss, B31W200 Series.
- 3. 3rd Coat: S-W ProMar 200 Latex Semi-Gloss, B31W200 Series (4 mils wet, 1.3 mils dry per coat).

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
5.01	Architectural Painting	Lump Sum

END OF SECTION

SECTION 09 97 01

INDUSTRIAL COATINGS

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Furnish labor, materials, tools, scaffolding, and paint for:
 - 1. Exposed piping, valves, fittings, and other metal surfaces, interior and exterior.
 - 2. Submerged metal surfaces.
 - 3. Structural and miscellaneous steel, including tanks and wet wells.
 - 4. Exterior above-ground concrete and masonry to 6" below ground level.
 - 5. Interior of concrete structures.
 - 6. Equipment furnished without factory finished surfaces.
 - 7. Ferrous metal portions of slide gate and valve pedestals and operators.
 - 8. All other surfaces requiring protection.
- B. Recoat, or touch-up, all equipment furnished with factory coatings which are damaged, scratched, or rusted during shipping, storage, or installation. Recoating to match original finish, quality, and appearance.

1.02 WORK EXCLUDED

- A. Architectural painting specified in Section 09 90 00 Painting and Coating.
- B. The following materials, items, and areas shall not be painted under this contract, except as noted:
 - 1. Surfaces of glass, china, ceramic tile vitreous enamel, chrome-plating, rubber, stainless steel, aluminum, fiberglass plastic, and galvanized metal, except as indicated on Drawings.
 - 2. Non-ferrous insulation jackets.
 - 3. Concealed interior surfaces of concrete block.
 - 4. Concealed ductwork, piping, and conduit.
 - 5. Insulated metal ductwork.
 - 6. Lubrication fittings, valve stems, shafting float rods, nameplates and instruments.
 - 7. Cast iron outdoor manhole covers and cast-iron outdoor manhole cover frames.
 - 8. Contact surfaces of rails and machined surfaces of equipment.
- C. The following items have either factory-applied permanent finishes or have been finish painted by others and shall not be painted under this contract.
 - 1. HVAC equipment specified under Division 23.
 - 2. Electrical equipment specified under Divisions 26 and 40.

1.03 REFERENCES

- A. The Society for Protective Coatings (formerly Steel Structures Painting Council SSPC):
 - 1. Steel Structures Painting Manual Vol. 2: Systems and Specifications.
 - 2. SSPC-SP 1: Surface Preparation Method Solvent Cleaning.
 - 3. SSPC-SP 2: Surface Preparation Method Hand Tool Cleaning.
 - 4. SSPC-SP 6/NACE No. 3: Surface Preparation Method Commercial Blast Cleaning.
 - 5. SSPC-SP 7/NACE No. 4: Surface Preparation Method Brush-off Blast Cleaning.
 - 6. SSPC-SP 10/NACE No. 2: Surface Preparation Method Near-White Metal Blast.
 - 7. SSPC-SP 13/NACE No. 6: Surface Preparation of Concrete.
- B. American Society for Testing Materials International (ASTM):
 - 1. ASTM B117 Standard Practice for Operating Salt Spray (Fog) Apparatus.
 - 2. ASTM D522 Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings.
 - 3. ASTM D610 Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces.
 - 4. ASTM D4060 Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.
 - 5. ASTM D4258 Standard Practice for Surface Cleaning Concrete for Coating.
 - 6. ASTM D4414 Standard Practice for Measurement of Wet Film Thickness by Notch Gages.
 - 7. ASTM D4787 Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates.
 - 8. ASTM D7234 Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers.
- C. National Association of Corrosion Engineers International (NACE):
 - 1. NACE SP0188 Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.
 - 2. NACE SP0288 Inspection of Lining Application in Steel and Concrete Equipment.
- D. American National Standards Institute (ANSI):
 - 1. ANSI/ASME A13.1 Scheme for the Identification of Piping Systems.

1.04 SUBMITTALS

- A. Product Data: Section 01 33 23 Shop Drawings, Product Data, and Samples.
- B. Schedule of products to be used and mil thicknesses to be applied in accordance with manufacturer's recommendations.

- C. Manufacturer's standard color selection charts. Engineer will use charts to select colors of industrial coatings.
- D. Coatings submitted as a substitution for the specified coating under each Service Condition shall include proof of equivalency to the specified coating. The equivalency data shall be submitted in tabular form and shall be as follows:

	Brand X	Brand Specified
Product		
Theoretical coverage rate		
Recommended wet and dry film thickness		
Pot life		
Shelf life		
% solids		
% VOC or solvent		
Any additional requirement for surface preparation beyond those specified		
Recommended temperature range for application		
Curing time		
Curing agent		

Submission of the equivalency data in any other format, or incomplete information, will be cause for rejection by the Engineer.

1.05 ADDITIONAL REQUIREMENTS

A. Workmanship:

- 1. Work to be done by skilled craftsmen in a manner comparable with the best standards of practice found in each trade.
- 2. Applicable surface preparation, coating and painting to conform with the requirements of the SSPC Steel Structures Painting Manual.
- 3. Contractor to provide a resident supervisor during cleaning and coating operations.

- 4. All coating and painting equipment to be suitable for each specific material being always applied and kept in first class working condition.
 - a. Compressors to have suitable traps and filters installed.
 - b. All equipment to be subject to Engineer's and/or paint manufacturer's approval.

B. Surface Preparation:

- 1. Evaluated as compared with SSPC-VIS 1 and SSPC-VIS 2 (ASTM D610).
- 2. Surfaces with grease to be hot detergent washed and rinsed as necessary prior to sandblasting and/or painting.
- 3. Type-Sandblasting Test: Standard metal plates of 8-1/2" x 11".
- 4. Plates to be prepared for each type sandblasting specified.
- 5. Any material applied upon improperly prepared surfaces will be removed and redone to the satisfaction of the Engineer at the sole expense of the Contractor.

C. Environmental Requirements:

- 1. Contractor responsibilities include:
 - a. Ensuring that coating work only occurs when environmental conditions comply with manufacturer's written requirements for same.
 - b. Continuously monitoring air and substrate temperatures and relative humidity to determine acceptability of environmental conditions and maintaining written logs for same which are available for Owner or Engineer's inspection.
 - c. Furnishing temporary environmental controls as needed to meet manufacturer's environmental requirements.
 - d. Preventing contamination of painted surfaces by adequate means.
 - e. Cleaning, washing, and recoating of areas which become contaminated with dirt, dust, or foreign material at no additional cost to Owner.
 - f. Anticipating when unfavorable environmental conditions are likely to occur, e.g., time of day when condensation occurs, and scheduling coating work around such times.
- 2. Do not apply coatings during the following conditions:
 - a. Air or substrate temperature measured in the shade is less than manufacturer's written minimum required temperature.
 - b. Surface to be coated is wet, damp, or has condensation present.
 - c. During rain, snowfall, mist, or when relative humidity exceeds manufacturer's written recommendations or within 18 hours of such conditions occurring.
 - d. During dust storms.
- 3. Suspend coating application whenever dew or moist conditions are present; do not resume until such conditions improve.
- 4. Complete coating work in advance of time of day when condensation occurs.
- 5. Contractor's efforts to fulfill environmental requirements as described are considered incidental work and no separate payment will be made therefor.

D. Inspection:

- 1. Concrete and non-ferrous metal, surfaces to be manually inspected with approved wet film thickness gauge.
- 2. Ferrous metal surfaces to be mechanically inspected with approved dry film thickness gauge.
- 3. Insufficient or defective areas: Rework as necessary.

E. Thickness Checking:

- 1. Thickness on ferrous metals to be checked with a non-destructive, magnetic type gauge in conformance with SSPC PA 2 Measurement of Dry Film Thickness with Magnetic Gages.
- 2. Thickness on concrete surfaces to be tested with a wet film thickness gage, such as those available through Paul N. Gardner Company, Inc. meeting ASTM D4414 shall be used to ensure a monolithic lining and uniform thickness during application.

F. Acceptable Thickness Inspection Devices:

- 1. Tinker-Rasor Models: AP and AP-N.
- 2. Tinker-Rasor Model M-1 6/1/2V.
- 3. Microtest units for dry-film thickness gauging.
- 4. Inspection devices to be operated as recommended by the manufacturer.
- 5. Devices and calibration plates furnished by the Contractor to be certified by the U.S. Department of Commerce, National Institute of Standards and Technology.
- 6. Devices to be supplied by Contractor at no additional cost to Owner and to be on project site whenever coatings are being applied.

1.06 DELIVERY AND HANDLING

- A. All materials to be brought to the site in the original sealed containers.
- B. Containers to be open or used only after Engineer's inspection for contents.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Products specified herein.
- B. Substitutions considered only if:
 - 1. Engineer has reviewed and taken no exceptions to Contractor's proof of equivalency data submitted per Paragraph 1.04.D.
 - 2. The substitute coating has a substantiated five-year record on projects of similar nature.
- C. All coating materials shall be VOC compliant in accordance with the latest version of EPA regulations 40 CFR Part 59 Subpart D National Volatile Organic Compound Emission Standards for Architectural Coatings. All coating materials shall be certified lead and chromate free.

- D. Paint and coatings for equipment shall not conflict with equipment manufacturer's recommendations.
- E. Field-applied coatings shall be compatible with shop primer furnished by others.

2.02 BLAST MEDIA

- A. Media for sandblasting operations: Copper slag, or other media, free of clays or other contaminants and which has sharp irregular edges and particle size gradation to produce an anchor profile in accordance with coating manufacturer's recommendations.
- B. Re-use of blast media is prohibited without the Engineer's written authorization.
- 2.03 SERVICE CONDITIONS: See Tables at end of this Section.

2.04 MAINTENANCE MATERIALS

- A. All unused single component paint and coatings in partially used containers remaining from work.
- B. Not less than 1% of all single component paint and coatings used in work; resealed partially used containers can be used to meet this requirement.

PART 3 EXECUTION

3.01 GENERAL

- A. Sandblasting and priming to be completed on any particular area within the period of an eight-hour working day.
- B. Primer application shall follow immediately after surface preparation and prior to any sign of corrosion.
- C. Surfaces not primed right after preparation within the eight-hour working period shall be re-prepared before primer application.
- D. Prior to final and unchangeable assembly, all surfaces shall be finished to the full satisfaction of the Engineer.

3.02 SURFACE PREPARATION

- A. Field blast cleaning for all surfaces: Dry sandblasting method unless otherwise directed.
- B. Existing facilities or finished coatings to be protected from sandblasting at all times.
- C. Cleaning of the sandblasting area: Section 01 74 00 Cleaning and Waste Management.

- D. Prior to application of coatings: Dry clean sandblasted surfaces.
- E. Welds to be neutralized with a suitable solvent compatible with the specified coating material.

3.03 APPLICATION

- A. Notify Engineer immediately after surface preparation and before commencement of coating operations of each large piece of the work.
- B. Starting work in a specific area shall be construed as acceptance of the surfaces, and thereafter, the Contractor shall be fully responsible for satisfactory work as required herein.
- C. All materials to be applied as recommended by their respective manufacturer.
 - 1. Recoat epoxy coatings within time limit specified by manufacturer. If time limit is exceeded, prepare epoxy surface as recommended by manufacturer, using such techniques as brush-off blasting to achieve the recommended surface profile.
- D. Each application of paint or coating to be:
 - 1. Applied at the proper consistency.
 - 2. Free of brush marks, sags, runs or evidence of poor workmanship.
 - 3. Avoid lapping on glass or hardware.
 - 4. Finished surfaces shall be free from defects or blemishes.
- E. Use protective coverings or drop cloths for floors, fixtures, and equipment.
- F. Whenever two or more coats of a dark colored paint or coating are specified, coats must be of variable color.
- G. All welds and irregular surfaces shall receive a brush coat prior to, and in addition to, application of the first complete specified coat.

3.04 CLEANUP

- A. Section 01 74 00 Cleaning and Waste Management.
- B. All spilled or splattered paint shall be cleaned up immediately.
- C. All sandblasting media shall be cleaned up and disposed of properly off-site at Contractor's expense.
- D. All discarded materials shall be disposed of properly off-site at Contractor's expense.
- 3.05 TABLE OF SERVICE CONDITIONS SEE PAGES WHICH FOLLOW
- 3.06 SCHEDULE OF SURFACES TO RECEIVE INDUSTRIAL COATINGS

	Surfac	<u>ee</u>	Service Condition	<u>Notes</u>
A.	Gener	<u>al</u>		
	1.	Process Equipment, Piping, and Appurtenances: All exposed interior, ferrous metal without factory topcoat and not galvanized, or subject to submergence, incidental splash, or corrosive moisture.	F2	
	2.	Process Equipment, Piping, and Appurtenances: All exposed exterior, ferrous metal without factory topcoat and not galvanized.	F4	
	3.	Ductile iron pipe and castings with factory asphaltic coating and requiring a field colored topcoat.	F7	Use as a prime coat for the applicable condition.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
1.13, 1.14, 2.08, 3.15, 3.23, 4.03, 5.04	Industrial Coatings on Air Valve Vents and Exposed Piping	Each or Lump Sum
5.01	Industrial Coatings	Lump Sum

SECTION 09 97 01, PAGES 09 97 01- 09 THRU 09 97 01-10 TABLE OF SERVICE CONDITIONS FOR INDUSTRIAL COATINGS

DFT: Dry Film Thickness, mils WFT: Wet Film Thickness, mils

Conditio		3.5	Prime Coat		Intermediate Coat		Finish Coats		
n	Surface Data	Manufacturer	Product	Mils	Product	Mils	Product	Mils	Remarks
	Surface Colored coatings for ferrous metals subject to submergence in sewage, scum, sludge, effluent such as chlorine contact tanks, clarifier troughs, digester equipment, etc.	Tnemec	Series N69 Epoxoline II	4-6 DFT	Series N69-Color Epoxoline II	4-6 DFT	Series N69-Color Epoxoline II	4-6 DFT	Total system shall not be less than 12 mils DFT at any spot. Coating shall be absolutely continuous.
F2	Surface Preparation Method	Sherwin Williams	Macropoxy 646 Fast Cure Epoxy, B58-600	6-10 DFT			Macropoxy 646 Fast Cure Epoxy, B58-600	6-10 DFT	See above.
	SSPC-SP10: Near white metal blast cleaning.	Carboline	Carboguard 691 Immersion Grade Epoxy	5-8 DFT			Carboguard 691 Immersion Grade Epoxy	5-8 DFT	See above.
		Or Engineer reviewed substitute							
	Surface Ferrous metals subject to corrosive moisture, incidental splash, atmosphere or condensation, but not subject to submergence.	Tnemec	Series 90-97 Tneme-Zinc	3.0 DFT	Series N69 Epoxoline II	4.0 DFT	Series 1074 Endura-Shield Polyurethane	3.0 DFT	
F4	Surface Preparation Method SSPC-SP6: Commercial blast cleaning	Sherwin Williams	Corothane 1 Galvapac Two Pack Zinc Primer, B65	3-4 DFT	Macropoxy 646 Fast Cure Epoxy, B58-600	6-10 DFT	Hi-Solids Polyurethane B65	3.0-4.0 DFT	
		Carboline	Carbozinc 859 Organic Zinc-Rich Coating	3-4 DFT	Carboguard 890 High- Build Epoxy	4-6 DFT	Carbothane 134 HG Aliphatic Acrylic Polyurethane	2-3 DFT	
Or Engineer reviewed substitute									

SECTION 09 97 01, PAGES 09 97 01- 09 THRU 09 97 01-10 TABLE OF SERVICE CONDITIONS FOR INDUSTRIAL COATINGS

DFT: Dry Film Thickness, mils WFT: Wet Film Thickness, mils

Conditio	C	M6	Prime Coat		Intermediate Coat		Finish Coats		D
n	Surface Data	Manufacturer	Product	Mils	Product	Mils	Product	Mils	Remarks
F7	Surface Metals finished with coal tar or other bleeding type finish	Tnemec	Series 1029 Enduratone Water-Based Acrylic	4.0 DFT					Intermediate and finish coat as specified elsewhere
	Surface Preparation Method SSPC-SP1: Solvent Clean	Sherwin Williams	0 VOC Acrylic, B66-600	2.5-4.0 DFT					See above.
		Carboline	Sanitile 120 Primer	1-2 DFT					See above.
		Or Engineer reviewe	d substitute						

END OF SECTION

SECTION 09 97 13.01

COATINGS FOR WELDED STEEL WATER STORAGE TANKS

PART 1 GENERAL

1.01 SCOPE

- A. The work of this Section includes coating of all interior and exterior surfaces of steel water storage tanks as specified herein and as indicated on Drawings.
- B. Testing and inspection performed by a NACE certified inspector.

1.02 REFERENCE SPECIFICATIONS AND STANDARDS

- A. Without limiting the general aspects of other requirements of these specifications, all surface preparation, coating of interior and exterior surfaces and inspection shall conform to the applicable requirements of the SSPC (Society for Protective Coatings), NACE International, ASTM (American Society for Testing and Materials), AWWA and the manufacturer's printed instructions.
 - 1. ASTM (American Society for Testing and Materials International):
 - a. ASTM D520: Standard Specification for Zinc Dust Pigment
 - b. ASTM D 4417: Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel
 - c. ASTM E337: Standard Practice Test Method for Measuring Humidity with a Psychrometer
 - d. ASTM D2200: Standard Methods of Evaluating Degree of Rusting on Painted Surfaces
 - e. ASTM D5402: Solvent Resistance of Organic Coatings Using Solvent Rubs
 - 2. ANSI (American National Standards Institute):
 - a. ANSI/ASC 29.4 Exhaust Systems: Abrasive Blasting Operations Ventilation and Safe Practice.
 - b. ANSI/NSF Standard 61: Drinking Water System Components Health Effects.
 - 3. AWWA (American Water Works Association):
 - a. AWWA C652: Disinfection of Water Storage Facilities
 - b. AWWA D102: Coating Steel Water Storage Tanks
 - 4. Consumer Product Safety Act, Part 1303
 - 5. Environmental Protection Agency:
 - a. EPA 524.2 Revision 4: Purgeable VOCs by GC/MS
 - 6. NACE International (National Association of Corrosion Engineers):
 - a. NACE Publication TPC2: Coatings and Linings for Immersion Service: Chapter 1 Safety, Chapter Surface Preparation, Chapter 3 Curing, and Chapter 4 Inspection

- b. NACE Standard RP0178: Standard Recommended Practice Fabrication Details, Surface Finish Requirements, and Proper Design Considerations for Tanks and Vessels to be Lined for Immersion Service
- c. NACE Standard RP0188: Standard Recommended Practice Discontinuity (Holiday) Testing of Protective Coatings
- d. NACE Standard RP0287: Field Measurement of Surface Profile of Abrasive Blast-Cleaned Steel Surfaces Using a Replica Tape
- e. NACE Standard RP0288: Standard Recommended Practice, Inspection of Linings on Steel and Concrete
- 7. OSHA (Occupational Safety & Health Administration):
 - a. 1915.35: Standards 29 CFR Painting
- 8. SSPC (Society for Protective Coatings, formerly Steel Structures Painting Council):
 - a. SSPC-SP2: Hand Tool Cleaning
 - b. SSPC-SP3: Power Tool Cleaning
 - c. SSPC-PA-1: Shop, Field and Maintenance Painting
 - d. SSPC-PA-2: Measurement of Dry Film Thickness with Magnetic Gages
 - e. SSPC-PA-3: Guide to Safety in Paint Application
 - f. SSPC-Guide 12: Guide for Illumination of Industrial Painting Project
 - g. SSPC-VIS 1-89: Pictorial Surface Preparation Standards for Painting Steel Surfaces
 - h. SSPC Paint Spec 36: Two Component Weatherable Aliphatic Polyurethane Topcoat, Performance-Based
- 9. SSPC/NACE Joint Standards:
 - a. SSPC-SP5/NACE 1: White Metal Blast Cleaning
 - b. SSPC-SP6/NACE 3: Commercial Blast Cleaning
 - c. SSPC-SP7/NACE 4: Brush-Off Blast Cleaning
 - d. SSPC-SP10/NACE 2: Near-White Metal Blast Cleaning
- B. The Engineer's decision shall be final as to the interpretation and/or conflict between any of the referenced specifications and standards contained herein.

1.03 CONTRACTOR

- A. The personnel performing the work shall be knowledgeable and have the required experience and skill to adequately perform the work for this project, in accordance with SSPC-PA1, "Shop, Field and Maintenance Painting".
- B. The Contractor's coating crew superintendent shall have five years practical experience and successful history in the application of specified product to surfaces of steel water tanks and be knowledgeable in all coating test procedures. Applicators shall have at least two years of experience in the surface preparation and application of coatings as described above. Upon request, the Contractor shall substantiate this requirement by furnishing a list of references and job completions.

1.04 QUALITY ASSURANCE

- A. General: Quality assurance procedures and practices shall be utilized to monitor all phases of surface preparation, application and inspection throughout the duration of the project. Procedures or practices not specifically defined herein may be utilized provided they meet recognized and accepted professional standards and are reviewed by the Engineer.
- B. Surface Preparation: Surface preparation will be based upon comparison with: "Pictorial Surface Preparation Standards for Painting Steel Surfaces: SSPC-VIS 1-89", ASTM D2200-95, "Standard Methods of Evaluating Degree of Rusting on Painted Surfaces", ASTM D 4417-91, Method A and/or Method C or NACE Standard RP0287-87. In all cases the written standard shall take precedence over the visual standard. In addition, NACE Standard RP0178-91, along with the Visual Comparator, shall be used to verify the surface preparation of welds.
- C. Application: No coating shall be applied when: 1) the surrounding air temperature or the temperature of the surface to be coated is below the minimum surface temperature for the products specified herein, 2) rain, snow, fog or mist is present, 3) the surface temperature is less than 5oF above the dew point, 4) the air temperature is expected to drop below the minimum temperature for the products specified within six hours after application of coating. Dewpoint shall be measured by use of an instrument such as a Sling Psychrometer in conjunction with U.S. Department of Commerce Weather Bureau Psychometric Tables. If any of the above conditions are prevalent, coating shall be delayed or postponed until conditions are favorable. The day's coating shall be completed in time to permit the film sufficient drying time prior to damage by atmospheric conditions.
- D. Measurement of Surface Profile After Blasting:
 - 1. Verify that required anchor profile, as specified herein, has been achieved using PRESS-O-FILMTM testing coupons available from Testex; Newark, Delaware, or Engineer reviewed equivalent.
 - 2. Use one test coupon for every 100 square feet of blast-cleaned surface.
 - 3. Sequentially number each test coupon and record on the coupon the location where anchor profile was measured and the value measured for anchor profile.
 - 4. Deliver all test coupons to the Owner as part of the Test Report described in Paragraph 3.10 of this Section.

E. Thickness Checking:

1. Coating film thickness shall be verified by measuring the wet film thickness of each coat as it is applied and the dry film thickness of the entire system. When film thicknesses are indicated without an indicated tolerance, the allowable gage tolerance shall be twice the indicated accuracy of the measurement; that is, for a measurement with an indicated accuracy of ± 0.25 mil, the allowable tolerance is ± 0.5 mil.

- 2. The wet film thickness shall be measured with a gage that will measure the wet film thickness within an accuracy of ± 0.5 mil. A wet film thickness measurement shall be made for each 100 sq. ft. of surface painted.
- 3. Dry film thickness of coatings shall be checked with a non-destructive, magnetic-type thickness gauge, as per SSPC-PA 2 "Measurement of Dry Film Thickness with Magnetic Gages", within an accuracy of ±0.25 mil. As many dry film thickness measurements as feasible shall be made so that there is approximately one measurement for each 100 sq. ft. of surface painted. References in PA 2 which allow 80% of the minimum thickness specified are not acceptable. Use an instrument such as a Tooke Gauge if a destructive test is deemed necessary by the Engineer.
- F. Holiday Checking: The integrity of 100 percent of interior coated surfaces below the high water mark shall be checked with a wet sponge low voltage holiday detector in accordance with NACE Standard RP0188 after the paint has cured to the extent recommended by coatings manufacturer or seven (7) days after the final coat has been applied, whichever is longer. Non-destructive holiday detector shall not exceed 67.5 volts, nor shall destructive holiday detector exceed the voltage recommended by the manufacturer of the coating system. The sponge shall be kept saturated with an electrolyte (5 percent sodium chloride) and a non-sudsing surfactant wetting agent solution, such as one ounce of Kodak Photo-Flo per gallon of tap water. During testing, the wet sponge shall be kept in continuous contact with the coated surface. All pinholes and/or holidays shall be marked and repaired in accordance with the manufacturer's printed recommendations and retested. No pinholes or other irregularities will be permitted in the final coating. The term "pinhole free" is defined as being absolutely continuous.
- G. MEK Double Rub Test (ASTM D5402): After the tank has reached "full cure" in accordance with the recommendations and written published data sheets of the coating manufacturer, the inspector shall perform MEK double rub tests to verify curing of the interior coating system.
- H. Inspection Devices: Until final acceptance of coating, the coating inspector shall have on the job site inspection devices in good working condition for measurement of surface profile after blasting, for detection of holidays, and measurement of dry film thickness of coating. The coating inspector shall also furnish U.S. Department of Commerce, National Bureau of Standards certified thickness calibration plates and/or plastic shims, depending upon the thickness gauge used, to test the accuracy of dry film thickness gauges and certified instrumentation to test the accuracy of holiday detectors. Dry film gauges and holiday detectors shall be made available for the Engineer's use at all times until final acceptance of application. Holiday detection devices shall be operated in the presence of the Engineer.
- I. Inspection: Inspection of coatings for this project shall consist of inspections conducted by an independent NACE certified test lab or an individual coatings inspector with a minimum of 5 years documented experience on similar projects. At

a minimum, the inspector shall inspect and test the surface prior to abrasive blasting, after abrasive blasting but prior to application of coating materials, and between subsequent coats of material. Final inspection shall take place after all coatings are applied, but prior to placing the tank in service. Contractor shall insure that sufficient rigging is in place so that the inspector shall be able to conduct the required inspections. The Independent Testing Laboratory shall provide certification to the Engineer that the tank surface was prepared in accordance with coating manufacturer's recommendations prior to the start of coating application work. All testing costs and services regarding inspection and testing of surface preparation and coating work are the sole responsibility of the Contractor, and no separate payment will be made thereof.

J. Warranty Inspection: Warranty inspection shall be conducted during the eleventh month following acceptance of all coating work. All defective work shall be repaired in accordance with this specification and to the satisfaction of the Engineer and/or Owner.

1.05 SAFETY AND HEALTH REQUIREMENTS

- A. General: In accordance with requirements set forth by regulatory agencies applicable to the construction industry and manufacturer's printed instructions and appropriate technical bulletins and manuals, the Contractor shall provide and require use of personal protective lifesaving equipment for persons working on or about the project site. The Contractor's work forces should comply with the provisions outlined in SSPC-PA-3 "Guide to Safety in Paint Application".
- B. Head and Face Protection and Respiratory Devices: Equipment shall include protective helmets which shall be worn by all persons while in the vicinity of the work. In addition, workers engaged in or near the work during sandblasting shall wear eye and face protection devices and air purifying half-mask or mouthpiece respirators with appropriate filters. Barrier creams shall be used on any exposed areas of skin.
- C. Ventilation: Where ventilation is used to control hazardous exposure, all equipment shall be explosion-proof. Ventilation shall reduce the concentration of air contaminants to a degree a hazard does not exist. Air circulation and exhausting of solvent vapors shall be continued until coatings have fully cured.
- D. Sound Levels: Whenever the occupational noise exposure exceeds maximum allowable sound levels, the Contractor shall provide and require the use of reviewed ear protection devices.
- E. Illumination: Adequate illumination shall be provided while work is in progress, including explosion-proof lights and electrical equipment. Whenever required by the Engineer, the Contractor shall provide additional illumination and necessary supports

- to cover all areas to be inspected. The level of illumination for inspection purposes shall be at least 40 foot-candles.
- F. Temporary Ladders and Scaffolding: All temporary ladders and scaffolding shall conform to applicable safety requirements. They shall be erected where requested by the Engineer to facilitate inspection and be moved by the Contractor to locations requested by the Engineer.

1.06 SUBMITTALS:

- A. Product Data: Section 01 33 23 Shop Drawings, Product Data, and Samples.
- B. Manufacturer's product specific application instructions.
- C. Schedule of products to be used in each application and mil thicknesses to be applied in accordance with manufacturer's recommendations.
- D. Manufacturer's standard color selection chart.
- E. Qualifications of NACE certified Independent Testing Laboratory personnel performing specified inspections and tests. Complete and submit Qualifications Form presented at end of this Section.
- F. Test Report of Dry Film Thicknesses.

1.07 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. All materials shall be brought to the jobsite in original sealed containers. They shall not be used until the Engineer has inspected the contents and obtained data from information on containers or label. Materials exceeding storage life recommended by the manufacturer shall be rejected.
- B. All coating materials shall be stored in enclosed structures to protect them from weather and excessive heat or cold. Flammable coatings shall be stored to conform with City, County, State and Federal safety codes for flammable coating or paint materials. At all times, coating materials shall be protected from freezing.

PART 2 MATERIALS

2.01 ACCEPTABLE MANUFACTURERS

A. Materials specified are those that have been evaluated for the specific service.

Products of the Tnemec Company, Inc. are listed to establish a standard of quality.

Equivalent materials of other manufacturer's may be submitted on written approval of the Engineer. As part of the proof of equality, the Engineer will require at the cost of the Contractor, certified test reports from a nationally known, reputable and

- independent testing laboratory conducting comparative tests as directed by the Engineer between the product specified and the requested substitution.
- B. Requests for substitution shall include manufacturer's literature for each product giving name, product number, generic type, descriptive information, solids by volume, recommended dry film thickness, percent VOC or solvent, recommended application temperature range, pot life, shelf life, and certified lab test reports showing results to equal the performance criteria of the products specified herein. In addition, a list of five projects shall be submitted in which each product has been used and rendered satisfactory service.
- C. Manufacturer's color charts shall be submitted to the Engineer at least 30 days prior to coating application. General Contractor and Painting Contractor shall coordinate work so as to allow sufficient time (normally seven to ten days) for coating materials to be delivered to the job site.

2.02 GENERAL REQUIREMENTS

- A. All materials for the interior wetted portion of the tank shall comply with the requirements of ANSI/NSF Standard 61 for potable water contact.
- B. All materials shall be lead-free as defined by the Consumer Product Safety Act, Part 1303.
- C. All zinc dust pigment contained in any zinc-rich material shall meet the requirements of ASTM D 520 Type III with regard to zinc content and purity.
- D. All high-gloss clear-coat products shall incorporate the use of a fugitive dye to aid in the proper application and coverage of such coats.
- E. All catalyzed polyurethane products shall at a minimum meet the requirements of SSPC Paint Specification Number 36, Level 3 Performance Level.
- F. No products containing MOCA (4,4' methylenebis (2-chloroaniline)) will be allowed.
- G. Inorganic zinc-rich primers shall not be utilized as a permanent part of the interior coating system on this project. Inorganic zinc-rich pre-primers shall be completely blasted and removed prior to installing the coating system on the interior water compartment. All surface preparation shall be to the degree specified herein.
- H. All coating materials shall be VOC compliant, containing no more than 2.8 lbs. VOC/gallon (340 g/L), and shall be certified lead and chromate free.

2.03 MATERIAL PREPARATION

A. Mix and thin materials according to manufacturer's latest printed instructions.

- B. Do not split kits of multi-component products.
- C. Do not use materials beyond manufacturer's recommended shelf life.
- D. Do not use mixed materials beyond manufacturer's recommended pot life.

2.04 TANK INTERIOR COATING SYSTEMS

- A. Three Coat High-Build, Zinc/Epoxy System:
 - 1. Surface Preparation Prior to Abrasive Blast Cleaning: All weld flux and spatter shall be removed by power tool cleaning. Sharp projections shall be ground to a smooth contour. All welds shall be ground to a smooth contour as per NACE Standard RP0178 and herein.
 - 2. Surface Preparation: SSPC-SP10 Near-White Metal Blast Cleaning. Anchor profile shall be 1.5 to 2.5 mils as per ASTM D 4417, Method C or NACE Standard RP0287.
 - 3. Coating System:
 - a. Shop Prime Coat: Applied at 2.5 to 3.5 dry mils. Tnemec Series 91-H2O Hydro-Zinc. Thin only with approved thinner, Tnemec 41-2 or 41-3 Thinner.
 - b. Field Prime Coat (Unprimed Weld Seams and Touch-Up Areas Only): Applied at 4.0 to 6.0 dry mils. Tnemec Series 20 or 20HS Beige Pota-Pox. Thin only with approved thinner, Tnemec 41-4 Thinner.
 - c. Stripe Coat: Applied by brush and scrubbed into all weld seams. In addition to weld seams, all edges, corners, bolts, rivets, and pits shall receive a stripe coat. Themec Series 20 or 20HS Tank White Pota-Pox.
 - d. 2nd Coat: Applied at 4.0 to 6.0 dry mils. Tnemec Series 20 or 20HS Beige Pota-Pox. Thin only with approved thinner, Tnemec 41-4 Thinner.
 - e. 3rd Coat: Applied at 4.0 to 6.0 dry mils. Tnemec Series 20 or 20HS Tank White Pota-Pox. Thin only with approved thinner, Tnemec 41-4 Thinner.
 - f. Total dry film thickness shall be a minimum of 12 dry mils per SSPC-PA 2 dry film inspection standards, with exception as noted in this specification.
 - g. For cold weather applications, Series 44-700 Urethane Accelerator may be added to Series 91-H2O.

2.05 TANK EXTERIOR COATING SYSTEMS

- A. Three Coat System for Extended Color and Gloss Retention:
 - 1. Surface Preparation Prior to Abrasive Blast Cleaning: All weld flux and spatter shall be removed by power tool cleaning. Sharp projections shall be ground to a smooth contour. All welds shall be ground to a smooth contour as per NACE Standard RP0178 and herein.
 - 2. Surface Preparation: SSPC-SP6 Commercial Blast Cleaning. Anchor profile shall be 1.5 to 2.0 mils as per ASTM D 4417, Method C or NACE Standard RP0287.

3. Coating System:

- a. Shop Prime Coat: Applied at 2.5 to 3.5 dry mils. Themec Series 91-H20 Hydro-Zinc. Thin only with approved thinner, Themec 41-2 or 41-3 Thinner.
- b. 2nd Coat: Applied at 4.0 to 6.0 dry mils. Themec Series 20 or 20HS Pota-Pox. Thin only with approved thinner, Themec 41-4 Thinner. (Two coats may be required if applied by roller.)
- c. 3rd Coat: Applied at 3.0 to 4.0 dry mils. Tnemec Series 1074 U/Gloss Color Endura-Shield II. (Two coats may be required if applied by roller.)
- d. Total dry film thickness shall be a minimum of 9.5 dry mils per SSPC-PA 2 dry film inspection standards, with exception as noted in this specification.
- e. For cold weather applications, Series 44-710 Urethane Accelerator may be added to Series 1074 U/Gloss at the rate specified on the Series 44-710 product data sheet.

4. Color:

a. Finish coat color selected by Owner from coating system manufacturer's standard colors. Prime and intermediate coats shall be contrasting colors to aid in application of proper coverage.

B. Exterior Tank Floor (Underside):

1. Shop blast the underside of the tank floor with a wheel abrader, and apply 2.0 to 3.0 dry mils of corrosion resistant alkyd industrial enamel paint.

C. Interior Roof Laps:

1. All interior roof lap joints shall be sealed with Sikaflex-1a polyurethane elastomeric sealant after the coating system has been installed.

PART 3 EXECUTION

3.01 GENERAL

- A. All surface preparation and coating shall conform to applicable standards of the Society for Protective Coatings (SSPC), NACE International and the manufacturer's printed instructions. Materials applied to the surface prior to the approval of the Engineer shall be removed and re-applied at no additional cost to the Owner.
- B. All work shall be performed by skilled craftsmen qualified to perform the required work in a manner comparable with the best standards of practice.
- C. The Contractor shall provide a supervisor at the work site during cleaning and application operations. The supervisor shall have the authority to sign change orders, coordinate work and make decisions pertaining to the fulfillment of the Contract.

- D. Dust, dirt, oil, grease or any foreign matter that will affect the adhesion or durability of the coating shall be removed by washing with clean rags dipped in an approved cleaning solvent and wiped dry with clean rags.
- E. Coating systems include surface preparation, prime coating and finish coatings. Unless otherwise approved in writing by the Engineer, prime coating shall be field applied. Where prime coatings are shop applied, the Contractor shall instruct suppliers to provide the prime coat compatible with the specified finish coat. Any off-site work which does not conform to this specification, or is subjected to damage during transportation, construction or installation shall be thoroughly cleaned and touched-up in the field as directed by the Engineer. The Contractor shall use repair procedures which insure the complete protection of all adjacent primer. The specified repair method and equipment may include wire-brushing, hand or power tool cleaning, or dry air blast cleaning. In order to prevent injury to surrounding painted surfaces, blast cleaning may require use of lower air pressure, smaller nozzle and/or abrasive blast particles, or shorter blast nozzle distances from surface shielding and masking. If damage is too extensive or uneconomical to touch-up, the entire item shall be blasted and then coated as directed by the Engineer.
- F. The Contractor's coating equipment shall be designed for application of materials specified and shall be maintained in first class working condition. Compressors shall have suitable traps and filters to remove water and oils from the air. Contractor's equipment shall be subject to approval of the Engineer.
- G. Application of the first coat shall follow immediately after surface preparation and cleaning and stripe coat, if applicable, before rust bloom occurs or the same day, whichever is less. Any cleaned areas not receiving first coat within this period shall be recleaned prior to application of first coat. Use of dehumidification equipment shall be first reviewed by the Engineer and coatings manufacturer prior to deviating from this provision.
- H. Prior to assembly, all surfaces made inaccessible after assembly shall be prepared as specified herein and shall receive the coating system specified.

3.02 SURFACE PREPARATION

- A. The latest revision of the following surface preparation specifications of the Society for Protective Coatings (SSPC) shall form a part of this specification. The summaries listed below are for informational purposes; consult the actual SSPC specification for full detail.
 - 1. Solvent Cleaning (SSPC-SP1): Removal of oil, grease, soil and other contaminants by use of solvents, emulsions, cleaning compounds, steam cleaning or similar materials and methods which involve a solvent or cleaning action.

- 2. Hand Tool Cleaning (SSPC-SP2): Removal of loose rust, loose mil scale and other detrimental foreign matter to a degree specified by hand chipping, scraping, sanding and wire-brushing.
- 3. Power Tool Cleaning (SSPC-SP3): Removal of loose rust, loose mil scale and other detrimental foreign matter by power wire-brushing, power impact tools or power sanders.
- 4. White Metal Blast Cleaning (SSPC-SP5/NACE No. 1): Air blast cleaning to a gray-white uniform metallic color until each element of surface area is free of all visible residues.
- 5. Commercial Blast Cleaning (SSPC-SP6 NACE No. 3): Air blast cleaning until at least two-thirds of each element of surface area is free of all visible residues.
- 6. Brush-Off Blast Cleaning (SSPC-SP7 NACE No. 4): Air blast cleaning to remove loose rust, loose mil scale and other detrimental foreign matter to a degree specified.
- 7. Near-White Metal Blast Cleaning (SSPC-SP10 NACE No. 2): Air blast cleaning until at least 95% of each element of surface area is free of all visible residues.
- 8. Power Tool Cleaning to Bare Metal (SSPC-SP11): Differs from SSPC-SP3 in that it requires more thorough cleaning and a surface profile not less than 1 mil.
- B. Slag, weld metal accumulation, and spatters not removed by the Fabricator, Erector or Installer shall be removed by chipping and/or grinding. All sharp edges shall be peened, ground or otherwise blunted as required by the Engineer. All grinding and finishing of welds, edges, etc. shall be performed prior to solvent cleaning and abrasive blasting. Welds shall be prepared as per NACE Standard RP0178 for all interior and exterior surfaces:
 - 1. Butt Welds: Shall be ground smooth and free of all defects, designation "D".
 - 2. Lap Welds: Shall be ground smooth and blended, designation "D".
 - 3. Fillet Welded Tee Joint: Shall be ground smooth and blended, designation "D".
- C. Field blast cleaning for all surfaces shall be by dry method unless otherwise directed. Blast nozzles shall be venturi-type nozzles with a minimum pressure at the nozzle of 90 psi.
- D. Particle size of abrasives used in blast cleaning shall be that which will produce a 1.5-2.5 mil (37.5 microns 65.0 microns) surface profile or in accordance with recommendations of the manufacturer of the specified coating system to be applied.
 - 1. If the profile of the blasted steel exceeds the profile specified above, the Contractor will be required to do one or both of the following:
 - a. Reblast the surface using a finer aggregate in order to produce the required profile.
 - b. Apply a thicker prime coat, if possible, given the limitations of the products being applied, in order to adequately cover the blast profile.

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- E. Abrasive used in blast cleaning operations shall be new, washed, graded and free of contaminants that would interfere with adhesion of coating and shall not be reused unless specifically approved in writing by the Engineer.
- F. During blast cleaning operations, caution shall be exercised to insure that existing coatings are not exposed to abrasion from blast cleaning.
- G. The Contractor shall keep the area of his work and the surrounding environment in a clean condition. He shall not permit blasting materials to accumulate as to constitute a nuisance or hazard to the accomplishment of the work, the operation of the existing facilities or to the surrounding environment.
- H. Blast cleaned surfaces shall be cleaned prior to application of specified coatings. All surfaces shall be free of dust, dirt, and other residue resulting from the abrasive blasting operation. No coatings shall be applied over damp or moist surfaces.
- I. All welds shall be neutralized with a suitable chemical compatible with the specified coating.
- J. Pitted areas on the tank interior shall be repaired by either filling with Tnemec Series 63-1500 Epoxy Filler and Surfacer or by welding. Epoxy filler shall be feathered smooth. Filler shall be applied after the prior to the application of the finish coat. No protrusions or spatter will be allowed. Pits deeper than 1/8" shall be filled by welding.
- K. Specific Surface Preparation: Surface preparation for the specific system shall be as noted in Sections 2.04 and 2.05.

3.03 NON-VISIBLE CONTAMINANTS

- A. Chloride, sulfate and ferrous ions (Fe2+) tests shall be performed on the interior metal portions of the tank after sandblasting but prior to the application of coatings. The maximum allowable limit of these non-visible contaminants is:
 - 1. The maximum level of chlorides is 30 milligrams per square meter or 3 micrograms per square centimeter.
 - 2. The maximum level of sulfates is 100 milligrams per square meter or 10 micrograms per square centimeter.
 - 3. The maximum level of ferrous ions (Fe2+) is 50 milligrams per square meter or 5 micrograms per square centimeter.
- B. If testing shows amounts present in the test solution to be greater than the limits listed herein, the Contractor shall, at no additional cost to the Owner, clean the surface of the entire tank interior with a 5,000 psi water blast with fine entrained abrasive until the levels in the test solutions are below the maximum acceptable level. Alternate cleaning methods may be allowed with prior approval of the Engineer. Surface shall be reblasted as specified in 2.04 and 2.05 at no additional cost to the Owner.

C. Contractor shall provide a written statement from coating materials manufacturer stating that the maximum acceptable levels are not less than those listed herein. Results of the testing shall be provided to the Engineer before any coatings are applied.

3.04 APPLICATION, GENERAL

- A. Coating application shall conform to the requirements of the Society for Protective Coatings Paint Application Specification SSPC-PA1, latest revision, for "Shop, Field and Maintenance Painting".
- B. Thinning will be permitted only as recommended by the manufacturer and reviewed by the Engineer, and utilizing the thinners specified in Sections 2.04 and 2.05.
- C. Each application of coating shall be applied evenly, free of brush marks, sags, runs, with no evidence of poor workmanship. Care shall be exercised to avoid lapping on glass or hardware. Coatings shall be sharply cut to lines. Finished surfaces shall be free from defects or blemishes.
- D. Protective coverings or drop cloths shall be used to protect floors, fixtures and equipment. Care shall be exercised to prevent coatings from being spattered onto surfaces which are not to be coated. Report to the Engineer surfaces from which materials cannot be satisfactorily removed.
- E. When two coats of coating are specified, where possible, the first coat shall contain sufficient approved color additive to act as an indicator of coverage or the two coats must be of contrasting color.
- F. Film thickness per coat as specified in Sections 2.04 and 2.05 are the minimum required. If roller application is deemed necessary, the Contractor shall apply additional coats as to achieve the specified thickness.
- G. All material shall be as specified.

3.05 COATING SYSTEMS APPLICATION

- A. After completion of surface preparation as specified for the specific system, materials shall be applied as noted in Sections 2.04 and 2.05.
- B. Care shall be taken so as to eliminate overspray and dry spray on the tank interior. Where such conditions are encountered, the surface shall be cleaned of all over spray and dry spray prior to the application of the succeeding coat.
- C. Areas rendered inaccessible after tank erection such as the spaces between roof plates and rafters shall receive the full coating system prior to erection and/or assembly.
- D. Full prime coat may be applied directly over stripe coat while stripe coat is wet.

3.06 DISINFECTION

- A. Disinfection of interior surfaces shall be performed in the presence of the Engineer in accordance with Section 33 16 13.13 Steel Aboveground Water Utility Storage Tanks.
- B. Disinfection shall be performed after protective coatings have been applied to the interior surfaces and allowed to thoroughly cure.
- C. Prior to disinfecting, the complete interior shall be washed down with clean water and thoroughly flushed out.
- D. All interior surfaces shall be thoroughly washed with a solution having a minimum chlorine content of 50 PPM. Chlorine solution accumulated on the bottom shall be drained to waste. Rinsing with clean water is not required.

3.07 SOLVENT VAPOR REMOVAL

- A. All solvent vapors shall be completely removed by suction-type exhaust fans and blowers before placing tank in operating service.
- B. All solvent vapors will be exhausted both during and after coating application as per AWWA D102 to allow the proper curing of the coating material.
- C. Ventilation shall be continued until such time as the coating has reached "full cure" as specified by the coating manufacturer.

3.08 VOC TEST

- A. After the tank has reached "full cure" as specified by the coating manufacturer, VOC tests shall be performed on the tank interior coating system. Samples shall be collected for testing by the Owner or his representative. Tests shall be performed in accordance with EPA 524.2 Revision 4 Purgeable VOCs by GC/MS. Total VOCs shall not exceed 100 ppb/100 micrograms per liter for 24-hour and 72-hour intervals.
- B. If the limits cited herein are exceeded, the Contractor shall take all actions necessary to reduce the total VOCs to the level specified herein. This includes but is not limited to continuing forced air ventilation, steam cleaning the structure, and rinsing the structure with clean potable water.

3.09 CLEAN UP

A. Upon completion of the work, all staging, scaffolding, blasting materials, and containers shall be removed from the site or destroyed in a manner reviewed by the Engineer. Coating spots or oil stains upon adjacent surfaces shall be removed and the jobsite cleaned. All damage to surfaces resulting from the work of this section shall

be cleaned, repaired or refinished to the satisfaction of the Engineer at no additional cost to the Owner.

3.10 TEST REPORT OF DRY FILM THICKNESS

A. A Test Report shall be prepared and submitted to the Owner at the conclusion of dry film thickness testing indicating the film thickness gage used, the locations where tests were made, the surface profile measurements, the dry film thickness at each location, and the name of the person making the tests. The Test Report shall be certified by a representative of the Contractor who witnessed the testing. If an Owner's representative was present at the time that testing was performed, the Test Report shall indicate the name of the Owner's representative.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
4.01	Coatings for Steel Water	Lump Sum
	Storage Tanks	_

END OF SECTION

Project Name	
Owner	

QUALIFICATIONS FORM FOR INDEPENDENT TESTING LABORATORY TO PERFORM TESTING OF SURFACE PREPARATION AND TANK COATING WORK PER SPECIFICATION SECTION 09 97 13.01 – COATINGS FOR WELDED STEEL WATER STORAGE TANKS

Name	e of Laboratory or Individual:
Addr	ess:
Phon	e:
Perso	onnel to perform testing
1.	Name:
	NACE Certified:yes Attach Certificationno
	If not, list other experience and formal training and attach certificate:
	<u> </u>
	<u> </u>
2.	Name:
	NACE Certified:yes Attach Certificationno
	If not, list other experience and formal training and attach certificate:
	This form shall be completed and submitted under Paragraph 1.06, Submittals. The

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Independent Testing Laboratory shall be reviewed by the Engineer prior to the start of any

work by the Laboratory.

SECTION 10 14 00

SIGNAGE

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Furnish and install signs listed in this Section with required mounting hardware.
- 1.02 RELATED WORK/REQUIREMENTS SPECIFIED ELSEWHERE
 - A. Division 01

1.03 SUBMITTALS

- A. Section 01 33 23 Shop Drawings, Product Data, and Samples:
 - 1. Product Data and Samples.
 - 2. Text Schedule.
 - 3. Samples of standard engraved sign colors.

1.04 QUANTITY

A. One (1) sign required for each description unless otherwise indicated.

PART 2 SAFETY

2.01 SAFETY SIGNS

- A. Comply with OSHA 29 CFR 1910.145
- B. Where scheduled and where standard graphics and wording are available, comply with ANSI Z535.2 Environmental Facility and Safety Signs.
- C. Wording: As scheduled, but may vary slightly to accommodate manufacturer's standard and comply with OSHA requirements.
- D. Size: 10" x 7" unless otherwise scheduled.
- E. Material and Construction:
 - 1. Aluminum (AL):
 - a. 40 mil aluminum with vinyl clad finish, can endure temperatures -40° to 170°F.
 - b. Rounded corners with mounting holes.
- F. Color: OSHA standard if applicable, otherwise as scheduled.

- G. Attachment and Mounting of Safety Signs: Use methods listed below as appropriate:
 - 1. Adhesive.
 - 2. Countersunk screws.
 - 3. Hung from two stainless steel or galvanized chains from handrails, pipes, and similar features.
 - 4. Where suitable mounting surfaces does not exist, mount on two vertical stainless steel unistrut posts with stainless steel hardware. Anchor posts to concrete surfaces or bury 2.5'in concrete footing.

2.02 SITE SIGNS

- A. Panel Material and Thickness:
 - 1. Galvanized steel: 18 gage, or
 - 2. 6061-T6 or 5052-H38 aluminum: 0.08" for less than 24" panel width, 0.12" minimum thickness for 24" and larger panel width.
 - 3. Reflectorized only if scheduled.
- B. Format: In accordance with "Manual of Uniform Traffic Control Devices".
- C. Letter Height: 6 inches.
- D. Color: To be selected from manufacturer's color charts.
- E. Posts: 3 lb/ft galvanized square tube steel post with 2.5' bury, 4' plus or minus bottom of sign, unless otherwise noted.
- F. Hardware: Galvanized, cadmium plated or stainless steel bolts, nuts and washers; 0.75" outside diameter washer on face side of signs.
- G. Signs: See Schedule.

2.03 ENGRAVED LAMINATED PLASTIC SIGNS

- A. Construction: Two contrasting colors of plastic stock laminated together for single-side engraving. Top layer is engraved through with the specified text thereby exposing the base layer.
- B. Materials:
 - 1. Exterior/interior use rated laminated impact acrylic.
 - 2. Fade Resistant: No noticeable change in color after 300 hours of exposure to xenon arc light per ASTM G155.
 - 3. Temperature Range: -40°F to 175° F.
 - 4. Colors: Engineer will select top and base layer colors from manufacturer's standard selection of submitted samples.
 - 5. Total Thickness: 0.125".
 - 6. Edges: Saw cut and buffed.
- C. Acceptable Manufacturers: E.R. Perry Signs & Engraving, Grand Marias, MN, (218) 387-9479, http://plastic-tags.com., or Engineer reviewed equivalent.

- D. Attachment, as appropriate:
 - 1. Adhesive.
 - 2. Countersunk screws.
 - 3. Hung from two stainless steel or galvanized chains from handrails, pipes, and similar features where suitable mounting surface does not exist.
- E. Font: Block style lettering, all capitals, 0.5" high, unless otherwise noted.
- F. Size: Signs uniformly sized for similar functions.
- G. Text: See Schedule.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Furnish mounting and attachment hardware for all signage as appropriate or as directed by Engineer.
- B. Install centered and level, in line, and in accordance with manufacturer's recommendations.
- C. Clean and polish, remove excess adhesive.
- D. Posts required only where scheduled.

3.02 SCHEDULE OF SIGNS

- A. Safety Signs:
 - 1. "Danger, Equipment Starts Automatically"
 - a. Location: On piping near booster pumps.
 - b. Quantity: Two (2)
 - 2. "Authorized Personnel Only"
 - a. Location: On Pump Building and Tank.
 - b. Quantity: Two (2)
- B. Site Signs:
 - 1. "Hondo 2 Pump Station"
 - a. Location: On building
 - b. Quantity: Two (2)
- C. Engraved Laminated Plastic Signs (1 each required unless noted otherwise):
 - 1. Hondo 2 Pump Station:

a.	"Suction Header"	On pipe
b.	"Booster Pump"	On motor
c.	"High Service Pump 1"	On motor
d.	"High Service Pump 2"	On motor
e.	"Discharge Header"	On pipe

f. "Relief Valve" On valve g. "Hydropneumatic Tank" On tank

- D. Other signs to be provided and installed later; wording to be provided by the Engineer near end of construction.
 - 1. Safety Signs: 4 required; all will be standard stock wording.
 - 2. Site Signs: 2 required.
 - 3. Engraved Laminated Signs: 8 required.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
5.01	Signage	Lump Sum

END OF SECTION

SECTION 10 44 00

FIRE EXTINGUISHERS AND ACCESSORIES

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Fire Extinguishers
- B. Accessories
- C. The extent of portable fire extinguishers and brackets are shown on the Drawings.

1.02 REFERENCES

- A. NFPA10-Portable Fire Extinguishers
- B. American National Standard ANSI A-117.1 2003
- C. Underwriters Laboratories Inc.: UL Fire Protection Equipment Directory.

1.03 QUALITY ASSURANCE

- A. Conform to NFPA 10 requirements for portable fire extinguishers.
- B. Provide fire extinguishers and accessories by a single manufacturer.

1.04 SUBMITTALS

- A. Submit brochure and product data in compliance with Section 01 33 23 Shop Drawings, Product Data, and Samples.
- B. Operation and Maintenance Data: Submit test, refill or recharge schedules and re-certification requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. J.L. Industries, Inc., 4450 West 78th Street Circle, Bloomington, MN 55435, (952) 835-6850, Fax: (952) 835-2218
- B. Larsen's Manufacturing Company
- C. Badger Fire Protection

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D. Potter Roemer.

2.02 FIRE EXTINGUISHERS

A. 10 lb. capacity Multipurpose Dry Chemical Type, UL listing 4A-60B:C.

2.03 ACCESSORIES

- A. Provide Extinguisher Brackets sized to support extinguisher type where brackets are indicated on the Drawings.
- B. Graphic Identification: provide vertical wall signage to be applied to wall surface above each extinguisher furnished

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install items included in this section in locations and at mounting heights indicated:
 - 1. Install wall brackets, maximum 48 inches from finish floor to top of extinguisher handle
- B. Securely fasten mounting brackets to structure, square and plumb, to comply with manufacturer's instructions.
- C. Position signage as required by authorities having jurisdiction

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
5.01	Fire Extinguishers	Lump Sum

END OF SECTION

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SECTION 23 09 13

THERMOSTATS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Thermostats.

1.02 SUBMITTALS

- A. Section 01 33 23 Shop Drawings, Product Data, and Samples.
- B. Complete manufacturer's catalog cuts.
- C. Engraving schedule.

PART 2 PRODUCTS

2.01 THERMOSTATS

- A. Enclosure: Withstand high humidity, dust, dirt, lint, and grease.
- B. Viewing Slots: Display setting and thermometer reading.
- C. Setting: Removable knurled knob at side.
- D. Dial calibration:
 - 1. 80° to 110° for cooling applications.
 - 2. 38° to 70°F for heating applications.
- E. Built-in bi-metallic thermometer.
- F. Steel and Brass Parts: Cadmium plated.
- G. Contacts: Mercury switch, DPST open on rise or open on fall as required by application.
- H. Contact Ratings: 4A at 120VAC, 2A at 240VAC, 1/8 HP, single phase, 120/240VAC.
- I. Mercoid Series 860 or Engineer approved equivalent.

2.02 THERMOSTAT SENSOR/TRANSMITTER ASSEMBLY

- A. RTD sensor and transmitter assembly mounted and completely enclosed in standard thermostat housing.
 - 1. RTD:
 - a. 100 ohm platinum

- b. Temperature coefficient: .00385
- c. Range: 0° to 100°F
- 2. Transmitter:
 - a. 24v loop powered
 - b. Accepts RTD temperature sensor as input.
 - c. Outputs 4-20mA signal proportional to the sensor input into 650 ohms maximum impedence.
 - d. Screw terminal connections.
 - e. Zero and span potentiometers.
- B. Pyromation #2215-T26-222-6240-H or Engineer approved equivalent.

PART 3 EXECUTION

3.01 MOUNTING

A. Unless shown otherwise on the Drawings, mount the box for a thermostat on an 8-inch by 8-inch by 3/4-inch piece of varnished AC plywood which is firmly mounted to the wall.

3.02 NAMEPLATE

A. Install nameplate above thermostat to identify equipment being controlled.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
5.01	Thermostats	Lump Sum

END OF SECTION

SECTION 26 00 10

GENERAL CONDITIONS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Labor, equipment, tools, materials, supplies, and operations necessary to install a complete electrical system, including that which may be reasonably implied on the Drawings or in the Specifications as being incidental to the work of Division 26.
- B. Labor, equipment, tools, materials, supplies, and operations required to make a completely electrically operable system of the equipment furnished under other Divisions of this Specification.

1.02 MISCELLANEOUS MATERIALS

A. The Drawings are not intended to and do not show all equipment such as junction boxes, outlet boxes, conduit, fittings, mounting and miscellaneous hardware, and similar. Even though such items may not be specifically mentioned in the Specifications nor shown on the Drawings, nor noted on Shop Drawings, if they are necessary to make a complete installation, include them in the work required under this Division.

1.03 QUALITY ASSURANCE

- A. Use only thoroughly trained and experienced personnel who are completely familiar with the requirements of this work and with the recommendations of the manufacturer of the specified items to fabricate, install, and test the work of this Division.
- B. Where the Specifications or Drawings call for equipment or methods to be of better quality or higher standards than required by referenced Codes or Standards, the Specifications and Drawings shall prevail.

1.04 SUBSTITUTIONS

- A. When requesting substitution of material for products specified in this Division, comply with Section 01 25 00 Substitution Procedures. Include as part of the request detailed descriptions and drawings showing all resultant changes to the electrical work.
- B. The design of certain equipment may be related to factors not immediately obvious. Changes in design of equipment may require technical justification, or require changes be made in other equipment to match the proposed changes, or require the equipment be supplied as specified, or any combination of the above, at no additional cost to the Owner.

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1.05 LOCATION OF ELECTRIC EQUIPMENT

- A. The Drawings or other Specification sections define the approximate location of services, cabinets, panelboards, switches, lights, receptacles, and other equipment. Determine the most suitable location by actual measurement during construction. Maintain clearance required by NEC Article 110. Propose final location and obtain approval of the Engineer in advance of installation.
- B. Coordinate location and configuration of electrical work with the work of other trades to avoid interference, to assure convenient access for operation and maintenance of equipment, for optimum luminaire placement, and for neat appearance.

1.06 SIZE AND RATING OF MATERIALS

- A. The size and rating of the conductors, conduits, overcurrent protection devices, disconnect devices, motor starters, and other related equipment used to provide and control electric supply to the various power consuming equipment furnished under this contract have been determined based on the requirements of the specified equipment. If the requirements of the power consuming equipment actually furnished causes a need to change the rating of any of these materials:
 - 1. Consult with the Engineer to determine the changes necessary to provide and control electric supply to the equipment furnished, and
 - 2. Install the agreed upon materials at no increase in the Contract amount or time.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 26 00 20

CODES, PERMITS, AND FINES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 COMPLIANCE

- A. Perform electrical work and provide material and equipment in compliance with the State of New Mexico Electrical Code (NMEC, but also referred to as NEC in these specifications for convenience) and other national, state, and local codes, regulations, laws, and ordinances. The Engineer will resolve conflicts between the above and the Specifications or the Drawings.
- B. Without relieving the Contractor from the obligation to comply with all provisions of the NMEC and other codes and standards, attention is directed to the following portion of the NMEC, 2017, 14 NMAC 10.4.11 B. (1) "Section 110.2 Approval." Only with written permission of the Engineer and of the Authority Having Jurisdiction (AHJ), provide certification of non-labeled equipment or material from a nationally recognized testing laboratory that has been approved by the electrical bureau.

1.02 PERMITS

A. Obtain electrical permits. This applies whether or not the AHJ requires a permit for the structural/process portion of a project.

1.03 INSPECTIONS AND CERTIFICATES

- A. Arrange and pay for electrical inspections.
- B. Correct deficiencies noted as a result of inspections then arrange for additional inspections.
- C. Furnish properly executed certificates of final electrical inspection and approval from the AHJ at the conclusion of the work and before final acceptance of the work by the Owner.
- D. It is recognized that inspection by the AHJ is intended to determine whether the work is in compliance with applicable codes, not to determine whether the work is in compliance with the Contract Documents.

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1.04 PAYMENTS TO THE AHJ

- A. Include in the Bid the cost of permits and initial inspections.
- B. No change in the Contract Amount will be allowed for other costs associated with this Section, such as but not limited to the cost for certification of non-labeled equipment, additional inspections, and fines/penalties levied by the AHJ. Exception: If a Change Order results in charges from the AHJ for an additional permit and/or additional inspections, then itemized, documented costs will be included in the Change Order amount.
- PART 2 PRODUCTS (NOT USED)
- PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 26 00 40

PROJECT RECORD DOCUMENTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 GENERAL

A. Except as may be stated below, this Section applies to Division 26 and to Section 40 80 00 – Plant Process Control Commissioning, and to Sections referenced therein. It contains minimum requirements; also comply with Section 01 78 39 – Project Record Documents.

1.02 LEGIBILITY

- A. Materials that are not sufficiently legible to the Engineer may be returned without being reviewed.
- B. Materials of marginal legibility may be accepted for preliminary review but rejected for use as final Record Documents.
- C. Minimum text height on project-specific submittal drawings such as schematics, connection diagrams, loop diagrams, and similar: 1/8 inch.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 CONTRACT DRAWINGS

- A. Maintain a complete set of Contract Drawings in "Record" condition. Mark, initial, and date changes, modifications, or corrections as they occur.
- B. Show by dimensions and by correct scale the location and burial depth of underground conduits, duct banks, conduit stubouts, and direct buried cables. Show location and depth at each end and at every bend.
- C. Show all differences between electrical and instrumentation design and the actual construction of electrical and instrumentation systems.
- D. Have the Drawings available for inspection by the Engineer during standard work hours at the project site.
- E. Furnish the "Record" Contract Drawings to the Engineer after completing the work and tests.

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3.02 SHOP DRAWINGS/SUBMITTALS

- A. Maintain a complete set of Shop Drawings in "Record" condition. Mark, initial and date changes, modifications, or corrections as they occur.
- B. Where required in the equipment sections, return field marked Shop Drawings to the respective manufacturer who shall transfer "Record" markings to the original tracings, stamp the originals "Record" and place the date adjacent to the stamp. Contractor submit.
- C. Where a connection diagram is required as part of the submittals for a Section of these Specifications, whether in Division 26 or Division 40 or not, the Record Documents for that Section shall include copies of the connection diagrams that show all field interconnection information. Where a wire goes to a field device, such as a STOP pushbutton, the interconnection information may simply say "STOP pushbutton, field." Where a wire goes to an equipment where it is terminated on a terminal board, show the wire destination by equipment name or abbreviation, then terminal board number, then terminal point number, AFD1-B 6 for example.
- D. Furnish other "Record" Shop Drawings to the Engineer.
- E. Furnish "Record" submittals to the Engineer where specified in individual sections.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	<u>Pay Unit</u>
6.02	Record Documents for Electrical Systems	Lot

END OF SECTION

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SECTION 26 00 60

EXTRA MATERIALS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Extra materials, such as spare parts, maintenance materials, and special tools for Division 26, Section 40 61 13 Plant Control System, for Sections referenced therein, and for other Sections as required below.
- B. Marking, packaging, and delivery of extra materials as required in Division 1.

1.02 SUBMITTALS

A. Include detailed descriptions of extra materials in the submittal materials for specific Sections and show in the Master List as required in Section 01 78 44 – Spare Parts and Maintenance Materials.

PART 2 PRODUCTS

2.01 EXTRA MATERIALS REQUIRED

- A. If the equipment submitted differs from that specified and the manufacturer recommends extra materials which differ from those specified, provide extra materials of equal function to those specified. Also provide additional materials if so recommended in the manufacturer's Operation and Maintenance Manual.
- B. Regardless of the Division/Section in which the equipment is specified, provide spares of every type and rating of fuse used in the project. Provide minimum quantity as shown below but provide more if so specified elsewhere.
 - 1. Fuses of 250 V or less: One standard package or ten, whichever is greater.
 - 2. 600 V fuses: Six.
 - 3. 15 kV fuses: Six refills.
- C. Regardless of the Division/Section in which the equipment is specified, provide spares of every type and rating of pilot lamp used in the project. Provide minimum quantity as shown below but provide more if so specified elsewhere.
 - 1. Incandescent lamps: Two standard packages or twenty, whichever is greater.
 - 2. LED lamps for heavy-duty industrial pilot devices: Two of each color.
- D. As required in specific Sections.

PART 3 EXECUTION (NOT USED)

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PART 4 PAYMENT

4.01 PAYMENT ITEM

Bid Item No.	Pay Item	Pay Unit
5.05	Extra Materials for Electrical Systems	Incidental

END OF SECTION

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SECTION 26 04 23

VERTICAL SOLID SHAFT MOTORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. 3-Phase vertical solid shaft motors.

1.02 SYSTEM DESCRIPTION

- A. Connect and test motors as shown on the Drawings, and as specified elsewhere.
- B. Generally, motors are supplied as an integral part of facility equipment described in other Sections of the Specifications. All 3-Phase 460V vertical solid shaft motors shall comply with this Section.

1.03 SUBMITTALS

- A. Submit as part of the respective equipment submittal.
- B. Complete descriptive catalog cuts.
- C. Rating sheet which shows: Voltage, phase, HP, FLA, service factor, RPM, guaranteed minimum efficiency and power factor at 50%, 75%, 100% load, and enclosure type.

1.04 OPERATION AND MAINTENANCE DATA

A. Manufacturer's Standard Manual.

PART 2 PRODUCTS

2.01 THREE PHASE VERTICAL SOLID SHAFT MOTOR REQUIREMENTS

- A. Rated 460V, 3-Phase, 60 Hz, 1.15 service factor unless specified otherwise under the equipment specifications.
- B. NEMA Design B with locked rotor and breakdown torques adequate for the specific application. Continuous duty.
- C. Cast iron frames, copper windings.
- D. Horsepower output sufficient to drive respective equipment at full load at 1.0 service factor (i.e., no allowance of 1.15 service factor in sizing HP) and without having the

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- windings exceed rated temperature at 40°C ambient at the altitude of the project. Minimum horsepower as required under the Equipment Specifications.
- E. Provide inverter duty motors for motors which are powered by variable frequency drives (VFDs), whether called for in the equipment specification or not, including motors for submersible pumps. Comply with the requirements of NEMA MGI Part 31.

F. Enclosures:

- 1. NEMA Weather Protected Type I with screens to prevent the entrance of rodents.
- 2. Canopy cap: Aluminum, such that it may be easily handled by one person.
- 3. Lifting lugs: Integrally cast to frame or end shield.
- 4. Base shall mate with driven equipment.
- G. Suitable for full voltage starting, starting with an autotransformer, or starting with a reduced-voltage solid-state starter, except suitable for part-winding start where shown in the equipment Section or on Drawings. Inverter duty where powered by an adjustable frequency drive.
- H. Conduit Boxes: Oversized.

I. Efficiency:

- 1. Motors of 7-1/2 HP and greater shall be high efficiency, and shall be catalogued by the manufacturer as a special premium efficiency design.
- 2. Efficiency calculations and testing shall comply with NEMA and IEEE standards, especially with IEEE-12 Test Method B.
- 3. The required nameplate NEMA nominal efficiencies for some horsepower ratings of 1800 RPM NEMA WP I motors are listed below. Efficiencies for other ratings furnished but not shown must be consistent with those shown. Slight variations from standard locked rotor current values will be allowed if necessary to achieve high efficiencies.

<u>HP</u>	1800 RPM	<u>HP</u>	<u>1800 RPM</u>
7.5	90.2	60	93.6
7.5 10	90.2	60 75	93.0 94.1
15	91.7	100	94.1
20	91.7	125	94.1
25	92.4	150	95.0
30	93.0	200	95.0
40	93.0	250	95.0
50	93.6	300	95.0

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- J. Bearings:
 - 1. Shall have a 1-year minimum and 5-year average life.
- K. Balance and Vibration:
 - 1. Comply with NEMA MG1-12.05 and MG1-12.06.
 - 2. All rotating parts shall be individually balanced. Balance of the assembled motor shall be .001 maximum vibration amplitude (peak to peak).
- L. Stainless Steel nameplate, riveted or screwed in place, shall include as a minimum:
 - 1. Manufacturer's Name.
 - 2. Model Number.
 - 3. Serial Number.
 - 4. Design Class.
 - 5. Frame Size.
 - 6. Horsepower.
 - 7. Service Factor.
 - 8. Locked Rotor Code.
 - 9. Class of Insulation.
 - 10. Voltage, phases, frequency.
 - 11. Full Load Amps.
 - 12. Full Load Speed.
 - 13. NEMA Nominal Efficiency Value.
 - 14. Rated Ambient Operating Temperature.
 - 15. Voltage Connection Schematic.
 - 16. All other information required by NEMA MG1-10.37 and MG1-10.38.
 - 17. ABMA Number for Each Bearing.

PART 3 EXECUTION (NOT USED)

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
5.01	Vertical Solid Shaft Motors	Lump Sum

END OF SECTION

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SECTION 26 05 19

LOW VOLTAGE WIRE AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Low voltage wire and cable.

1.02 SYSTEM DESCRIPTION

- A. Furnish wire and cable for all systems except:
 - 1. Where supplied as part of an equipment or system.
 - 2. Where specifically stated otherwise in other parts of the Specifications or on the Drawings.
- B. Install, connect, mark, and test all wire and cable.

1.03 SUBMITTALS

A. Manufacturer's standard literature.

PART 2 PRODUCTS

- 2.01 600V POWER AND GENERAL PURPOSE WIRE (COPPER)
 - A. Meet NEC 310, UL 83, and the ANSI C8 Series.
 - B. Conductor: Copper.
 - C. NEC Type: THWN/THHN.
 - D. Minimum wire size, unless specifically noted otherwise on the Drawings:
 - 1. 480V: #10 AWG.
 - 2. 120/208/240V: #12 AWG.
 - 3. Control: #14 AWG, stranded.
 - 4. Grounding/bonding conductors: #12, except #14 for control runs.

2.02 600 POWER AND GENERAL PURPOSE WIRE (ALUMINUM)p

- A. Meet UL Standard 1581 for stranded AA-800 series aluminum allow conductors.
- B. Conductor: Aluminum.
- C. NEC Type: XHHW-2.
- D. Wire Size: #6 to 1000 kcmil.

2.03 SHIELDED CABLE (TWSH)

- A. 90°C operation.
- B. Single Pair: Stranded bare or tinned copper, #16 AWG with 600V insulation, meet NEC 336.
- C. Insulation: Extruded PE, PVC, or PVC/Nylon.
- D. Conductor Identification: Colored pairs.
- E. Pair Construction: Twisted pair, lay 1-1/2 inches to 2-1/2 inches.
- F. Core Tape: Polyester with 25% overlap.
- G. Shield: Polyester supported aluminum tape with tinned #18 AWG copper drain wire.
- H. Jacket: Ultraviolet stabilized, flame retardant extruded black PVC with non-hygroscopic rip cord.

2.04 TRAY CABLE (TC)

- A. Meet NEC 336, 501, 725, 727, and 760. UL listed as Type TC. UL listed as suitable for direct burial in sizes #14 AWG and larger.
- B. Flame, moisture, and sunlight resistant. Meet UL 1581 Vertical Tray Flame Test at 70,000 BTU.
- C. Ratings:
 - 1. 600V
 - 2. 90°C dry locations; 75°C wet locations.
- D. Construction:
 - 1. Conductor: Stranded soft annealed copper.
 - 2. Insulation: Polyvinyl chloride with 5 mil nylon jacket.
 - 3. Jacket: Polyvinyl chloride.
- E. Conductor Identification:
 - 1. #8 AWG and larger: ICEA Method 4.
 - 2. #l0 AWG and smaller: ICEA Table K 2, Methods 1 and 4.
 - 3. As shown on Drawings or Schedules.

2.05 DEVICENETTM CABLE

- A. DeviceNet Thick Cable:
 - 1. UL Labeled 600V rated power limited tray cable (PLTC).
 - 2. Power pair, signal pair, drain wire, braided shield, and jacket.
 - 3. Specifically designed for DeviceNet data communications networks.
 - 4. Meet the standards of ODVATM (<u>www.odva.org</u>) for trunk cable.

- B. DeviceNet Thin Cable:
 - 1. UL Labeled 300V rated CL2/AWM cable.
 - 2. Power pair, signal pair, drain wire, braided shield, and jacket.
 - 3. Specifically designed for DeviceNet data communications networks.
 - 4. Meet the standards of ODVA (www.odva.org) for drop cable.
- C. Northwire, Inc. (<u>www.northwire.com/devicenet</u>) DataCELL® FIELD DeviceNet Cable or Engineer reviewed equivalent.

2.06 ETHERNET CABLE

- A. Labeled as c(UL)US compliant.
- B. Verified to Category 6, Plenum Rated, 600 MHz, IEEE802.3/IEEE802.5.
- C. Four pair, 23 AWG.
- D. Rated Temperature: 75°C.
- E. Flammability Test.
- F. Use ANSI/TIA/EIA compliant connectors and installation.
- 2.07 PROFIBUS CABLE.
 - A. NEC PLTC. UL listed.
 - B. For Profibus DP signals.
 - C. 300V 75°C.
 - D. Construction:
 - 1. Two 22 AWG (7x30 AWG) stranded copper with FRFPE insulation, twisted.
 - 2. 100% coverage foil insulation.
 - 3. 65% coverage tinned copper braided shield.
 - 4. Purple PVC jacket.
 - E. Belden Profibus DP Hi-Flex, 3079E, or equivalent.

2.08 MODBUS CABLE

- A. Two Pair Shielded Cable.
- B. 100% Shield Coverage.
- C. Tinned copper conductors with tinned copper braided drain wire.
- D. Belden 3107A, or equivalent.

2.09 OTHER WIRE AND CABLES

A. As supplied under other Sections or as required on the Drawings or Schedules.

PART 3 EXECUTION

3.01 COLOR CODING

- A. 600V Power and General Purpose Wire:
 - 1. Neutral and ground as required by NEC. Where two neutrals are run in a conduit, make one white and one grey. For three: one white, one grey, and one white that is field marked with a band of grey tape at each end.
 - 2. 480V Phases: Brown, orange, yellow (A,B,C, respectively).
 - 3. 120/240V: Black and blue.
 - 4. 120/208V: Black, blue, violet (A,B,C, respectively).
 - 5. Motor Control Leads:
 - a. THWN/THHN: Red to field devices with white (grey) neutral.
 - b. Tray Cable: Inherent to cable.
 - 6. THWN/THHN: #14 to #10 AWG: Colored insulation.
 - 7. THWN/THHN: Larger than #0: Tape may be used.
- B. TWSH and TC: Inherent to cable construction.
- C. Color shall be the same from end to end of a run. Do not change conductor color at splices or terminal boards.

3.02 MARKING

- A. Mark all field conductors unless directed otherwise on the Drawings or Schedules.
- B. Text:
 - 1. Power and Control Circuits associated with MCC:
 - a. Mark power feeders to motors with the motor control center number, cubicle number and terminal strip number, such as, 28 2A-T1 for MCC 28, Cubicle 2A, Phase A.
 - b. Mark control conductors with motor tag number followed by MCC cubicle terminal point number; such as, M3941-X2. Use pump or equipment number in the absence of a tag number.
 - 2. All lighting circuits and power circuits not associated with a motor control center (MCC): Panel designation and circuit number, such as, LP1-12, or PPA-23, 25, 27.
 - 3. Lighting and power circuits from a panelboard furnished as an integral part of a MCC: Panel designation and circuit number, such as, LP1-12, or PPA-23, 25, 27.
 - 4. Control Circuits not associated with MCC: Terminal board number or wire number shown on schematics and/or submittals.

- 5. Instrumentation (all ends of complete run of all milliamp signal cables): Tag number, i.e., LS01, on pair, then "+" on positive conductor. Use black for positive polarity and white for negative.
- 6. Mark otherwise as specifically shown on the Drawings or Schedules.

C. Method:

- 1. Hot marked (embossed, not just surface printed) heat shrink tubing of the proper diameter; Raychem, or
- 2. Typed or computer printed, wrap-on, cloth adhesive labels held in place with a length of clear heat shrinkable tubing, or
- 3. Typed or computer printed, wrap-on labels held in place with a wrapped and heat bonded cover, 3M ScotchCode, or
- 4. Engineer reviewed equivalent.
- 5. Direct hot marking of wire or labeling methods, which depend solely on adhesive for attachment, are not acceptable.
- D. Location: Install wire markers at every connection point to terminal boards, control stations, indicators, starters, instruments, and similar equipment, and at all splices.

3.03 TAGGING

A. Tag conductors and cables unless directed otherwise on the Drawings or Schedules.

B. Text:

- 1. Power and Control Circuits associated with MCC: MCC number and cubicle designation, such as MCC28-2BL.
- 2. All lighting circuits and power circuits not associated with a motor control center (MCC): Panel designation and circuit number, such as, LP1-12, or PPA-23, 25, 27.
- 3. Lighting and power circuits from a panelboard furnished as an integral part of a MCC: Panel designation and circuit number, such as, LP1-12, or PPA-23, 25, 27.
- 4. Control Circuits not associated with MCC: Name of equipment being controlled.
- 5. Instrumentation: Tag number.
- 6. Mark otherwise as specifically shown on the Drawings or Schedules.

C. Method:

- 1. Loosely group conductors of same service. Use tie wraps to keep grouped.
- 2. Install marking tag as specified in Section 26 05 53 Electrical Identification.
- D. Location: In pull boxes, handholes, manholes, and other enclosures where accessible but neither terminated nor spliced. It is not necessary to tag conductors in 4x4 or smaller boxes, or in conduit bodies.
- E. Mark the cover of 4x4 or smaller boxes with a permanent black felt tip marker to indicate wiring content as required in Paragraph 3.03.B above.

3.04 INSTALLATION

- A. Install all wiring in conduit, except where specifically allowed otherwise on the Drawings.
- B. Bending Radii: Not less than permitted by ICEA or as recommended by cable manufacturer, whichever is greater.
- C. Cable in cable trays, open wireway, and trenches:
 - 1. Except for individual THWN grounding conductors, use TC or PLTC only.
 - 2. Maintain separation between AC and DC cables.

D. Splicing:

- 1. Power Circuits:
 - a. Splicing of THWN/THHN and XHHW-2 conductors is permissible in boxes, enclosures, handholes, manholes or similar accessible and protected locations.
 - b. Splicing in conduit bodies is not permitted.
- 2. Control circuits and instrument wiring:
 - a. No splicing allowed.
 - b. If intermediate connections are required, provide enclosure and terminal block(s) where allowed by Engineer. Mark conductors as required above in this Section. Mark terminal boards as required in Section 26 27 27 Wire Connectors and Accessories.
- 3. Direct buried splices allowed only as shown on the Drawings or Schedules.

E. Shields of TWSH:

- 1. Ground instrumentation cable shields at the PLC Cabinet.
- 2. Cut shield at field end 1/2 inch shorter than cable pair(s). Install heat shrink tubing over shield to prevent contact with ground.

3.05 UNUSED CONDUCTORS OF TC, PLTC

A. When a cable has conductors which are not shown to be terminated then fold them back and tape in place. Do not cut short.

3.06 GROUNDING CONDUCTORS

- A. Grounding Electrodes/Grounding Electrode Conductors: Bare copper.
- B. Equipment Grounding Conductors: Insulated as required in Paragraph 2.01, or as part of a cable. Bare copper where shown thus on the Drawings.

3.07 SCHEDULE

- A. Wire and cable required under this Section for this project:
 - 1. Paragraph 2.01 600V Power and General Purpose Wire.
 - 2. Paragraph 2.03 Shielded Cable (TWSH).
 - 3. Paragraph 2.06 Ethernet Cable.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.Pay ItemPay Unit1.25, 5.05Low Voltage Wire and CablesLump Sum

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING

PART 1 GENERAL

1.01 SYSTEM DESCRIPTION

- A. Furnish, install, connect, and test a complete grounding system for all non-current carrying conductive components and grounded circuit conductors of the wiring system, building structural steel, metallic piping, motor controls and panels, transformer neutrals and cases, motor frames, and other electrical systems and components.
- B. Where grounding systems are not shown on the Drawings, as a minimum, ground in accordance with the NEC.
- C. Where grounding systems are shown on the Drawings and are more stringent than required by the NEC, the Drawings take precedence.

1.02 SUBMITTALS

A. Literature for electrolytic ground rods.

PART 2 PRODUCTS

2.01 GROUND RODS

- A. High carbon steel rod with minimum 0.01 inch thick electroplated copper coating.
- B. Minimum 5/8 inch diameter and minimum 10 foot long; provide larger if so scheduled or shown on the Drawings.
- C. Nehring Electrical Works Company NCC series (NCCS series for sectional rods) or Engineer approved equivalent.

2.02 ELECTROLYTIC GROUND RODS

A. Manufacturer:

- 1. Minimum 10 years experience manufacturing electrolytic ground rods.
- 2. ISO 9002 certified.

B. Ground Rod:

- 1. UL listed.
- 2. 100% self activating/sealed and maintenance free without addition of chemical or water solutions.
- 3. Operate by hygroscopically extracting moisture from the air to activate the electrolytic process improving performance.

- 4. 100% copper 2 inch nominal diameter hollow copper tube with a minimum wall thickness of 0.083 inches.
- 5. Permanently capped on the top and bottom with air breather holes in the top of the tube and holes in the bottom of the tube for electrolyte drainage into the surrounding soil.
- 6. Factory filled with non-hazardous Calsolyte to enhance grounding performance.
- 7. Ten feet long unless shown otherwise by schedule or Drawings.
- 8. Provide a stranded 4/0 AWG Cu ground wire that is bonded to the side of rod by means of heavy-duty exothermic welding process.
- 9. 25 year Manufacturer's Warranty.
- 10. Lyncole XIT or Engineer approved substitution.

C. Backfill Material:

- 1. Provide manufacturer recommended quantity but minimum 50 pounds per rod.
- 2. Natural volcanic, non-corrosive form of clay grout backfill material free of polymer sealants, which absorbs approximately 14 gallons of water per 50 pound bag for optimal 30% solids density and which has a pH value of 8-10 with maximum resistivity of 3 ohm-m at 30% solids density.
- 3. Lynconite II or Engineer approved substitution.

2.03 GROUND ACCESS BOX

A. Composite Box:

- 1. For non-traffic applications only.
- 2. Provide snap-lock flush cover with "breather" holes.
- 3. Nominal twelve inch diameter by ten inches high.
- 4. Lyncole model XB-12F or Engineer approved substitution.
- 5. Use only where specifically called for on Drawings.

B. Precast Concrete Access Box, Medium Traffic:

- 1. Slots for conduit entrances.
- 2. Minimum size 10 inch diameter by 12 inches high.
- 3. Round cast iron grate flush cover with "breather" slots.
- 4. Lyncole Model XB-12C or Engineer approved substitution.
- 5. Unless shown otherwise on the Drawings, use in dirt areas, in sidewalks, and in asphalt dust aprons.

C. Precast Concrete Access Box, Heavy Traffic:

- 1. Minimum twelve inch diameter by ten inches high.
- 2. Cast iron frame with lifting sockets.
- 3. Triangular cast iron cover with breather holes.
- 4. Lyncole model XB-22 or Engineer approved equal.
- 5. Unless shown otherwise on the Drawings, use in driveways, parking lots, access aprons, alleys (paved or otherwise), private streets, and public streets.

2.04 GROUND CONDUCTORS AND TAPS

- A. Stranded soft-drawn bare copper.
- B. Conductor Size: NEC Article 250, unless shown larger on Drawings.

2.05 CONNECTIONS

- A. Use heavy duty exothermic welding process (HDEWP) or NEC/UL approved/listed compression connectors for all copper to copper grounding connections and for copper to ground rod connections.
- B. Use NEC/UL approved/listed compression connectors from copper conductor to structural reinforcing rod. Burndy Hyground Hygrid YGL-C or Figure 6 Hytap YGHP-C, or equal.
- C. Connection to power equipment (switchboard, MCC, panelboard, AFD, and similar): Install compression lugs on wire and bolt lugs to equipment ground bus.

PART 3 EXECUTION

3.01 CONDUIT AND RACEWAY SYSTEMS

- A. Conduit Systems at Panels and Boxes: Double locknuts with sealing-type locknut on outside. Use bonding jumpers for conduits installed in concentric or eccentric knockouts and between conduits installed at non-metallic boxes.
- B. Conduit Systems: Install a green insulated grounding conductor in all conduits for the length of the conduit. Size conductor in accordance with the NEC, as a minimum, unless otherwise specified on the Drawings. Use grounding bushing and connectors.
- C. Install a #4/0 (minimum) bare copper grounding conductor under all underground primary power duct banks. No grounding conductor is required in primary conduits.
- D. Install bare copper grounding conductors within or under other duct banks as shown on the Drawings.

3.02 SOLID GROUND RODS

- A. Install in firm soil outside of excavated areas.
- B. Use driving studs or other suitable means to prevent damage to threaded ends of sectional rods.
- C. Unless either excluded or shown otherwise on the Drawings, install access box at each rod. If box will have concrete cast adjacent to it, install one-half inch expansion material around box before pouring concrete. Set box flush with concrete surface.

D. Depth:

- 1. Where access box is installed, drive rod so top is 4 inches below finished grade.
- 2. Where access box is not installed, drive rod so top is 24 inches below finished grade.

3.03 ELECTROLYTIC GROUND RODS

- A. Install according to manufacturer's instructions.
- B. Use for lightning protection grounds, whether specifically differentiated on the Drawings or not.
- C. Use for other grounds where shown on the Drawings.
- D. Install precast concrete access box at each rod. If box will have concrete cast adjacent to it, install 1/2-inch expansion material around box before pouring concrete. Set box flush with concrete surface.

3.04 STRUCTURE GROUNDING ELECTRODE SYSTEM

A. Where shown on the Drawings, install bare copper grounding conductor in the concrete of the footing. Braze copper conductor to the tail of a reinforcing rod at minimum four places. Bond copper conductor to equipment where shown. Bond copper conductor to building structural steel columns, metallic piping, and similar, whether shown or not.

3.05 MARKING OF GROUND ACCESS BOXES

- A. If called for on the Drawings, mark each ground access box.
- B. Where an access box is surrounded by concrete, stamp the legend "GND" into the concrete adjacent to the box, minimum one inch high letters.
- C. Where an access box is surrounded by asphalt, pour a 20 inch x 6 inch x 12 inch deep concrete marker in a nearby non-traffic area with the legend "GND BOX ?? FT" (where ?? is the number of feet from the marker to the box) and an arrow pointing to the box, minimum one-inch high characters.
- D. Where an access box is surrounded by dirt, pour a six inch by six inch by twelve inch deep concrete marker adjacent to it. Stamp the legend "GND" into the concrete, minimum one inch high letters.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
1.25, 5.05	Grounding and Bonding	Lump Sum

END OF SECTION

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SECTION 26 05 29

HANGERS AND SUPPORTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Strut Systems.
- B. Supports.
- C. Anchors.

1.02 SUBMITTALS

A. Not required.

PART 2 PRODUCTS

2.01 CORROSION RESISTANT METAL STRUT SYSTEM

A. Channel:

- 1. Designed with edges turned in, forming lips which allow special spring loaded nuts to be inserted anywhere along the channel.
- 2. Material: 6063-T6 aluminum, or 304 stainless steel.
- B. Spring Loaded Nut and Spring:
 - 1. Nut made of 304 stainless steel and designed to provide positive locking in place when tightened.
 - 2. Spring made of zinc chromate plated steel or stainless steel.
- C. Braces, Brackets, and Structural Shapes Used in the Assembly of Metal Strut: 6063-T6 aluminum, 5052-H32 aluminum, or 304 stainless steel.
- D. Threaded Rod, Bolts, and Nuts: 304 stainless steel.
- E. All materials by the same manufacturer and designed as a system.
- F. Dimensions and Style:
 - 1. Single strut: 1-5/8" by 1-5/8" 12 gage, solid.
 - 2. Back-to-back strut: 1-5/8" x 3-1/4" 12 gage, solid.
 - 3. As specifically noted otherwise on Drawings.
- G. Unistrut, B-Line, Superstrut, or Engineer reviewed equivalent.

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2.02 FIBERGLASS STRUT SYSTEM

- A. Strut and Hanger Rod Construction: Linear glass strands, continuous mat laminates, and corrosion-resistant polyester resins simultaneously pultruded to form a uniform rigid thermoset shape.
- B. Fiberglass: Self-extinguishing with UL 94 V-O classification.
- C. Hanger Rod Washers: Stamped from pultruded flat stock.
- D. Hanger Rod Square Nuts: Made from pultruded flat stock.
- E. Hanger Rod Nex Nuts and Strut Nuts: Injection molded.
- F. Hanger Rod Beam Clamps and Pipe Straps: Steel, with 15 mil PVC coating and SS bolts.
- G. Deflection Versus Loading and Recommended Loading: Equal to or better than that of Rob Roy Industries Rob-Glass Fiberglass Strut Support System.
- H. Single Strut: 1.715 by 1.76 by 0.15 wall by length.
- I. Back-to-Back Strut: 1.715 by 3.52 by 0.15 wall by length.

2.03 METAL STRUT SYSTEM

- A. Same as Paragraph 2.01 except galvanized or painted steel.
- B. Hardware: Zinc or cadmium plated.

2.04 ANCHORS

- A. Comply with the requirements of Division 5, specifically with Section 05 50 01 Anchor Bolts and Chemical Anchors. Lead shields with lag bolts: not acceptable. Concrete tapping screws: not acceptable.
- B. Anchors placed in poured concrete: Stainless steel expansion bolts, such as Hilti, Wejit, or equal, or chemical anchors.
- C. Anchors Placed in Concrete Masonry Units:
 - 1. Chemical anchors.
 - 2. Toggle bolts may be used in hollow portions of concrete masonry units in Non-Process Indoor Areas.

PART 3 EXECUTION

3.01 ANCHORS

A. Comply with the installation requirements of Section 05 50 01 – Anchor Bolts and Chemical Anchors.

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3.02 SUPPORT OF ALUMINUM CONDUIT AND BOXES

A. Support with stainless steel bolts, washers, and nuts and aluminum clamps, plates, angles, and/or strut.

3.03 SUPPORT OF OTHER CONDUIT AND BOXES

- A. Support with stainless steel bolts, threaded rod, washers, and nuts and stainless steel clamps, plates, angles and/or stainless steel strut.
- B. As allowed in Paragraph 3.05.

3.04 FLEXIBLE STRAP

A. Flexible steel and/or copper perforated straps (e.g. plumber's tape) are not acceptable for support of any electrical item.

3.05 USAGE OF STRUT

- A. Do not install fiberglass strut where exposed to sunlight.
- B. Do not cast fiberglass or aluminum strut in concrete.
- C. Follow manufacturer's recommendation as to maximum loading.
- D. Do not exceed deflection stated in manufacturer's literature.
- E. Unless specifically allowed otherwise on Drawings, use painted Metal Strut Systems (Paragraph 2.03), only in Non-Process Indoor Areas.
- F. Unless specifically allowed otherwise on Drawings, use galvanized Metal Strut Systems (Paragraph 2.03), only in Non-Process Indoor Areas, and in indoor spaces in which liquid sewage or sludge is not handled, such as a blower room.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	<u>Pay Unit</u>
5.05	Electrical Hangers and Supports	Lump Sum

END OF SECTION

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SECTION 26 05 33.13

ELECTRICAL CONDUIT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Conduit and accessories.

1.02 SUBMITTALS

- A. Manufacturer's standard literature for conduits and fittings.
- B. Additional Submittals Required for PVC RMC:
 - 1. Copy of ETL or UL Report to show compliance with the requirements of Paragraph 2.02 A.2.
 - 2. Furnish documentation certifying that each installer, who will install PVC RMC on this project, has been trained by the manufacturer in the proper methods and tools for installing PVC RMC.
 - 3. Furnish a certification from the conduit manufacturer that a representative of the manufacturer has inspected the completed installation, found the installation to conform to the Manufacturer's recommendations, and certifies the Manufacturer's Warranty is in effect. Include the ending date of the warranty on the face of the warranty.

C. Additional Submittals Required for RTRC:

- 1. Furnish documentation certifying that each installer, who will install RTRC on this project, has been trained by the manufacturer in the proper methods and tools for installing RTRC.
- 2. Where installed in Class 1 Division 2 locations, if in the Schedule, or were required on the Drawings, furnish a certification from the conduit manufacturer that a representative of the manufacturer has inspected the completed installation, found the installation to conform to the manufacturer's recommendations, and certifies the Manufacturer's Warranty is in effect. Include the ending date of the warranty on the face of the warranty.

PART 2 PRODUCTS

2.01 RIGID METAL CONDUIT (RMC)

A. Steel RMC:

- 1. Meet NEC 344 and ANSI C80.1.
- 2. Listed and labeled under UL6 or CSA recognized.
- 3. Electro-galvanized on outside, inside, and on threads.

B. Aluminum RMC:

- 1. Meet NEC 346, UL 6, and ANSI C80.5.
- 2. Listed and labeled under UL6 or CSA recognized.

2.02 POLYVINYL CHLORIDE COATED RIGID METAL CONDUIT (PVC RMC)

A. Standards:

- 1. Comply with NEC 344, UL 6, and ANSI C80.1.
- 2. ETL Verified to meet Intertek ETL SEMKO High Temperature Water PVC Coating Adhesion Test Procedure, or successfully tested by UL for PVC adhesion after 240 hours at 100°C in an air-circulating oven and 600 hours of salt spray (fog) exposure in accordance with ASTM B 117-94.
- 3. Each length of conduit shall bear the ETL Verification Mark "ETL Verified to PVC-001" and a UL6 label.
- B. Steel Conduit: Threaded, then hot-dip galvanized inside, outside, and on the threads, then coated inside, outside, and on the threads.

C. External PVC Coating:

- 1. 0.035 to 0.045 inch thick polyvinyl chloride on the full length of the exterior of the conduit except on the threads.
- 2. Comply with NEMA RN 1 Type A.
- 3. Minimum strength of bond between galvanized steel and PVC coating: 3500 PSI.

D. External Urethane Coating:

- 1. Minimum 2 mil thickness of clear two-part urethane.
- 2. Apply on threads, overlapping the PVC coating and the inner coating.

E. Internal Urethane Coating:

- 1. Minimum 2 mil thickness of colored two-part urethane.
- 2. Finished coating: Sufficiently flexible so it does not peel or crack when bends are made in the conduit.
- 3. Apply on the full length of the interior of the conduit.

F. Boxes and Fittings:

- 1. Listed and labeled under UL514B.
- 2. Same materials as the conduit.
- 3. Coated on the exterior, interior, and threads the same as the conduit.

G. Boxes, Fitting, and Sealing Fittings for Hazardous Locations:

- 1. Listed under UL886.
- 2. Same materials as the conduit.
- 3. Coated on the exterior, interior, and threads the same as the conduit.
- 4. Provide gas seals which are designed and manufactured so the total allowable fill in the gas seal is not less than the total allowable fill in the conduit.

- H. PVC and Urethane Coating Repair Materials: By the conduit manufacturer.
- I. Provide Manufacturer's Warranty that the conduit and fittings are free from defects in material and workmanship. Length of warranty: 5 years from the date of shipment from the manufacturer's plant or 3 years from the date the installation is certified, whichever occurs last.
- J. Perma-Cote, Robroy, Ocal, or Engineer reviewed equivalent.

2.03 RIGID NONMETALLIC CONDUIT (RNC)

- A. Might be referred to as RNMC on the Drawings.
- B. Meet NEC 352 and NEMA TC2.
- C. Listed/labeled under UL 651 for use with conductors operating at 90°C.
- D. Ultraviolet resistant.
- E. Schedule 40 Polyvinyl Chloride Except Schedule 80:
 - 1. Where called for in the schedule.
 - 2. Where installed exposed, or
 - 3. Where called for on Drawings.
- F. Glue all Joints Except:
 - 1. Provide bell and spigot expansion joint with O rings where required for expansion/contraction, and
 - 2. Provide glue to thread fittings for transition to threaded conduit systems.
- G. Fittings and Cement: By conduit manufacturer.
- H. Carlon Plus 40 (Plus 80), or Engineer reviewed equivalent.
- 2.04 FIBERGLASS REINFORCED THERMOSETTING RESIN CONDUIT (RTRC)
 - A. Meet NEC 355 and NEMA TC14.
 - B. Listed/labeled under UL 2420 (below grade) and UL 2515 (above grade).
 - C. Manufacturing Process:
 - 1. Manufactured using a single circuit filament winding process.
 - 2. Winding mandrels shall be straight and true as to produce non-tapered conduits.
 - 3. Epoxy based resin system with no fillers, using an anhydride curing agent.
 - 4. Fiberglass shall consist of continuous E-glass Grade "A" roving.
 - 5. Curing using two step oven heated process.
 - 6. Interior conduit body walls shall be smooth and all fibers embedded in the epoxy.

D. Mechanical Characteristics:

1. Tensile strength: 11,000 psi (ASTM D2105).

2. Compression strength: 12,000 psi (ASTM D695).

3. Impact resistance: ASTM D2444.

Minimum Impact Resistance @ 0°C		
Size (inches)	Standard Wall Ft-lbs	Heavy Wall Ft-lbs
0.75	20	150
1	25	400
1.5	35	500
2	40	550
2.5	55	600
3	70	700
3.5	80	850
4	120	1,000
5	160	1,200
6	200	1.300

E. Minimum Wall Thickness:

Size (inches)	Standard Wall – Wall Thickness (inch)	Heavy Wall – Wall Thickness (inch)
0.75	.070	.25
1	.070	.25
1.5	.070	.25
2	.070	.25
2.5	.070	.25
3	.070	.25
3.5	.070	.25
4	.096	.25
5	.096	.25
6	.096	.25

- F. Couple by means of bell and spigot with triple seal gasket or with glued couplers. Glued couplers required when there is no interference joint (i.e. after a field cut).
- G. Elbows: Factory formed.
- H. Factory assemble couplers onto conduit where adapting to different conduit types.
- I. Two-Part Epoxy: Provided by manufacturer of conduit.
- J. Champion Fiberglass or Engineer reviewed equivalent.

2.05 ELECTRICAL METALLIC TUBING (EMT)

- A. Meet NEC 358. Listed/labeled under UL 797.
- B. Connectors and Couplings:
 - 1. Steel, not die-cast.
 - 2. Rain-tight compression type, T&B TC11xA or equivalent.
 - 3. Neither set screw nor indenter type will be acceptable.

2.06 FLEXIBLE METAL CONDUIT (FMC)

- A. Meet NEC 348. Listed/labeled under UL 1.
- B. Steel.
- C. Use a single piece for each run. Do not use couplings.
- D. Connectors: Steel squeeze type, Appleton Catalog Numbers 7480 through 7490, or Engineer reviewed equivalent.

2.07 LIQUID-TIGHT FLEXIBLE METALLIC CONDUIT (LFMC)

- A. Meet NEC 350.
- B. Listed/labeled under UL 360 for use in ambient temperatures from -30°C to +80°C, wet.
- C. Galvanized steel with UV resistant PVC jacket.
- D. Use a single piece for each run. Do not use couplings.
- E. Connectors: Appleton ASTM series or Engineer reviewed equivalent.

2.08 LIQUID-TIGHT FLEXIBLE NONMETALLIC CONDUIT (LFNC)

- A. Conform to NEC 356.
- B. Listed/labeled under UL 1660 for use in ambient temperatures up to +80°C, dry; +60°C, wet.
- C. Sunlight resistant.
- D. Use a single piece for each run. Do not use couplers.
- E. Connectors: Appleton ASTM series or Engineer reviewed equivalent.

2.09 OTHER CONDUITS

A. Meet requirements of appropriate NEC article and applicable UL standard.

B. Use only after specific written approval of the Engineer.

2.10 FLEXIBLE EXPLOSION-PROOF COUPLING (XPFC)

- A. Listed/labeled under UL 886.
- B. Braided steel or copper alloy with inner insulating sleeve.
- C. Fittings: Threaded.
- D. Crouse-Hinds Series EC, or Engineer reviewed equivalent.

2.11 CABLE CONNECTOR

- A. Aluminum liquid tight, strain relief type, T & B 29XXSST series.
- B. Where installed through enclosure wall, also use sealing ring with SS retainer, T&B 5262 series.

2.12 CONDUIT GAS SEALS

- A. Approved for use in Class I and Class II areas as defined in NEC Article 500.
- B. Listed/labeled under UL 886.
- C. Malleable iron construction with NPT threads.
- D. Where used with PVC RMC or RTRC conduit, provide seals with the same coating systems as the conduit and other fittings.
- E. Designed so the cross-sectional area is larger than or equal to the cross-sectional area of the conduit.

PART 3 EXECUTION

3.01 CONDUITS REQUIRED

- A. Many conduits and associated conductors are not shown or are only partially shown on plan views in the Drawings. Install as if fully shown.
- B. In addition to conduits that are shown on plan views in the Drawings:
 - 1. Install conduits which are shown in the conduit schedules. Schedules are appended to this Section or are included in the Drawings.
 - 2. An entry in a conduit schedule requires conduits and conductors end-to-end, complete. For example, there is only one entry for a given motor feeder, even though there is actually one conduit and set of conductors from the starter to the local disconnect switch and another from the disconnect switch to the motor.
 - 3. Install as implied for circuiting, such as where a panelboard circuit number is shown adjacent to a wiring device, and from switches to associated luminaires.

- 4. Install as called for in panelboard schedules.
- 5. Install as called for in tables shown as part of schematic diagrams.
- 6. Install as required for control of process equipment. Pay special attention where recommendations of the manufacturer of the process equipment supplied differ from that shown in the design.
- 7. Install as required for a complete system.
- 8. Install as called for on the One-Line Diagram.

3.02 INSTALLATION

A. Conduit Bends:

- 1. Factory made or made with a conduit bending machine recommended by the conduit manufacturer.
- 2. If EMT is specifically allowed in the matrix of conduit usage then bends in EMT may be made with a hand bender which fully supports the side walls.
- B. Wrench tighten all threaded joints, couplings, fittings, and connectors.
- C. Run conduits concealed in finished areas and where indicated on the Drawings. In many places, such as at motors and surface-mounted wiring devices in pump rooms and electrical rooms, the end of a run may be an exposed vertical riser even though the symbol used for the conduit denotes concealed.
- D. Run exposed conduit either parallel with or perpendicular to structural members of the building or structure except where allowed otherwise by the Engineer.
- E. The only conduit that may be above a roof is conduit that serves equipment on that roof. Locate roof penetrations so no horizontal runs of conduit are required on the roof.
- F. Conduit installed above lay-in ceilings will be considered to be concealed, and need not comply with parallel/perpendicular requirements for exposed conduit. Route to avoid interference with piping, duct work, and luminaries. Locate conduit well above the lay-in ceiling. Support independently of ceiling suspension wires.
- G. Do not install conduit on slabs, decks, sidewalks or floors where it may create a trip hazard. The Engineer or Owner judges what conditions are "trip hazards". Conduits may be installed on slabs only with written permission from the Engineer or Owner.
- H. Drainage: Avoid pockets in conduit runs. Provide suitable drainage fittings in low spots in exposed conduit. Weep holes not permitted.

I. Field Cuts and Threads:

- 1. Cut ends of conduit square. Ream to remove burrs and sharp edges.
- 2. Non-factory threads: Same effective length, thread dimensions, and taper as factory cut threads.

- 3. Carefully remove burrs from threads.
- 4. For steel RMC, paint conduit threads with vinyl repair compound, same as used for PVC RMC.

J. Supports:

- 1. Comply with NEC and Section 26 05 29 Hangers and Supports.
- 2. In horizontal conduits runs install one-hole conduit straps with the anchor below the conduit.

K. Conduit Ends:

- 1. Where conduits terminate in hand holes, manholes, trenches, floor cavities, or similar, or through concrete into open-bottom enclosures plug spaces between conductors/cables and conduit with duct seal.
- 2. Protect conduit ends during construction to prevent entrance of foreign material.
- 3. Install insulated throat grounding bushing on conduit ends and install bonds as specified in Section 26 05 26 Grounding and Bonding, and as required by the NEC.
- 4. Where conduits enter an enclosure from underground, whether through concrete or from earth (such as in a transformer), set end of conduit at two to three inches above the surrounding or nearby concrete.
- L. Clean and swab inside by mechanical means to remove foreign materials and moisture before wires or cables are installed, also for spare conduits.

M. Spare Conduits:

- 1. Blow a pull string through the conduit.
- 2. If end is buried or exposed to weather, glue pull string to inside of cap with silicone seal, let set, leave adequate slack, and then install cap.
- 3. Where not exposed to weather, seal conduit end with duct seal.
- N. Use anti-seize compound on threads of aluminum RMC.
- O. Conduit and Boxes Installed on Guard Rails:
 - 1. Allowed only where shown on the Drawings or where specifically proposed in writing by the Contractor and approved by the Engineer.
 - 2. If allowed for conduits, mount on the outside of the rail (opposite from the walking surface).
 - 3. If allowed for enclosures, install strut on the outside of the rail then extend upward to support enclosures.
 - 4. Where guard rail is removable, provided with a gap and chains, or has a gate, run conduit on the side of the bridge, below the level of the walking surface.
- P. Where shown on Drawings, provide sleeves for conduit penetrations. Where the penetration is through the wall of a process structure which contains water, provide mechanical "link-seals" between the inside of the sleeve and the outside of the conduit. Seal other penetrations with 40-year rated silicone seal.

- Q. Requirements where conduits enter/exit a structure/building below grade:
 - 1. Do not run conduits in/through footings.
 - 2. Bury conduits larger than 2 inch trade size minimum 12 inches below the bottom of the footing.
 - 3. Fewer than five conduits of 2 inch trade size or less in a loose grouping may penetrate the stem wall.
 - 4. More than five conduits of any size in a grouping:
 - a. Bury minimum 12 inches below the bottom of the footing or
 - b. Submit structural details of blockouts and reinforcing through the stem wall for review by the Engineer. After conduits are installed through a blockout, fill the remaining space with non-exothermic, non-shrink grout.
- R. Expansion Joints: Where conduit spans building expansion joints or in long duct runs, use expansion fittings and bonding jumpers.

3.03 INSTALLATION OF PVC RMC

- A. Comply with installation requirements of Paragraph 3.02. In addition, comply with the requirements of Paragraph 3.03.
- B. Obtain training and certification of installers of PVC RMC from the manufacturer and use only installers who are trained and certified and whose records are on file with the Engineer, all specifically for this project.
- C. Use special bending tools, vise jaws, pliers, wrenches, drivers, and other tools designed for working with PVC RMC to eliminate damage to the PVC coating.
- D. Repair external coating where damaged. Apply coating repair liquid in multiple coats so the thickness of the coating at the entire damaged area is minimum 80 mils.
- E. Paint all metal surfaces exposed by field cutting and/or threading with colored two-part urethane and allow to dry before installing conduit.
- F. Paint male threads with coating repair liquid immediately prior to installation of a fitting or coupling.
- G. During installation, seal PVC to PVC at the joints with coating repair liquid.
- H. The requirements of the above five paragraphs are minimum requirements, even if more stringent than the recommendations of the manufacturer. If portions of the recommendations of the manufacturer are more stringent than the above, follow those as well. Bring objections of the conduit manufacturer (if any) to the Engineer for resolution.
- I. Furnish the services of an authorized representative of the conduit manufacturer to inspect the finished installation.
 - 1. If the representative cites installation problems then rectify the problems.

- 2. When the representative finds the installation to be at least in accordance with the manufacturer's recommendation, then obtain from the representative and furnish to the Owner a certification from the conduit manufacturer that the installation conforms to the manufacturer's recommendations and that the Manufacturer's Warranty is in effect.
- 3. If during the warranty period any material or the installation of any material is defective, replace or repair such material as mutually agreed between the Owner and the Contractor. Replacement or repair operations shall not adversely affect the warranty.

3.04 INSTALLATION OF RTRC

- A. Comply with installation requirements of Paragraph 3.02. In addition, comply with the requirements of Paragraph 3.04.
- B. Obtain training and certification of installers of RTRC from the manufacturer and use only installers who are trained and certified and whose records are on file with the Engineer, all specifically for this project.
- C. Use special tools designed for working with RTRC.
- D. Where installed in a Class I Division 2 location, for below grade elbow elbows, and where penetrating a concrete slab, only Heavy Wall RTRC shall be used. All other locations Standard Wall is acceptable, except if noted otherwise in the Schedule or on the Drawings.
- E. Where installed in Class 1 Division 2 locations, if in the Schedule, or were required on the Drawings, furnish the services of an authorized representative of the conduit manufacturer to inspect the finished installation.
 - 1. If the representative cites installation problems then rectify the problems.
 - 2. When the representative finds the installation to be at least in accordance with the manufacturer's recommendation, then obtain from the representative and furnish to the Owner a certification from the conduit manufacturer that the installation conforms to the manufacturer's recommendations.
 - 3. If during the warranty period any material or the installation of any material is defective, replace or repair such material as mutually agreed between the Owner and the Contractor. Replacement or repair operations shall not adversely affect the warranty.

3.05 DUCT BANKS

- A. Encase conduits in 4000 PSI concrete. Comply with the requirements of Division 2 for earthwork and of Division 3 for concrete.
- B. Drawings show known interferences but others may exist. Where close to known interferences or where evidence of other interferences is found in the field, hand excavate trench.

- C. Install conduits using plastic spacers. Provide spacers maximum of 8 feet on center, but closer where so shown in the conduit manufacturer's instructions or where required for adequate support at elbows, offsets, or sweeps.
- D. Remove mud and other foreign substances from conduits before pouring of concrete.
- E. Provide minimum 3-inches of concrete all around the outside of conduits. Provide minimum 3-inches of concrete between walls of adjacent conduits.
- F. To prevent floating, tie down duct banks with reinforcing bars and steel wire before pouring concrete.
- G. Dye all concrete red. Use seven to eight pounds of Bayferrox CC16 Red dye, or Engineer reviewed equivalent, per cubic yard of concrete mix.
- H. Prevent loose dirt from falling into trench during concrete pouring operations.
- I. Pour each section, i.e. riser to riser, riser to pull box, pull box to pull box, etc., of duct in one operation. If such construction is not feasible, construction joints will be permitted, subject to review of Engineer, provided 40 mil PVC RMC is used a minimum of 5 feet on both sides of joint, and minimum four #4 by ten-foot reinforcing bars are run through the joint.
- J. Make sure that concrete flows all around all conduits by suitable means, except do not use mechanical concrete vibrators and do not significantly displace conduits.
- K. Duct bank concrete may be poured without forming, provided trench walls are firm and do not cave; otherwise, use forms as specified in Division 3.
- L. After construction of duct banks is complete, pull a mandrel through each duct. Use a mandrel 1/4 inch smaller in diameter than duct unless the manufacturer recommends otherwise. If any obstructions are encountered or if there is evidence of water pocket in duct, locate, remove and replace that section at no cost to Owner.
- M. Where shown on the Drawings, install bare copper ground wire under or in concrete of duct bank. Connect to ground conductors/ground bars at each end.

3.06 APPLICATION

A. RMC:

- 1. Steel RMC is not permitted direct buried.
- 2. Aluminum RMC is not permitted:
 - a. In contact with earth.
 - b. Embedded in concrete.
 - c. In contact with concrete below grade, outdoors, or in wet indoor locations.

B. PVC RMC:

- 1. Permitted in areas subject to corrosive environment.
- 2. Permitted underground, direct buried.
- 3. Use where required by other paragraphs of this Section or other Sections.
- 4. Permitted for elbows in larger size underground installations of RNC.
- 5. Use for all penetrations of slabs except:
 - a. Where a run of RNC comes into the bottom of an enclosure having an open bottom, such as an MCC.
 - b. Where the upward continuation of a run is anchored to a block or poured concrete wall directly and close above the penetration.
 - c. Where the upward continuation of a run will be hidden within a wall.
 - d. Where Heavy Wall RTRC is used to penetrate a slab.

C. RNC:

- 1. Do not use where exposed to direct sunlight.
- 2. Permitted underground or direct buried.
- 3. Do not use RNC elbows for underground installations with conduit sizes 2 inches or greater. Elbows may be RTRC or PVC RMC.

D. RTRC:

- 1. Permitted in areas subject to corrosive environment.
- 2. Permitted underground, direct buried.
- 3. Permitted for elbows in larger size underground installations of RNC.
- 4. Use where required by other paragraphs of this Section or other Sections.

E. EMT:

1. Use only where shown in the matrix of conduit usage.

F. Flexible Conduits:

- 1. Use for final connection to luminaires, motors, dry type transformers, HVAC equipment, water heaters, unit heaters, and similar applications.
- 2. Do not install within a wall or slab. Do not install as/in a penetration of a wall or slab.
- 3. Do not install in lengths of more than 18 inches except:
 - a. For connection of lay-in luminaries.
 - b. For connection of equipment where O&M manual recommends moving it for maintenance, such as certain models of uninterruptible power supply systems.
 - c. For connection of adjustable frequency drives.
 - d. Where proposed in writing case-by-case by the Contractor and specifically allowed by the Engineer. No other exceptions to length restrictions.
- 4. LFMC and LFNC: Allowed as a factory component of luminaires and/or process equipment.
- 5. FMC: Allowed as a factory component of luminaries.
- 6. Use FMC for connections to adjustable equipment and devices in air ducts or plenums.

G. Use XPFC for final connection to motors or other equipment subject to vibration in Class I Division 1 areas; also in Class I Division 2 areas if so required by NEC. XPFC is not shown in the matrix of conduit usage but use as required by above, by NEC, and where specifically called for on the Drawings.

H. All Conduits:

- 1. Use type specifically called for on the matrix of conduit usage. If not shown in the matrix of conduit usage, comply with requirements shown on the Drawings. If not shown in either the matrix of conduit usage or on the Drawings, refer to the matrix of conduit usage for all other work.
- 2. No plastic conduit allowed above lay-in ceilings where the cavity functions as an air-handling plenum, regardless of matrix of conduit usage.
- 3. Do not install exposed conduits in finished areas, such as laboratories, offices, training rooms, and similar. Clarify any questionable area with the Engineer in the field before installing.

I. Matrix of Conduit Usage:

- 1. The matrix of conduit usage is shown on the Drawings.
- 2. If multiple columns are marked, any marked type is allowed subject to NEC restrictions and restrictions above, such as but not limited to those concerning buried conduits, elbows, penetrations, exposed installation, and use in cavities.
- 3. Different parts of a run may be of different type conduit, such as where a flexible connection is required.
- 4. If a column is marked "C" then use only where concealed in a wall or above a gypsum board or lay-in ceiling.
- 5. If a column is marked "CA" then use only above a gypsum board or lay-in ceiling.
- 6. If a column is marked "E" then use only for connections between electrical supply and control equipment, not for connection of utilization equipment and not for connection of field devices such as flow transmitters and hand switches. A marking of "E" is typically intended to be limited to electrical rooms.
- 7. If a column is marked "H" then use only above 6-feet or directly above equipment where not subject to damage.
- 8. See matrix of conduit usage for other column marking notes.
- 9. Where the matrix of conduit usage shows RNC for outdoor use, it is allowed only where protected from direct sun exposure, such as under a bridge or under a digester cover.

3.07 SIZE

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- A. The Drawings and/or conduit schedules may show a minimum size for certain conduit runs. Where size is not shown, then comply with Paragraph C. below.
- B. If a conduit size has to be increased because a motor or other equipment furnished by the Contractor requires more power (and therefore larger wire and conduit than shown) than the specified motor or equipment, then include the cost of the larger conduit in the Bid.

- C. Minimum Size Requirements:
 - 1. As required by NEC, but larger if so shown on the Drawings or required below.
 - 2. Lighting circuits except circuits to HID pole lights: 1/2 inch.
 - 3. HID Pole Lighting Circuits: 1 inch.
 - 4. 120/208/240V Receptacle Circuits: 1/2 inch.
 - 5. Last Receptacle in Run: 1/2 inch.
 - 6. Other Runs: 3/4 inch.
 - 7. 120/208/240V branch circuits to a single load: 1/2 inch.
 - 8. 208/240V Feeders: 3/4 inch.
 - 9. 480V Circuits: 3/4 inch.
 - 10. 120 VAC Control Circuits: 1/2 inch minimum: 3/4 inch for 10 to 20 #14; 1 inch minimum for more than 20 #14, then by NEC.
 - 11. Shielded or Coaxial Cable: 3/4 inch.
 - 12. Circuits of Special Systems: As shown on Drawings or as required in the specification section for the respective system.
 - 13. Other Circuits: 3/4 inch.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
1.25, 5.05	Electrical Conduit	Lump Sum

END OF SECTION

SECTION 26 05 33.16

BOXES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Boxes.

1.02 SUBMITTALS

A. None required.

PART 2 PRODUCTS

2.01 BOXES LOCATED OUTDOORS AND IN PROCESS AREAS

- A. NEMA 4X stainless steel.
- B. Heavy-Duty Device Boxes for use with Rigid Metal Conduit:
 - 1. Copper-free cast aluminum.
 - 2. Conduit hubs cast integral with box.
 - 3. Hubs exterior to box.
 - 4. Conduit hubs with tapered threads (NPT).
 - 5. Integral green ground screw.
 - 6. Unless explicitly shown otherwise on Drawings, covers by same manufacturer as box.
 - 7. Crouse-Hinds FS/FD series or equivalent.
- C. Heavy Duty Device Boxes for use with PVC RMC: Same as Paragraph B. but from the manufacturer of PVC RMC and coated the same as the conduit.
- D. Standard Duty Device Boxes for use with Rigid Metal Conduit:
 - 1. Die-cast aluminum.
 - 2. Conduit hubs cast integral with box.
 - 3. Hubs interior to box.
 - 4. Conduit hubs with tapered threads (NPT).
 - 5. Red Dot, or Engineer reviewed equivalent.
- E. As called out in specific Sections or on the Drawings.

2.02 BOXES LOCATED IN NON-PROCESS INDOOR AREAS

A. NEMA 12 for starter enclosures, control panels, and similar unless a different type is called for on the Drawings or in specific Sections or as scheduled.

- B. Device Boxes for Use with EMT:
 - 1. Single piece steel with conduit knock outs.
 - 2. Four inch square by 2-1/8 inch deep, with appropriate device cover.
 - 3. Steel City Catalog No. 2G4D series, or Engineer reviewed equivalent.
- C. Device boxes for use with rigid conduit: Paragraph 2.01 C.
- D. As called out in specific Sections or on the Drawings.

2.03 BOXES LOCATED IN HAZARDOUS AREAS

- A. Copper-free cast aluminum.
- B. UL listed for NEC Class and Division where installed.

2.04 CONDUIT CONNECTORS

- A. NEMA 4X Boxes: Watertight hubs; PVC coated watertight hubs for use with PVC RMC.
- B. Cast Boxes: Threaded portion of box.
- C. NEMA 12 Boxes: "O-ring" type lock nut connectors.
- D. NEMA 3R Boxes: Lock nut connectors for conduit connections to the bottom of the box but watertight hubs for all other conduit connections.
- E. Steel Boxes Used with EMT:
 - 1. Steel, not die-cast.
 - 2. Concrete-tight and rain-tight.
 - 3. Compression type, not set screw nor indenter type.
 - 4. Steel City TC-11x series, or Engineer reviewed equivalent.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Boxes: Securely support independent of conduits so that they are level and in vertical and horizontal alignment.
- B. Flush Boxes: Properly plumb, flush, and aligned with the surface surrounding it.
- C. Boxes Outside:
 - 1. Fully accessible and visible.
 - 2. Do not use "Exception" to Article 314.29 of the NEC.

D. Device Boxes.

- 1. Unless shown differently on Drawings or required by field conditions, inside in non-process areas mount receptacle boxes 18 inches centerline above finished floor.
- 2. Unless shown differently on Drawings or required by field conditions, outside and in process areas mount receptacle boxes 30 inches centerline above finished grade or floor.
- 3. Unless shown differently on Drawings or required by field conditions, mount toggle switch boxes 48 inches centerline above finished floor
- 4. Install heavy duty device boxes unless the use of standard duty device boxes are explicitly called for on Drawings.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	<u>Pay Unit</u>
1.25, 5.05	Electrical Boxes	Lump Sum

END OF SECTION

SECTION 26 05 43

UNDERGROUND PULL BOXES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. 600V underground pull boxes.

1.02 SUBMITTALS

A. Manufacturer's literature.

PART 2 PRODUCTS

2.01 VEHICULAR TRAFFIC PULL BOXES

- A. Meet AASHTO H-20 standards of 32,000 pounds single axle load over a 10-inch by 10-inch area.
- B. Precast, steel reinforced, PortlandTM cement concrete, completely enclosed, whether four-sided with top and bottom, or cylindrical with top and bottom. Provide 2-inch diameter drain hole in center of bottom.
- C. Cast iron ring.
- D. Cover:
 - 1. Cast iron.
 - 2. Watertight seal to ring.
 - 3. No hole through cover.
 - 4. Provide pockets for insertion of pick for removal.

2.02 NON-DELIBERATE VEHICULAR TRAFFIC PULL BOXES

- A. Subjected to and shown to pass all of the performance and testing for Tier 15 of ANSI/SCTE77-2002 Specification for Underground Enclosure Integrity. UL labeled to that standard.
- B. Polymer concrete. Vertical rather than sloped walls. Solid bottom. Stackable as required. Gasket to match cover.
- C. Heavy duty cover with gasket. Molded-in lifting points. Pentahead SS bolts with boots to exclude water. Provide two pentahead sockets for the project.
- D. Strongwell Quazite, such as gasketed PG style box with gasketed HG cover or similar.

PART 3 EXECUTION

3.01 TYPE REQUIRED

- A. In paved areas, use AASHTO H-20 boxes as specified in Paragraph 2.01 unless specifically shown otherwise on the Drawings.
- B. In other areas, use ANSI Tier 15 boxes as specified in Paragraph 2.02 unless specifically shown otherwise on the Drawings.

3.02 INSTALLATION OF AASHTO H-20 BOXES

- A. Excavate down to 24 inches below proper depth for bottom of box. Install engineered fill, same as used for pavement sub-grade. Compact to 95% modified proctor or to match paving requirements, whichever is greater. Drill 10-inch hole in dirt at center of box. Fill with 1-inch sieve gravel. Re-compact as needed. Place 1-foot square portion of 1/2-inch by 1/2-inch SS wire mesh in center. Set box plumb and to grade required below. Partially backfill and compact to match paving requirements.
- B. Drill sides of box for conduits. Install conduits. Fill annulus with non-shrink, non-exothermic grout.
- C. Backfill and compact to match paving requirements.
- D. Set box so the cover will be 1/2 inch above the high point of the surrounding surface. Contour and slope paving to meet box over a 3-foot area, so as to prevent runoff from standing on the cover.

3.03 INSTALLATION OF ANSI TIER 15 BOXES

- A. Drill a 2 inch diameter hole in the center of the bottom of the box.
- B. Excavate down to approximately 18 inches below proper depth for bottom of box. Place 1-inch sieve gravel with the same or larger footprint as the footprint of the box and nominal 18 inches inch depth. Place 1-foot square portion of 1/2-inch by 1/2-inch SS wire mesh in center. Set box plumb on wire mesh and to grade required below. Partially backfill and compact to 90% modified proctor.
- C. Drill sides of box for conduits. Install conduits. Fill annulus with non-shrink, non-exothermic grout.
- D. If boxes are stacked, seal thoroughly between sections with silicone seal.
- E. Backfill and compact to match civil design requirements of surrounding area.
- F. Boxes in sidewalks: Set 1/4 inch above surrounding concrete. If in a sloped portion of sidewalk, set upper lip of box above upper slope. Contour concrete as needed to avoid runoff from standing on the box and to avoid a trip hazard.

G. Boxes in dirt areas: Do not place in a swale, taking the location of the box on the Drawings as approximate to allow adjustment to avoid swales. Set 3 inches above surrounding finished grade.

3.04 OTHER REQUIREMENTS

- A. Provide boxes which are approximately 20% larger than NEC minimum in length and width dimension. Provide depth to accommodate burial depths of conduits.
- B. Leave minimum one full turn of each cable/conductor in the box. Tag as specified in Section 26 05 53 Electrical Identification.
- C. Splices are not allowed in underground pull boxes unless specifically called for on the Drawings, case-by-case.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
1.25, 5.05	Underground Pull Boxes	Lump Sum

END OF SECTION

SECTION 26 05 53

ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nameplates and marking tags.

1.02 SUBMITTALS

A. Not required.

PART 2 PRODUCTS

2.01 NAMEPLATES (NP)

A. Minimum Character Height:

- 1. One-half inch for the title of equipment which meets any of the following criteria.
 - a. Oil-filled transformers.
 - b. Engine generator sets.
 - c. Motor Control Centers (MCC).
 - d. Floor mounted PLC enclosures.
 - e. Automatic and manual transfer switches.
 - f. Service disconnecting means.
 - g. Equipment 400A or greater.
 - h. Equipment greater than 600V.
 - i. Equipment with interrupt rating greater than 22 kAIC.
- 2. Three-eighths inch for the title of equipment which do not meet the criteria above and meets any of the following criteria.
 - a. Dry transformers.
 - b. Individual starters.
 - c. Individual MCC sections.
 - d. Panelboards rated less than 400A.
 - e. Motor/equipment disconnecting means.
 - f. Motor and/or control terminal boxes.
 - g. Wall mounted control panels.
- 3. One-eighth inch minimum for other text but larger as specified below or if called for on the Drawings.

B. Engraved Nameplates:

- 1. Black engraving stock with white core, unless shown otherwise, below or on the Drawings.
- 2. Gravoply, or Engineer reviewed equivalent.

C. Printed Nameplates:

- 1. Vinyl, self-adhesive tape. Provide white, tan (sand), or gray for least contrast with color of surrounding surface.
- 2. Color of lettering: Black.
- 3. BradyTM Handimark® printer With Brady B-580 tape or Engineer reviewed equivalent.

2.02 CAUTION AND WARNING NAMEPLATES

- A. Comply with NEC and OSHA requirements.
- B. Engraved Nameplate: Red with white text.
- C. Instead of an engraved or custom-printed label, a standard, off-the-shelf label, such as from Seton, is acceptable.
- D. Character Size: 1/4 inch minimum height.

2.03 MARKING TAGS

- A. Engraved plate as in Paragraph 2.01 with minimum 1/8-inch character height.
- B. Drill hole for attaching.
- C. Attach with tie wrap.

PART 3 EXECUTION

3.01 NAMEPLATES REQUIRED

A. Motor Nameplates:

- 1. Install a red nameplate on each motor or other electrically controlled equipment that has maintained (two-wire), remote, or automatic control.
- 2. Character size: Caution: one-half inch characters; balance: 1/4 inch.
- 3. Text equivalent to "CAUTION. THIS EQUIPMENT MAY START AUTOMATICALLY OR REMOTELY."
- 4. Instead of an engraved or custom-printed label, a standard, off-the-shelf label, such as from Seton, is acceptable. Comply with NEC and OSHA requirements.
- B. Voltage Warnings: As required by NEC and OSHA.
- C. Where called for in other Sections.
- D. As scheduled.
- E. As required on the Drawings. Generally, a note on a Drawing will call for a nameplate or NP. The type (engraved or printed) is mentioned on the Drawings only if an engraved NP is required in a location in which a printed nameplate might otherwise be allowed in the paragraphs below.

3.02 MOUNTING OF NAMEPLATES

- A. Engraved Nameplates:
 - 1. Use indoors or outdoors.
 - 2. On panel fronts, attach with screws or drive rivets. Elsewhere, attach with 30 year rated silicone seal.
 - 3. Attach with edge parallel to edge of enclosure or device plate.
- B. Printed Nameplates:
 - 1. Use only inside a fully enclosed and roofed building or structure.
 - 2. Do not use where exposed to sunlight, precipitation, freezing temperatures.
 - 3. Do not use where Drawings call for engraved nameplates.
 - 4. Self-adhesive.
 - 5. Attach with edge parallel to edge of enclosure or device plate.

3.03 SCHEDULE

- A. Minimum nameplate requirements. Refer to Drawings and other Sections for additional requirements. Where italicized enter equipment specific information and where bold text is fixed.
 - 1. Panelboards, switchgear, MCCs and similar:
 - a. Line 1: Equipment Name.
 - b. Line 2: Fed From: Source equipment.
 - 2. Transformers:
 - a. Line 1: Equipment Name.
 - b. Line 2: Fed From: Source Equipment.
 - c. Line 3: Feeding: Destination Equipment.
 - 3. Automatic and Manual Transfer Switches:
 - a. Nameplate 1:
 - 1) Line 1: Equipment Name.
 - 2) Line 2: Feeding: Destination Equipment.
 - b. Nameplate 2 (install next to respective position/indication):
 - 1) Line 1: Source 1: Source Equipment.
 - c. Nameplate 3 (install next to respective position/indication):
 - Line 1: Source 2: Source Equipment.
 - 4. Equipment disconnecting means located near the respective equipment, starter/equipment controllers not located in a MCC and similar:
 - a. Line 1: Equipment Name.
 - b. Line 2: Equipment Tag Number.
 - c. Line 3: Fed From: Source Equipment.
 - 5. MCC cubicles (starters):
 - a. Line 1: Equipment Name.
 - b. Line 2: Equipment Tag Number.
 - c. Line 3: Starter Type and size (e.g. VFD, FVNR Size 2, RVSS).
 - d. Line 4: load HP rating.

- 6. MCC cubicles (circuit breaker):
 - a. Line 1: Circuit breaker rating.
 - b. Line 2: Feeding Equipment Name.
- 7. MCC cubicles (feeders):
 - a. Line 1: Feeder Circuit Breaker or Feeder Lugs.
 - b. Line 2: Fed From: Source Equipment.
- 8. MCC cubicles (miscellaneous):
 - a. Line 1: Description of cubical (e.g. Spare FVNR Size 1, E-Net I/O).
 - b. Line 2: Tag number if applicable.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	<u>Pay Item</u>	Pay Unit
1.25, 5.05	Electrical Identification	Lump Sum

END OF SECTION

SECTION 26 08 10

ELECTRICAL TESTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical testing.

1.02 SUBMITTALS

- A. Four copies of Megger test reports.
- B. Four copies of performance test reports.

PART 2 PRODUCTS

2.01 TEST EQUIPMENT

- A. Provide equipment to perform testing.
- B. Test equipment shall bear a current calibration sticker which shows performance, when it was calibrated, and when it is next due for calibration.
- C. Have calibration performed by a testing laboratory which uses reference instruments whose accuracy is documented and traceable to National Institute for Standards and Technology reference standards.

PART 3 EXECUTION

3.01 MEGGER TESTING

- A. Test feeder and branch circuits which will operate at greater than 250V to ground with a 1000V ohm-m.
- B. Record test results between phases, phase to neutral, phase to ground, and neutral to ground.
- C. Prepare and submit test reports.
- D. Tests deemed unsatisfactory by the Engineer:
 - 1. Replace defective conductor and all other conductors which are in the same conduit.
 - 2. Re-test and re-submit.

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3.02 PERFORMANCE TEST

- A. Demonstrate to the Engineer the satisfactory performance of all electrical equipment moved, modified, or provided under this Contract including, but not limited to, demonstrating that all equipment works properly in HAND and that hardware type automatic control components and systems work properly.
- B. Calibrate plant equipment and instrumentation as required for proper operation.
- C. If testing and/or calibration requirements are shown in Division 40:
 - 3. Perform megger testing as required in this Section.
 - 4. Where more stringent performance testing or more stringent calibration procedures are required in Division 40, follow those more stringent requirements and submit reports as required in Division 40.

3.03 OTHER TESTS

A. As required in other Sections.

3.04 WITNESS

- A. Notify Engineer minimum 3 working days before Megger testing.
- B. Notify Engineer minimum 7 working days before performance testing.
- C. Engineer will either witness the testing or waive the requirement.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
5.05	Electrical Testing	Lump Sum

END OF SECTION

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SECTION 26 22 13.10

LOW-VOLTAGE DRY TYPE TRANSFORMERS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Low voltage transformers dry type transformers for general lighting and power service.

1.02 SUBMITTALS

A. Complete manufacturer's catalog cuts with ratings.

PART 2 PRODUCTS

2.01 DRY TYPE TRANSFORMERS

- A. UL Listed/Labeled two-winding dry type transformers with voltage, phases, and kVA ratings as shown on Drawings or Schedule.
- B. Copper windings.
- C. Connection: Furnish 3-Phase transformers with delta connection on higher voltage windings and wye connection on lower voltage windings.
- D. Maximum design temperature rise over 40°C ambient:
 - 1. Single phase:
 - a. 2 kVA and less 80°C .
 - b. 3 kVA through 25 kVA 115°C.
 - c. Greater than 25 kVA 150°C.
 - 2. 3-Phase:
 - a. 45 kVA and less 115°C.
 - b. Greater than 45 kVA 150°C.
- E. Furnish transformers rated 30 kVA and less with core and coil resin encapsulated suitable for indoor or outdoor use.
- F. Furnish transformers rated greater than 30 kVA with ventilated enclosure rated NEMA 1 where installed indoors or NEMA 3R where outdoors.
- G. Minimum taps required:
 - 1. Transformers rated 3 kVA or less: No taps.
 - 2. Transformers rated greater than 3 kVA through 30 kVA: Two 2.5% full capacity above normal (FCAN) and two 2.5% full capacity below normal (FCBN) taps.

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- 3. Transformers rated greater than 30 kVA: Two 2.5% full capacity above normal (FCAN) and four 2.5% full capacity below normal (FCBN) taps.
- H. Furnish transformers with different or other features as shown on Drawings or Schedule, such as but not limited to aluminum windings, different winding connections, additional taps.
- I. Transformers which fall within the scope of the Guide for Determining Energy Efficiency for Distribution Transformers, published by the National Electrical Manufacturers Association® (NEMA® TP-1-2002): Meet Class I Efficiency Levels for distribution transformers specified in Table 4-2 of the Guide.
- J. Cutler-Hammer type EP and DS-3 single phase or type EPT and DT-3 three phase, General Electric type QB, QMS, and QL single phase and type QMS3 and QL three phase, Square D Class 7400, or Engineer reviewed equivalent.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install transformer plumb and level.
- B. Provide clearance around transformer for access and ventilation as recommended by manufacturer.
- C. Use flexible conduit for connections to transformer case. Make conduit connections to transformer enclosure only at locations designated by the manufacturer's installation instructions.
- D. After normal operating load have been energized, measure secondary voltages and adjust tap settings as necessary. Record tap settings on record drawings.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

<u>Pay Item</u>	<u>Pay Unit</u>
oltage Dry Type	Lump Sum
	oltage Dry Type ransformers

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Panelboards.

1.02 SUBMITTALS

- A. Summary Sheet showing:
 - 1. Voltage, phases, and main bus ampacity.
 - 2. MLO panels: Type of main lugs.
 - 3. MCB panels: Main breaker rating.
 - 4. Neutral and ground bar ratings.
 - 5. Bus material and plating.
 - 6. Short circuit rating.
 - 7. Flush or surface mount, enclosure NEMA type, and trim details.
 - 8. Rating and arrangement of branch circuit breakers.
 - 9. Description of specified factory assembled modification including, but not limited to, sub-feed breakers, sub-feed lugs, feed-through lugs, and metering transformers.
- B. Panelboard layout showing all circuit breakers, strapping and mounting hardware for future circuit breakers, and space for future strapping and mounting hardware.
- C. If the submitted circuit breaker layout differs from the Drawings then demonstrate that the phase current balance will be substantially the same.

1.03 OPERATIONS AND MAINTENANCE DATA

- A. As-built layout drawing showing location, ampacity, and poles of each breaker.
- B. Copies of all directories.
- C. Settings used for electronic trip units and ground fault relays.

1.04 QUALITY ASSURANCE

- A. Conform to the following:
 - 1. UL 50 Enclosures for Electrical Equipment.
 - 2. UL 67 Panelboards.
 - 3. NFPA 70 National Electrical Code.
 - 4. NEMA PB1 Panelboards.
 - 5. UL 489, "Molded Case Circuit Breakers and Circuit Breaker Enclosures".
 - 6. NEMA AB1, "Molded Case Circuit Breakers".

PART 2 PRODUCTS

2.01 PANELBOARDS – COMMON REQUIREMENTS

- A. Voltage, phases, and current ratings as shown on Drawings.
- B. Minimum branch circuit breaker space as shown on Drawings.
- C. Minimum Box Width:
 - 1. 14 inches for:
 - a. 100 amp, single phase, flush mounted.
 - b. 100 amp, 208Y/120 volt, 3-Phase, flush mounted.
 - 2. 20 inches for all others.
- D. Main circuit breaker (MCB) or main lugs only (MLO) as shown on Drawings.
- E. Bus: Tin plated aluminum unless shown otherwise on the Drawings or Schedule.
- F. Ground Bar: Furnish all panelboards with a ground bar having a screw for each pole.
- G. Neutral Bar:
 - 1. 208Y/120V and 120/240V single phase panelboards: Provide 100% neutral bar with a screw for each pole unless shown otherwise on the Drawings or Schedules.
 - 2. 480Y/277V panelboards which are used as service equipment: Provide 100% neutral bar.
 - 3. 480Y/277V panelboards which power 277V loads, such as site lighting and UV systems, and elsewhere required on the Drawings: Provide 100% neutral bar with a screw for each pole.
 - 4. 480V panelboards which power no 277V loads: No neutral bar required.
- H. Furnish sub-feed breakers, sub-feed lugs, feed-through lugs or other factory options as shown on Drawings.
- I. Flush or surface mount as shown on Drawings.
- J. Listed and labeled for service entrance use if used for service entrance equipment or so indicated on Drawings.
- K. Circuit Breakers:
 - 1. Furnish circuit breakers recommended by the manufacturer of the panelboard for use in the panelboard furnished.
 - 2. Provide as shown on Drawings or Schedules.
- L. Furnish all required strapping and mounting hardware required for the future installation of a circuit breaker of the frame size shown where "FUTURE" is shown on the Drawings or Schedules.

- M. Furnish a panelboard with the required space for the future installation of strapping, mounting hardware, and circuit breakers where "SPACE" is shown on the Drawings or Schedules."
- N. Circuit Breaker Mounting and Connection:
 - 1. Connection between line side of circuit breaker and bus by direct bolted connection, or
 - 2. Connection between line side of circuit breaker and bus by spring tension jaws designed to produce increased contact pressure under fault conditions and entire circuit breaker secured in place with bolt, and
 - 3. No restriction on ability to mount circuit breakers of different frame size or number of poles opposite each other.
- O. Manufacturers and Types:
 - 1. Cutler-Hammer: Pow-R-Line 1 and Pow-R-Line 2.
 - 2. General Electric: AQ, AE, and AD.
 - 3. Square D: NQOD and NF.
 - 4. Engineer reviewed equivalent.

2.02 ENCLOSURE AND TRIM

- A. Enclosure rated NEMA 1, NEMA 3R, NEMA 4, NEMA4X SS or NEMA 12 as shown on Drawings or Schedules.
- B. Enclosure constructed of zinc-coated sheet steel for all but NEMA4X SS.
- C. For NEMA 3R, 4, and 12, provide enclosure with exterior surfaces prepared, primed and painted in a light grey, ANSI 49 or similar color, at the factory.
- D. Flush mounted 208Y/120V and 120/240V single phase panelboards rated 100A: Furnish with decorative trim fastened to the box on four sides with screws or screwdriver operable captive latches and a hinged and latched door to cover access to circuit breaker operating handles but without access to any energized parts.
- E. Flush mounted 208Y/120V and 120/240V single phase panelboards rated greater than 100A and all flush mounted 480V panelboards: Furnish "door-in-door" trim.
 - 1. Inner door with hinges and latch to cover access to circuit breaker operating handles but without access to any energized parts.
 - 2. Outer door hinged on one side and secured on remaining sides with captive screws or screw driver operated latches. Provide door that provides full access to wiring gutter on all four sides when open.
 - 3. Provide decorative trim around box to cover the gap between the enclosure and the wall surface.
 - 4. Provide trim prepared, primed and painted in a light grey, ANSI 49 or similar color, at the factory.

- F. Furnish Surface Mounted Panelboards with "Hinged Trim" Cover:
 - 1. Inner door with hinges and latch to cover access to circuit breaker operating handles but without access to any energized parts.
 - 2. Trim hinged at one edge of box and secured on remaining sides with captive screws or screw driver operated latches. Provide door that provides full access to wiring gutter on all four sides when open.
 - 3. Provide trim prepared, primed and painted in a light grey, ANSI 49 or similar color, at the factory.
- G. Furnish latched and lockable door with metal frame cardholder with clear plastic window on inside of door for panel directory.
- H. Provide other features as shown on the Drawings or Schedules.

2.03 OVERCURRENT PROTECTIVE DEVICES

- A. General: Provide circuit breakers as integral components of panelboard with indicated features, ratings, characteristics, and settings.
- B. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and necessary appurtenances for future circuit breakers as show on the Drawings or Schedules.

C. Molded-Case Circuit Breakers:

- 1. General: UL489, "Molded Case Circuit Breakers and Circuit Breaker Enclosures," and NEMA AB 1, "Molded Case Circuit Breakers."
- 2. Suitable for use with conductors operating at 75°C.
- 3. Characteristics: Frame size, trip rating, number of poles, and short-circuit interrupting capacity rating as shown on the Drawings or Schedules.
- 4. Interrupting capacity not less than shown on the Drawings or Schedules. Furnish all circuit breakers with full interrupting capacity. Do not use series ratings.
- 5. Tripping Device: Quick-make, quick-break toggle mechanism with inverse-time delay and instantaneous over-current trip protection for each pole.
- 6. Adjustable instantaneous trip devices: Front adjustable; factory adjusted to low trip setting.
- 7. Solid state trip devices: When called for on the Drawings, provide molded case circuit breakers that use solid-state trip devices.
- 8. Furnish circuit breakers for lighting circuits that are switching duty rated.
- 9. Furnish heating, air conditioning, or refrigeration (HACR) rated circuit breakers when called for on the Drawings or Schedules.
- 10. Furnish single pole circuit breakers with ground fault interrupting capability when called for on the Drawings or Schedules. When required furnish Class A (6mA.) or Class B (30mA.) as shown on the Drawings or Schedules.

- D. Electronic Circuit Breaker Trip Devices: True RMS sensing, microprocessor based, solid-state overcurrent trip device system that includes one or more integrally mounted current transformer or sensor per phase, a release mechanism, and the following features:
 - 1. Temperature compensation to assure accuracy and calibration stability from -20°C to \pm 55°C.
 - 2. Time-current tripping functions, field adjustable with the breaker closed and energized, as scheduled or shown on the Drawings, often abbreviated as L, S, I, and G.
 - a. Adjustable long-time pick-up current.
 - b. Adjustable long-time-delay.
 - c. Adjustable short-time pick-up current.
 - d. Adjustable short-time-delay.
 - e. Adjustable instantaneous trip current.
 - f. Adjustable ground-fault pick-up current.
 - g. Adjustable ground-fault-delay.
 - h. Selectable I2t function on short-time-delay.
 - i. Selectable I2t function on ground-fault-delay.
 - 3. Clear, sealable cover over adjustments.
 - 4. Other factory options as shown on the Drawings or Schedules.
 - 5. Trip Indication: Labeled lights or mechanical indicators indicating long-time overload, short-time overload, instantaneous, or ground fault as cause of trip. If lights are used, furnish with integral power source capable of maintaining indication for not less than 48 hours.
 - 6. Arrangement to permit testing of all functions without removal from panelboard and to permit viewing and adjustment of all functions without removal of any metal panels.
 - 7. Furnish 80% rated circuit breakers unless otherwise shown on the Drawings or Schedules.
- E. Other devices as shown on the Drawing or Schedules.

PART 3 EXECUTION

3.01 PANELBOARD INSTALLATION

- A. Install panelboards following manufacturer's instructions.
- B. Mount panelboards plumb and rigid.
- C. Mount flush panelboards so that the trim fits flat against finished wall.
- D. For MLO panelboards, install compression lugs on conductors with press and die recommended by lug manufacturer. Bolt lug to bus.

3.02 IDENTIFICATION

A. Properly and accurately label panel directories by hand during construction.

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- B. Install neatly typed, accurate directories in holders prior to Substantial Completion.
- C. Identify panelboard and its source with a nameplate.

3.03 KEYS

- A. Keep panelboard keys properly marked and identified with panel number and location.
- B. Furnish the Owner at least two copies of all panelboard keys, with tag showing identifying number and location of panel.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
5.05	Panelboards	Lump Sum

END OF SECTION

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SECTION 26 27 10

ELECTRICAL SERVICE

PART 1 GENERAL

1.01 RELATED SECTIONS

A. Section 01 21 00 – Allowances.

1.02 SYSTEM DESCRIPTION

- A. Arrange with the Public Service Company of New Mexico (PNM) for extension of overhead primary service to the northwest segment of the property and for a new PNM owned transformer to serve the West Electrical Building. PNM to provide: all overhead primary, pole riser, primary underground conduit/cable, step-down transformer, primary connections, current transformers, meter base, meter, and meter wiring. Contractor to provide trench and backfill for 24-inch wide by 51-inch deep ditch for primary conduit, transformer pad, 4-inch stubout from primary side of pad for connection to primary conduit, strut stand for meter base, and metering conduit, all in compliance with PNM requirements, whether shown on the Drawings or not.
- B. Arrange with PNM and the Owner for an outage of no more than 4 hours for connection of a new feeder to the existing transformer.
- C. Pay PNM the amount required in order for PNM to begin construction.
- D. Submit to the Engineer detailed documentation related to all PNM charges.
- E. Upon favorable review of PNM charges by the Engineer, make complete payment to PNM then recover the amount of payments made to PNM under the Allowance.

1.03 CONSTRUCTION POWER

- A. Include in the Bid costs associated with arrangement with PNM to furnish construction power.
- B. Limited 480V power is available at the existing WWTP that may be used for local construction power in the area near the temporary WAS pumps, but not for trailer or office power and not for pumping. Include cost of temporary electrical utilization equipment and connections in the Bid.

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PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

PART 4 PAYMENT

4.01 PAYMENT TERMS

Bid Item No.	Pay Item	Pay Unit
6.08	Electrical Service	Allowance

END OF SECTION

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SECTION 26 27 13

ELECTRICAL METERING

PART 1 GENERAL

1.01 WORK INCLUDED

A. Electrical metering for Owner's equipment; not applicable to electric utility revenue metering.

1.02 SUBMITTALS

- A. Complete manufacturer's catalog cuts.
- B. Schematic and connection diagrams.

PART 2 PRODUCTS

2.01 CURRENT TRANSFORMER

- A. Window type.
- B. Voltage Rating: 600V, 60 Hz.
- C. ANSI Accuracy: 0.3 with Burdens B-0.1, -0.2, -0.5.
- D. Thermal Rating, Current: 3.0X minimum at 30°C, 200:5 to 500:5.
- E. Mechanical Current Withstand: Unlimited.
- F. Secondary Terminals: Cupped setscrew clamp type with short circuiting device and clear cover.
- G. G.E. JAK-O, Eaton T-Line.

2.02 CURRENT TRANSFORMER

- A. Window type designed especially for mounting on the secondary bushings of distribution transformers.
- B. Voltage Rating: 600V, 60 Hz.
- C. ANSI Accuracy: 0.3 with Burdens B-0.1, -0.2.
- D. Thermal Rating, Current: 2.0X at 30°C.
- E. Mechanical Current Withstand: Unlimited.

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- F. Secondary Terminals: 1/4-28 brass studs, cup washers, nuts, with short circuiting device and cover.
- G. G.E. JAB-O, Eaton.

2.03 TEST SWITCHES

- A. Designed for shorting and testing applications in current transformer secondary circuits.
- B. Base and interpole barriers of self-extinguishing insulating material.
- C. Current carrying parts of nickel plated copper, brass, bronze, or phosphor bronze.
- D. Operating handle designed to protect the operator from contact with live parts and have marker slot.
- E. Short-circuit jaw shall be make-before-break.
- F. Clear cover of self-extinguishing polycarbonate.
- G. Provide four test plugs for current circuits.
- H. States No. C3-406-L and 1011-K, Meter Devices.

2.04 PANEL METER

- A. Digital multifunction meter and transducer.
 - 1. As a minimum, provide capability to measure the following values at the accuracy in +/- percent of full scale, resolution, and range shown.
 - a. Volts: A-N, B-N, C-N, A-B, B-C, C-A; 0.2%; 0.1%; 0 to 2000, then kV.
 - b. Amps: A, B, C, N; 0.2%; 0.1%; 0 to 2000, then kA.
 - c. Power Factor: A, B, C, total; 1.0%; 1.0%; 1 to 0.5.
 - d. kW: A, B, C, total; 0.4%; 0.1%; 0 to 2000, then MW.
 - e. kVA: A, B, C, total; 0.4%; 0.1%; 0 to 2000, then MVA.
 - f. Frequency: A, B, C, total; .05 Hz; .01 Hz; 45 t0 75 Hz.
 - g. kVAH: A, B, C, total; 0.4%; 1 kVAH; 0-999,999.
 - h. kWH: A, B, C, total; 0.4%; 1 kWH; 0-999,999.
 - i. % THD: Amps A, B, C; Volts A-N, B-N, C-N; 0.5%; 0.2%; 0 to 100%.
 - j. K-Factor: Amps A, B, C.
 - 2. Minimum two line display.
 - 3. Fully programmable from front-accessible key pad including wye, delta, number of elements, transformer ratio, as well as scaling and parameter adjustments. Program stored in non-volatile eeprom.
 - 4. On-board memory for maximum and minimum values of each measured parameter and for accumulation of demand, kWH, and kVAH.
 - 5. Harmonic measurement.
 - 6. Programmable 4 to 20 mA outputs:

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- a. One for kW, one for amps.
- b. Accuracy: as required in Paragraph A. 1. above.
- 7. Input voltage (unless scheduled otherwise): 120V, maximum 0.1 VA burden per phase, withstand 200% continuous overvoltage and ten times rated voltage for 3 seconds.
- 8. Input current: 0 to 5A, maximum 0.1 VA burden per phase, withstand 200% continuous overcurrent and ten times rated current for 3 seconds.
- 9. Input/output isolation:
 - a. 5500 VAC from any input to ground, power supply, or to optional communications module or relay output terminal,
 - b. 5500 VAC from mA outputs to ground, power supply, or to optional communications module or relay output terminal.
 - c. Pass ANSI/IEEE C37.90.1 5000 volt fast transient test.
- 10. Ambient operating temperature: minus 20°C to plus 60°C.
- 11. True RMS sensing at 32 samples per cycle for measurements, 128 for harmonies.
- 12. Update time: every 100 milliseconds internally, display programmable for 0.1 to 10 seconds update. Set at 0.5 seconds.
- 13. Control power: 48 VDC +/- 20% at maximum 6VA, or as scheduled.
- 14. Fundamental frequency range: 45 to 65 Hz.
- 15. Housing with standard switchboard dimension and cutout in accordance with ANSI C39.1.
- 16. UL Recognized component.
- 17. Three year Manufacturer's Warranty.
- 18. Allen-Bradley 1404-M5, General Electric EPM5300P, Square D PM 850, plus options or Engineer reviewed substitute.

PART 3 EXECUTION

3.01 CONNECTION

- A. Connect each current transformer (CT) to a test switch.
- B. Leave CT shorted at CT and at test switch until gear is ready for start-up testing.

PART 4 PAYMENT

4.01 PAYMENT TERMS

Bid Item No.	Pay Item	<u>Pay Unit</u>
5.05	Electrical Metering	Lump Sum

END OF SECTION

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SECTION 26 27 16

CABINETS AND ENCLOSURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cabinets.
- B. Enclosures.

1.02 SUBMITTALS

A. Not Required.

PART 2 PRODUCTS

2.01 CABINETS AND ENCLOSURES

- A. NEMA 4X outdoors, exterior shall be steel with white polyester powder paint or 316L SS for all outdoor panels that contain any type of electronics. NEMA 4X disconnect switches and other enclosures such as J-Boxes and Pull-Boxes are excluded.
- B. NEMA 12 indoors. Other types allowed as noted on the Drawings.
- C. Continuous hinged doors are required for all cabinets and enclosures 6"x 6" or larger. NEMA 4X enclosures 24"x20" or larger shall have 3-point latch. Enclosures with clamps are not acceptable.
- D. Padlockable.
- E. Hoffman or equivalent.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Securely support independent of conduits.
- B. Level in the vertical and horizontal.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
1.25, 5.05	Electrical Cabinets and Enclosures	Lump Sum

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wiring Devices: Switches, receptacles, covers.

1.02 SUBMITTALS

A. Complete manufacturer's catalog cuts.

PART 2 PRODUCTS

2.01 TOGGLE SWITCHES

- A. Heavy-duty, "silent" AC type, 20A, 120V 277V.
- B. Back and side wiring feature. Positive clamping with screw-activated pressure plate.
- C. Poles and Contact Action: As shown on the Drawings.
- D. Motor Switching Rated:
 - 1. 1-1/2 horsepower at 120V.
 - 2. 2 horsepower at 240V.
- E. Manufacturers:
 - 1. Hubbell HBL1221, HBL1222, HBL1223, HBL1224 series.
 - 2. Pass & Seymour 20AC1, 20AC2, 20AC3, 20AC4 series.
 - 3. Engineer reviewed equivalent.
- F. Other features or switches as shown on the Drawings or Schedules.

2.02 DUPLEX RECEPTACLES

- A. Commercial Grade Duplex Receptacle:
 - 1. NEMA 5-15R.
 - 2. Back and side wiring feature. Positive clamping with screw activated pressure plate.
- B. Specification Grade Duplex Receptacle:
 - 1. NEMA 5-15R.
 - 2. Back and side wiring feature. Positive clamping with screw activated pressure plate.
 - 3. Positive grounding without bonding jumpers.

- C. GFCI Receptacle:
 - 1. NEMA 5-15R.
 - 2. Side wired.
 - 3. Flush polycarbonate face.
 - 4. Trip level: 4 to 6 mA.
 - 5. Trip time: .025 sec. nominal.
 - 6. Operating temperature: -35°C. to +66°C.
 - 7. Hubbell GF5252A series, Leviton 6599 series, Pass & Seymour 1591 series, or Engineer reviewed equivalent.
- D. Hospital Grade Duplex Receptacle:
 - 1. NEMA 5-15R.
 - 2. Back and side wiring feature. Positive clamping with screw activated pressure plate.
 - 3. Positive grounding without bonding jumpers.
 - 4. Marked with green dot on face.
 - 5. Hubbell 8200/8300 series, Leviton 8200/8300 series, Pass & Seymour 8200/8300 series, or Engineer reviewed equivalent.
- E. All toggle switches and duplex receptacles: By same manufacturer. Other switches and receptacles by the same manufacturer, except where shown by a different manufacturer in the Schedule or on the Drawings.

2.03 OTHER RECEPTACLES

A. Other devices as scheduled or as shown on the Drawings.

2.04 DEVICE PLATES

- A. Proper for the device(s) installed.
- B. Use a single plate for multiple devices.
- C. Oversize Polycarbonate or Nylon:
 - 1. Premium grade.
 - 2. Match device color.
 - 3. Use on flush boxes in appropriate areas.
 - 4. Use standard size plate if oversized plate is not manufactured.
 - 5. Hubbell PJ series or Engineer reviewed equivalent.
- D. Standard Size Polycarbonate or Nylon:
 - 1. Premium grade.
 - 2. Match device color.
 - 3. Use on surface-mounted boxes in appropriate areas.
 - 4. Use on flush boxes in appropriate areas if oversized plate is not manufactured.
 - 5. Same manufacturer, material, and appearance as oversize Polycarbonate or Nylon.

- E. 302/304 Stainless Steel: Hubbell S1, or Engineer reviewed equivalent.
- F. NEMA 7 in hazardous areas.
- G. Telephone Plates: Match material and general appearance of other device plates in the area.
- H. Special Plates: As Scheduled or as shown on the Drawings.
- I. Outdoor Toggle Switch Covers: Wet location lift cover, self-closing.
- J. Damp Location Duplex Receptacle Cover and Box:
 - 1. Single horizontal self-closing lid.
 - 2. Die cast aluminum or polycarbonate.
 - 3. UL listed as raintight in the closed position.
 - 4. Meet NEC 406.8 (A).
 - 5. Box: Designed for the specific cover and device combination and recommended by the manufacturer of the cover for use with the particular weatherproof cover.
- K. Wet Location Duplex Receptacle Cover and Box:
 - 1. Single horizontal self-closing.
 - 2. Polycarbonate.
 - 3. Paintable.
 - 4. Other features as shown on the Drawings or Schedules.
 - 5. UL listed as NEMA 3R with a cord connected.
 - 6. Meet NEC 406.8 (B) (1).
 - 7. Unless shown differently on the Drawings or Schedules, furnish Carlon E9UHG, TayMac 60310, or Engineer approved equivalent.
 - 8. Box: Designed for the specific cover and device combination and recommended by the manufacturer of the cover for use with the particular weatherproof cover.

PART 3 EXECUTION

3.01 DEVICE COLOR

- A. Special Colors:
 - 1. Where scheduled.
 - 2. Where called for on the Drawings.
 - 3. Where manufacturer's or industry standard for device, such as orange for isolated ground receptacles and red for emergency power receptacles.
- B. All others: White.

3.02 USAGE OF RECEPTACLES

- A. Furnish GFCI Type Receptacles at Each Location:
 - 1. Where required by NEC or
 - 2. Where scheduled or
 - 3. Where called for on the Drawings.
- B. Unless shown otherwise on the Drawings or Schedules, use commercial grade receptacles as specified herein.

3.03 COVER TYPE

- A. Wet Location, In-use: Outdoors and in process areas not excepted immediately below.
- B. Damp Location: Indoor, above-grade process areas except spaces, such as blower rooms, that have no piping that carries sewage or sludge.
- C. Stainless Steel: In laboratories, offices, meeting rooms, lobbies, and other similar office/commercial type areas.
- D. Standard Size Polycarbonate/Nylon or Galvanized Steel: Indoor surface-mounted device boxes.
- E. Oversize Polycarbonate/Nylon: Indoor flush-mounted device boxes.
- F. As scheduled or as called for on the Drawings.

3.04 INSTALLATION POSITION

- A. Mount toggle switches at 42 inches centerline above finished floor unless shown otherwise on the Drawings.
- B. Indoors: Mount duplex receptacles at 18 inches centerline above finished floor, unless shown otherwise on the Drawings.
- C. Outdoors and In Areas Considered Wet Location: Mount duplex receptacles at 30 inches centerline above finished grade or finished floor unless shown otherwise on the Drawings.

3.05 IDENTIFICATION

- A. Mount nameplate above cover plate of each receptacle and switch.
- B. Text:
 - 1. Receptacles: Panelboard designation and circuit number(s). For example: "PP3-2, 4, 6" or "LP2IG-17."
 - 2. Switches: Circuit designation as above and description of lights controlled.
 - 3. Otherwise as shown on the Drawings or Schedules.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.Pay ItemPay Unit1.25, 5.05Wiring DevicesLump Sum

END OF SECTION

SECTION 26 27 27

WIRE CONNECTORS AND ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wire connectors and accessories.

1.02 SUBMITTALS

- A. If products from manufacturer and of the model shown in Part 2 are to be furnished, submittals are not required and will not be reviewed.
- B. If products from a different manufacturer or of a different model than shown in Part 2 are to be furnished:
 - 1. Submit complete manufacturer's cuts.
 - 2. Furnish other material demonstrating product equivalence as directed by the Engineer.
- C. If a manufacturer and model are not shown in Part 2, furnish complete manufacturer's cuts.

PART 2 PRODUCTS

2.01 600V WIRE NUTS

- A. UL listed and CSA certified for 600V maximum building wire, 1000V maximum fixture wire, 105°C maximum temperature rating.
- B. Color coded outer shell to identify manufacturer approved wire combinations.
- C. Nylon insulated.
- D. Reusable.
- E. Scotch 3M Ranger 312 or Ranger 512, or Engineer reviewed equivalent.

2.02 BUTT CONNECTORS

- A. Non-insulated, brazed seam or seamless, compression type.
- B. Insulation: Tubular pre-stretched EPDM rubber cold shrink insulators. 3M 8420 series or Engineer reviewed equivalent.

2.03 LOCKING FORK WIRE TERMINALS

- A. UL listed and CSI certified.
- B. One-piece burr-free electro-tin plated copper, locking fork style.
- C. Ranges Required:
 - 1. 22-18 AWG for 4, 6, 8, 10 studs.
 - 2. 16-14 AWG for 4, 6, 8, 10, 1/4 studs.
 - 3. 12-10 AWG for 6, 8, 10, 1/4 studs.

D. Barrel:

- 1. Silver-brazed seam.
- 2. Beveled opening to facilitate wire insertion.
- 3. Multiple V-grooves inside barrel for better wire retention.
- 4. Non-insulated.
- E. Scotch 3M M18-4FL through M10-14FL or Engineer reviewed equivalent.
- F. Installation Tool:
 - 1. Hardened steel jaws, and handles.
 - 2. Color-coded, indent shape dies.
 - 3. Compound lever action with a ratchet mechanism to insure positive closure for full crimping cycle.
 - 4. Capable of being field adjusted to proper calibration.
 - 5. Complete with operation, maintenance, and calibration instructions.
 - 6. Scotch 3M TR-490 or Engineer reviewed equivalent.

2.04 SMALL RING TONGUE WIRE TERMINALS

- A. Same as Paragraph 2.03 except ring terminal.
- B. Scotch 3M M18-4R/S through M10-12R or Engineer reviewed equivalent.
- C. Installation Tool: Scotch 3M TR-490 or Engineer reviewed equivalent.

2.05 LARGE RING TONGUE WIRE TERMINALS

- A. Same as Paragraph 2.03 except ring terminal in sizes from #8 to #4/0 AWG for 3/8, 1/2 studs.
- B. Thomas and Betts StaKon D through L or Engineer reviewed equivalent.
- C. Installation Tool: T&B TBM6 or TBM6S or Engineer reviewed equivalent.

2.06 AREA LIGHTING CONNECTION KIT

- A. Complete kit with Allen set screw multiple connector blocks; separable, crimp-on wire terminals; UV stabilized waterproof multiple entry boot; fuse holder, and fuse for branch circuit.
- B. Buchanan 82S series or Engineer reviewed equivalent.

2.07 MEDIUM DUTY TERMINAL BLOCKS

- A. UL component recognized.
- B. Voltage Rating: 600V UL.
- C. Material: Nylon with elevated marking strip.
- D. Spacing: 0.375 inch center to center.
- E. Contacts:
 - 1. Electrical grade copper alloy.
 - 2. Tubular clamp type.
 - 3. 40A.
- F. Wire Range: #22 to #10 AWG.
- G. Maximum Service Temperature: 105°C.
- H. Buchanan #0715, #0730, #64, #68, #99, and #52, or Engineer reviewed equivalent.

2.08 HEAVY DUTY TERMINAL BLOCKS

- A. UL component recognized.
- B. Voltage Rating: 600V UL.
- C. Material: Nylon with elevated marking strip.
- D. Spacing: 0.5 inch center to center.
- E. Contacts:
 - 1. Electrical grade copper alloy.
 - 2. Tubular clamp type.
 - 3. 70A.
- F. Wire Range: #18 to #6 AWG.
- G. Maximum Service Temperature: 125°C.
- H. Buchanan #0243; #0250; #64; #68; #99; and #52, or Engineer reviewed equivalent.

2.09 POWER DISTRIBUTION BLOCKS

- A. UL component recognized.
- B. Tin plated high conductivity aluminum.
- C. Main and branch conductor size and number as shown on the Drawings or Schedules.
- D. Number of poles as shown on the Drawings or Schedules.
- E. Manufacturers:
 - 1. Square D: Class 9080 Type LB.
 - 2. Cooper/Bussman: 16 Series.
 - 3. Engineer reviewed equivalent.

2.10 DIN RAIL-MOUNTED CONTROL TERMINAL BLOCKS

A. General:

- 1. Comply with UL standards 486 and 1059.
- 2. Termination:
 - a. Box type clamp in which a screw applies continuous pressure to a plate which compresses the wire against the current bar, or
 - b. An automatic wire clamping system design to increase the clamping force as force is applied to pull the wire out of the clamp. Furnish clamping system with minimum retention forces (lbs) not less than shown in the following table:

Wire Size	<u>Type of Wire</u>	
<u>AWG</u>	<u>Solid</u>	Stranded
14	20.5	13.5
12	31.5	20.5
10	38.5	23.0
8	69.0	41.0

- 3. Accept solid or stranded wire, or stranded wires with ferrules.
- 4. Mount on standard TS 35 DIN-rail.
- B. Terminal Blocks, 600V Rating:
 - 1. Digital and analog signals: 6mm spacing (.238"), for 22-10 AWG wire.
 - a. DC positive or supply: Grey body.
 - b. DC negative or return: Blue body.
 - 2. DC shield and drain wire: 6mm spacing.
 - a. Terminals insulated from ground: Yellow body.
 - b. Terminals grounded to rail: Yellow body with green stripe.
 - 3. AC signal or power: 8mm spacing (.315 inch), for 22-8 AWG wire.
 - 4. AC foreign voltage, where circuits remain live after opening of control voltage disconnect switch: 8mm spacing, orange body.

5. AC equipment ground, terminals grounded to rail: 8mm spacing, yellow body with green stripe.

C. Switch Terminal Blocks:

- 1. DC: 6mm spacing, short hinged blade, grey body, orange blade.
- 2. AC: 8mm spacing, long hinged blade, grey body, orange blade.

D. Fuse-Holder Terminal Blocks:

- 1. DC or AC: Fused switch style, for 6.35x32mm (1/4-inch x 1-1/4-inch) fuses, greater than 13mm (.512 inch) spacing, with blown fuse indicator.
- 2. Self-contained without the need for an end cover.
- E. Other terminal blocks as shown on the Drawing or Schedules.

F. Accessories:

- 1. Mounting Rails: Bichromated zinced steel or anodized copper.
- 2. End Sections for Blocks: Required on the open extremity of each size and style of terminal block.
- 3. Circuit Separator: Required between blocks of different voltages, power and control, AC and DC.
- 4. End Stops for Rails: Required at the extremities of each series of terminal blocks.
- 5. Jumpers: Required for jumpering between blocks. Either a. or b. as below, or as specified on the Drawings.
 - a. Comb type.
 - b. Bar type.
- G. Markers: Required for every terminal block and board.
 - 1. Terminal Block: Side mount, pre-printed vertical or horizontal to match board alignment. Coordinate abbreviations of text with Engineer if descriptor exceeds available space.
 - 2. Terminal Board: End stop marker holder.
- H. Test Devices and Plugs: Provide during testing, and leave with the project spares the following items:
 - 1. Screw head test receptacle for 6mm blocks (if used): Four each.
 - 2. Screw head test receptacle for 8mm blocks (if used): Four each.
 - 3. Test plugs for the above receptacles: Eight each.

I. Manufacturers:

- 1. Phoenix Contact.
- 2. Wago.
- 3. Engineer reviewed equivalent.

2.11 CABLE GRIPS

A. Material: 302 or 304 stainless steel.

- B. Heavy duty unless shown otherwise on the Drawings.
- C. Single offset eye unless shown otherwise on the Drawings or otherwise submitted and reviewed.
- D. Basket weave, rod closure, reusable.
- E. Hubbell Kellems or Engineer reviewed equivalent.

2.12 CONNECTORS FOR DEVICENETTM

- A. Comply with ODVATM standards.
- B. Provide connectors which are designed so disconnection of a device does not disrupt the network and as shown on the Drawings.
- C. Provide drop line connectors/connections to match end devices.

PART 3 EXECUTION

3.01 WIRE NUTS

- A. For splices on copper conductors #8 AWG and smaller.
- B. Consult manufacturer's instructions for approved wire nut based on combination of wires being spliced.
- C. Do not use for splices that may become submerged, such as in manholes, handholes, underground pull boxes, and wet wells.
- D. Do not use for control or instrumentation conductors.

3.02 COMPRESSION TYPE CONNECTORS

A. Use only the tool and die specified by the manufacturer for installation.

3.03 BUTT CONNECTORS

A. For splices on 120, 240, 480V circuit conductors #6 AWG and larger (except at motors). Use only where specifically required on Drawings.

3.04 MOTOR LEAD CONNECTORS

- A. Solid wire: 600V wire nuts.
- B. Stranded Wire:
 - 1. Install non-insulated, brazed seam or seamless, ring terminal compression lugs on each conductor, then bolt together.

C. Insulate with Scotch 5300 - 5204 Series pigtail kits, or Engineer reviewed equivalent.

3.05 MARKING OF TERMINAL BOARDS AND TERMINALS

- A. DIN-Rail Mounted Terminal Systems: See Part 2.
- B. Other Terminal Boards:
 - 1. Engraved Micarta nameplate with 1/8-inchletters.
 - 2. Adjacent to each row or column of terminals.
 - 3. Text: As shown on Drawings or submittals.
- C. Terminal Points:
 - 1. Mark each terminal that will be wired.
 - 2. Mark other terminals if so shown on Drawings.
 - 3. Text: As shown on Drawings or submittals; if not shown, then match wire number.

3.06 INSTALLATION, ORIENTATION, AND CONNECTION OF DIN RAIL TERMINALS

- A. Mount switch and fuse-holder terminal blocks so the blades will fall open, with the hinge at the bottom if blocks are mounted vertically (horizontal rail).
- B. Connect switch and fuse-holder terminal blocks so the blade is de-energized; i.e., with voltage on the non-hinged side and load on the hinged side.
- C. Install DIN rails with empty space for one future block for each ten installed, except that no rail shall have fewer than four empty spaces for the largest block used.
- D. Attach DIN rails each 15 cm (6 inch).
- E. Other devices such as relays, surge protectors, power terminals, and interface modules may occupy the same rail as terminal blocks.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
1.25, 5.05	Wire Connectors and Accessories	Lump Sum

END OF SECTION

SECTION 26 28 13

LOW VOLTAGE FUSES

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1.01 SECTION INCLUDES

- A. Fuses.
- B. Fuse blocks and holders.

1.02 SUBMITTALS

- A. Catalog cuts.
- B. Time-current characteristic curves.
- C. Current limitation curves.
- D. Operating temperature characteristics.
- E. Submit only for the types of fuses, blocks, and holders required by the Drawings.

1.03 EXTRA MATERIALS

A. Section 26 00 60 – Extra Materials for Electrical Systems.

PART 2 PRODUCTS

2.01 CURRENT LIMITING, DUAL-ELEMENT, TIME DELAY FUSES

- A. Time Delay: 10 seconds minimum at five times rated current.
- B. Note Well: Overload portion of dual element shall open at a temperature not greater than 300°F.
- C. Interrupting Rating at rated voltage: 300,000A RMS symmetrical.
- D. UL Class RK-5.
- E. 250VAC: Bussmann Fusetron FRN-RK_SP or Engineer reviewed equivalent. 600VAC: Bussmann Fusetron FRS-RK_SP or Engineer reviewed equivalent.

2.02 FAST CURRENT LIMITING, DUAL-ELEMENT, TIME DELAY FUSES

A. Time Delay: 10 seconds minimum at five times rated current.

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- B. Note Well: Overload portion of dual element shall open at a temperature not greater than 300°F.
- C. Interrupting Rating: 300,000A RMS symmetrical.
- D. UL Class RK-1.
- E. 250 VAC: Bussmann Low Peak LPN-RK or Engineer reviewed equivalent. 600 VAC: Bussmann Low Peak LPS-RK or Engineer reviewed equivalent.
- 2.03 HIGH AMPACITY, FAST CURRENT LIMITING, TIME DELAY FUSES
 - A. Open at 150% of rated current within 4 hours.
 - B. Time Delay: 4 seconds minimum of 5 times rated current.
 - C. Interrupting Rating: 300,000A RMS symmetrical.
 - D. UL Class L.
 - E. 600 VAC: Bussmann Low-Peak KRP-C or Engineer reviewed equivalent.
- 2.04 CONTROL TRANSFORMER PRIMARY AND INSTRUMENT FUSES
 - A. Open at 135% of rated current within 1 hour.
 - B. Time Delay: 4 seconds minimum at three times rated current.
 - C. Interrupting Rating: 200,000A RMS symmetrical.
 - D. UL Class CC, with rejection feature.
 - E. 600 VAC: Bussmann CC-Tron FNQ-R or Engineer reviewed equivalent.
- 2.05 SMALL DIMENSION CONTROL CIRCUIT FUSES
 - A. Bussmann AGC, ABC, MDL, MDQ, MDX, or Engineer reviewed equivalent, to match current and voltage of circuit. Use dual-element fuses unless recommended otherwise by equipment manufacturer or shown as fast acting on the Drawings.
- 2.06 REJECTION FUSE BLOCKS FOR 2.01 AND 2.02 FUSES
 - A. Base: Phenolic.
 - B. Box terminals.
 - C. Bussmann Class R Phenolic or Engineer reviewed equivalent.

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2.07 REJECTION FUSE BLOCKS FOR 2.04 FUSES

- A. Base: Phenolic.
- B. Copper alloy box terminals.
- C. Bussmann BC603-1B, BC603-2B, BC603-3B, or Engineer reviewed equivalent.

2.08 REJECTION FUSE HOLDERS FOR 2.04 FUSES

- A. Body: Phenolic, with mounting holes for bolting to panel, and screw knob.
- B. Combination 1/4-inch quick connect/solder terminals.
- C. Bussmann HPF-RR or Engineer reviewed equivalent.

2.09 FUSE HOLDERS FOR 2.05 FUSES

- A. Body: Phenolic with bayonet knob.
- B. Voltage Rating: 250V.
- C. Maximum Fuse Size: 20A.
- D. Terminals: 1/4-inch right angle quick connect
- E. Bussmann HTB-48I or Engineer reviewed equivalent.

PART 3 EXECUTION (NOT USED)

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
1.25, 5.05	Low Voltage Fuses	Lump Sum

END OF SECTION

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SECTION 26 28 16

ENCLOSED SWITCHES

PART 1 GENERAL

1.01 SYSTEM DESCRIPTION

- A. Enclosed switches.
- B. May also be referred to as disconnect switches, safety switches, and/or service disconnects switches.

1.02 SUBMITTALS

A. Not required.

PART 2 PRODUCTS

2.01 ENCLOSED SWITCHES

- A. Type of Enclosure: See Paragraph 3.02.
- B. Service Disconnect Switches: 3 pole plus neutral and ground. Other switches: 3 pole plus ground unless neutral is required by the Drawings.
- C. 600V unless shown otherwise on Drawings.
- D. Ampere Rating: As shown on Drawings.
- E. Heavy duty, padlockable to the off position.
- F. Switch Mechanism: Positive action quick-make, quick-break, with visible blades.
- G. Non-fusible: Where shown on Drawings.
- H. Fusible:
 - 1. Where shown on Drawings.
 - 2. Fuse clips reject all except Class R current limiting fuses.
- I. Provide electrical interlock kits, as shown in Drawings, on those switches through which the control circuit wiring is routed. The kit shall have one NO and one NC contact rated 10A resistive and 6A inductive or two NO where noted. The contacts, when actuated, shall break the control circuit before the safety switch opens.
- J. Switches with non-metallic NEMA 4X enclosures: Square D Class 3110 Krydon® or Engineer reviewed equivalent.

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- K. Switches with NEMA 1, 3R, 12, 4X SS enclosure: General Electric Type TH, Cutler-Hammer DH, Square D Class 3110, or Engineer reviewed equivalent.
- L. Switches with NEMA 7, 8, or 9 enclosure: Crouse Hinds FLS, or Engineer reviewed equivalent.

PART 3 EXECUTION

3.01 MARKING

- A. Furnish engraved nameplate on each switch.
- B. Text as shown on the Drawings, but if not shown, then:
 - 1. Source of power to the switch, example "Fed From MCC1."
 - 2. Name and Tag Number of equipment served, example "Influent Lift Pump 1, PMP1011."

3.02 TYPE OF ENCLOSURE

- A. Comply with the matrix which is appended to this Section.
- B. If not shown in matrix, comply with requirements shown on Drawings.
- C. If not shown in either place, then:
 - 1. NEMA 1 in indoor non-process areas, such as: blower rooms, electrical rooms, administration building offices and mechanical rooms.
 - 2. NEMA 4X non-metallic in indoor process areas where there is liquid piping but no open liquid, such as a room with sludge pumps.
 - 3. NEMA 4X SS in indoor process area where there is open liquid, such as a membrane basin.
 - 4. NEMA 3R outdoors in areas more than 100 feet from a primary/secondary process structure. This includes structures containing raw or partially treated sewage but not a UV disinfection structure.
 - 5. Stainless steel NEMA 4X in all other indoor and outdoor areas, including but not limited to areas less than 100 feet from a primary/secondary process structure.
 - 6. Regardless of any/all other requirements above: NEMA 7 in classified (hazardous) areas, whether indoors or outdoors.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
1.25, 5.05	Enclosed Switches	Lump Sum

END OF SECTION

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SECTION 26 28 16.10

SWITCH RATED PLUGS AND RECEPTACLES

PART 1 GENERAL

1.01 SYSTEM DESCRIPTION

- A. Switch rated plugs.
- B. Receptacles.

1.02 SUBMITTALS

A. Complete manufacturer's catalog cuts.

PART 2 PRODUCTS

2.01 DISCONNECTING MEANS NON-CLASSIFIED

- A. Not for use in classified areas as defined in NEC Article 500.
- B. Where stainless steel is required on the drawings, provide disconnect in accordance with Paragraph 2.03.
- C. For use on motors rated \leq 75Hp (@ 480V, 3-Phase) and non-motor loads \leq 150A, where shown on Drawings.
- D. UL 2682 Listed.
- E. Ratings:
 - 1. Voltage as shown on the Drawings.
 - 2. For non-motor loads, provide current rating as shown on the Drawings.
 - 3. For motor loads, provide Hp rating as shown on the Drawings.
- F. Auxiliary Contacts: Provide as shown on Drawings. If not shown on Drawings, provide two auxiliary contacts.
- G. Plug and receptacle must have constant pressure butt-contacts with solid silver-nickel nipples.
- H. Minimum 65 kA short circuit rating.
- I. Plug and receptacle must incorporate an integral switching mechanism to ensure the load is broken before the plug is removed from the receptacle.
- J. Housing: NEMA 4X IP66 + IP67, Poly casing.

- K. Provide a poly handle with figure draw plates (2).
- L. Receptacle:
 - 1. Dead front construction.
 - 2. Padlock lockable.
 - 3. Cover cap.
 - 4. Provide 70 degree metal angle junction box adaptor, unless shown otherwise on Drawings.
- M. Temperature Range: -40° to 140°F.
- N. ISO 9001 certified.
- O. Meltric DSN or Engineer reviewed equivalent.

2.02 DISCONNECTING MEANS CLASS I DIVISION 2

- A. Suitable for Class I Division 2 Group A, B, C, D and Class 2 Division 2 Group E, F, and G as defined in NEC Article 500.
- B. For use on motors rated \leq 40 Hp (@ 480V, 3-Phase) and non-motor loads \leq 60A, where shown on Drawings.
 - 1. Where stainless steel is required on Drawings, provide disconnect in accordance with Paragraph 2.03.
 - 2. Where ampacity rating exceeds that as described above, provide disconnect in accordance with Paragraph 2.03.
- C. When installed on a motor, provide a nameplate above the disconnect which states: "NOT A LOAD BREAKING DISCONNECTING MEANS."
- D. UL Listed or CSI rated for Class I Division 2 Group A, B, C, D and Class II Division 2 Group E, F, G environments.
- E. Ratings:
 - 1. Voltage as shown on Drawings.
 - 2. For non-motor loads, provide current rating as shown on Drawings.
 - 3. For motor loads, provide nameplate current rating x 1.25 at a minimum.
- F. Auxiliary Contacts: Two.
- G. Plug and receptacle must have constant pressure butt-contacts with solid silver-nickel nipples.
- H. Plug and receptacle must incorporate an integral switching mechanism to ensure the load is broken before the plug is removed from the receptacle.
- I. Housing: NEMA 4X IP66 + IP67, Poly casing.

- J. Provide a poly handle with figure draw plates (two).
- K. Receptacle:
 - 1. Dead front construction.
 - 2. Padlock lockable.
 - 3. Cover cap.
 - 4. Provide 70 degree angle junction box adaptor, unless shown otherwise on Drawings.
- L. Temperature range: -40° to 140°F
- M. ISO 9001 certified.
- N. Meltric DXN or Engineer reviewed equivalent.
- 2.03 DISCONNECTING MEANS CLASS I DIVISION 1
 - A. Suitable for Class I Division 1 and 2, Group C and D as defined in NEC Article 500.
 - B. For use on motors rated \leq 160Hp (@ 480V, 3-Phase) and non-motor loads \leq 200A, where shown on Drawings.
 - C. When installed on a motor, provide a nameplate above the disconnect which states: "NOT A LOAD BREAKING DISCONNECTING MEANS."
 - D. UL Listed for Class I Group C and D environments (UL 1010).
 - E. Ratings:
 - 1. Voltage as shown on Drawings.
 - 2. For non-motor loads, provide current rating as shown on Drawings.
 - 3. For motor loads, provide nameplate current rating x 1.25 at a minimum.
 - F. Auxiliary Contacts: Where auxiliary contacts are required on Drawings provide the 60A, 100A, or 200A version respectively. Consult with manufacturer of contact limitations.
 - G. Plug and receptacle must have constant pressure butt-contacts with solid silver-nickel nipples.
 - H. Plug and receptacle must incorporate an integral switching mechanism to ensure the load is broken before the plug is removed from the receptacle.
 - I. Housing: Stainless Steel Type 316.
 - J. Fully submersible, when fully mated, to withstand 200psi (external pressure) and 100psi (internal pressure).

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K. Plug:

- 1. Mechanical cord clamp strain relief on cable attached to connector when connected to a cable.
- 2. Conduit treaded when connected to conduit.
- 3. Cover cap.

L. Receptacle:

- 1. Dead front construction.
- 2. Padlock lockable.
- 3. Cover cap.
- 4. Provide factory junction, unless shown otherwise on Drawings.
- M. ISO 9001 certified.
- N. Vantage Technology SD Millennium Series or Engineer reviewed equivalent.

PART 3 EXECUTION

3.01 MARKING

- A. Furnish engraved nameplate on each receptacle.
- B. Refer to Section 26 05 53 Electrical Identification.

3.02 TYPE OF ENCLOSURE

- A. Comply with requirements shown on Drawings.
- B. If not shown on Drawings then:
 - 1. Paragraph 2.01 in non-process and non-hazardous, unclassified process areas.
 - 2. Paragraph 2.02 in Class I Division 2 areas.
 - 3. Paragraph 2.03 in Class I Division 1 areas, and chemical storage rooms.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	<u>Pay Item</u>	<u>Pay Unit</u>
1.25, 5.05	Switch Rated Plugs and	Lump Sum
	Receptacles	

END OF SECTION

SECTION 26 29 23

VARIABLE FREQUENCY DRIVES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Variable Frequency Drives (VFDs) and appurtenances.

1.02 SUBMITTALS

- A. Product data.
- B. Ratings and features.
- C. Elevation and footprint views.
- D. Schematic and internal connection diagrams.
- E. Submit calculations for site de-ratings of all VFDs being provided.
- F. VFD manufacturer's published engineering procedures for de-rating calculations.
- G. Recommended Spare Parts List:
 - 1. Name/function of part.
 - 2. Catalog number.
 - 3. Quantity recommended.
 - 4. Cost (each) if bought under Change Order to Contract.
 - 5. Future source of supply, local to project if available.
- H. Certification of Manufacturers:
 - 1. Experience.
 - 2. ISO 9001 status.
- I. For VFDs mounted in Motor Control Centers (MCC), provide submittals for VFD as part of MCC submittal.

1.03 OPERATION AND MAINTENANCE DATA

- A. Product data.
- B. Ratings and features.
- C. Elevation and footprint views.
- D. Schematic and internal connection diagrams.
- E. One complete set of drawings in AutoCAD (.dwg) format and in .dxf format on DVD.

F. Manufacturer's standard Operation and Maintenance (O&M) Manual with troubleshooting guide and parts list.

1.04 QUALITY CONTROL

- A. All standard variable frequency drives, all options, all assemblies: UL listed and labeled and/or CSA certified/labeled.
- B. Provide VFDs which bear CE Marks meeting the following directives:
 - 1. Machine directive, 89/392/EEC.
 - 2. Low voltage directive, 73/23/EEC.
 - 3. EMC directive, 89/336/EEC.
- C. Provide VFDs which comply to the following EMC (Electromagnetic compatibility) standards, as applicable to the input power, output power and control inputs/outputs:
 - 1. Conducted Emission EN55011, class A group 1 or class B group 1 as applicable (150 kHz 30 MHz).
 - 2. Radiated Emission EN55011, class A group 1. (30 MHz 1000 MHz).
 - 3. Immunity EN 61000-4-2 Electrostatic discharges (ESD).
 - 4. Immunity EN 61000-4-3 Radiated electromagnetic field, 1 kHz, 80 % amplitude modulated. (80 MHz 1000 MHz).
 - 5. Immunity EN 61000-4-4 Burst transients $5/50 \mu S$.
 - 6. Immunity EN 61000-4-5 Surge transients $1,2/50 \mu S$.
 - 7. Immunity ENV 50204 Radiated electromagnetic field, pulse modulated (900 MHz \pm 5 MHz).
 - 8. Immunity EN 61000-4-6 Radio Frequency Common Mode Voltage 1 kHz, 80% amplitude modulated (150 kHz 80 MHz).
 - 9. Immunity VDE 0160 Section 7.3.1.1 Class W2 Test Pulse: Mains transients.

D. VFD Manufacturer:

- 1. ISO 9001 certified and ISO 14001 certified.
- 2. Demonstrate a continuous period of manufacture and development of variable frequency drives for at least 10 years.

1.05 SOURCE

A. Obtain drive from a factory authorized representative/distributor which provides local sales, parts, technical, and warranty support, and which employs factory authorized and trained personnel.

PART 2 PRODUCTS

2.01 VARIABLE FREQUENCY DRIVE

A. Major Components:

- 1. AC line disconnect, lockable, door interlocked, if scheduled or shown on the Drawings. Most drives for this project do not require internal disconnects.
- 2. AC input fuses for protection of AC to DC converter.

- 3. VFD bypass circuit if scheduled or shown on Drawings.
 - a. Drive input isolation: manual 480V switch with auxiliary contacts or IEC contactor as shown on Drawings.
 - b. Drive Output Isolation: IEC contactor, sized to match drive output rating.
 - c. Bypass contactor: NEMA starter with electronic overload relay, size as scheduled.
 - d. Provide separate compartments and configure components such that it is possible to run the motor in bypass mode while having absolutely no voltage above 24 VDC present in the VFD compartment.
- 4. Phase to phase and phase to ground transient protection on input. Comply with the requirements of EN 6100-4-4 Burst Transients and EN 6100-4-5 Surge Transients.
- 5. AC to DC converter with AC reactor or DC choke to limit inrush and reduce harmonics.
- 6. DC to AC Converter:
 - a. Provide adjustable frequency pulse width modulated (PWM) synthesized sine wave output.
 - b. Use IGBT devices which are protected against over-voltage, over-current, over-temperature, and reverse voltage.
 - c. SCR, GTO, or thyristor devices are not acceptable.
 - d. Set carrier frequency to the lowest available unless a higher frequency is recommended by the manufacturer and allowed by the Engineer. Coordinate output filter selection with carrier frequency.
- 7. Provide drive output protection such that short circuit or ground fault on the motor leads does not damage the drive.
- 8. Motor Overload Protection:
 - a. Drives with bypass: provide a separate solid-state overload relay.
 - b. Drives without bypass: provide a separate solid-state overload relay or provide speed sensitive solid state motor overload protection integral to the drive electronics.
- 9. Control power transformers for drive itself, for bypass contactors, and for others loads as shown on the Drawings. Provide extra VA capacity as scheduled or shown on Drawings.
- 10. Provide additional controls as shown on Drawings.
- 11. 24 VDC power supply with 400 mA available for use by Owner's controls.

B. Efficiency:

- 1. Minimum efficiency at 100% load: 96%.
- 2. Minimum efficiency at 20% load: 92%.
- C. Input Voltage as scheduled or shown on the Drawings:
 - 1. 208V 3-Phase nominal, self-adjusting for 200-240V $\pm 10\%$ input or
 - 2. 460V 3-Phase nominal, self-adjusting for 380-480V $\pm 10\%$ input.
 - 3. 120V single phase.
 - 4. Displacement Power Factor: 94% or greater from no load to full load.

D. Output Voltage: Zero to line voltage, to match input, 3-Phase, 0 to 120 Hz, variable voltage (volts/Hertz) up to 60 Hz, constant voltage above 60 Hz. However, for drives which power positive displacement pumps or blowers, provide sensorless vector control capability.

E. Output Frequency Control Options:

- 1. Manual speed control by means of keypad or front-panel mounted potentiometer.
- 2. 4 to 20mA signal into input port which is isolated from AC power, ground, and drive electronics internal power and ground:
 - a. Direct control of frequency,
 - b. PID control for closed loop speed regulation, closed loop process control, or open loop torque control. See Schedule.
- 3. Features, such as programmable hardware inputs, to allow control of frequency as:
 - a. Above choices,
 - b. Preset frequencies,
 - c. Commanded over communications link.

F. Skip Frequencies:

- 1. Provide three adjustable set points that lock out continuous operation at frequencies which may produce mechanical resonance.
- 2. Provide set points with bandwidth adjustable from 0 to 60 Hz.
- G. Flying Start: Provide capability of determining the speed and direction of a spinning motor and automatic adjustment of VFD output so it can "pick-up" the motor at the rotating speed.
- H. Provide a drive which has the NP horsepower rating and minimum output current capacity scheduled, after the drive is derated for altitude and ambient temperature, not just large enough for the HP of equipment shown on Drawings.

I. Duty Rating:

- 1. Where scheduled below, provide drives that are rated standard duty "variable torque" and which can provide at least 110% of scheduled minimum current capacity for at least 1 minute out of 5 minutes.
- 2. All other drives: heavy duty "constant torque" which can provide at least 150% of scheduled minimum current capacity for at least 1 minute out of 5 minutes.

J. Operator Interface Panel:

- 1. Liquid Crystal Display: Minimum two lines of 16 characters.
- 2. Full numeric keypad plus navigation and "enter".
- 3. As a minimum, use for adjustment of drive parameters, including transfer of drive setup from one drive to another, and display of drive operations as selected by facility Operator.
 - a. Minimum frequency and maximum frequency.
 - b. Multiple acceleration and deceleration ramps.
 - c. Three bypass frequencies with adjustable bandwidths.
 - d. Preset speeds.
 - e. Current limit.
 - f. Low speed and high speed load compensations.

- g. Slip compensation.
- h. Magnetization current.
- i. PID parameters and feedback scale factor.
- j. Warning current High/Low.
- k. Warning frequency High/Low.
- 1. Warning feedback High/Low.
- m. Power loss ride through mode.
- n. Flying start mode.
- o. DC Braking:
 - 1) Time,
 - 2) % current,
 - 3) Cut-in frequency.
- p. Motor Parameters:
 - 1) kW (HP),
 - 2) Voltage,
 - 3) Frequency,
 - 4) Full load current,
 - 5) Base RPM.
- q. Diagnostics:
 - 1) Display a minimum of the last four fault events.
 - 2) Display other diagnostic parameters.
- r. Display of Drive Operations at Operator Request:
 - 1) Reference signal [%].
 - 2) Reference signal [unit].
 - 3) Feedback [unit].
 - 4) Frequency [Hz].
 - 5) Motor current [A].
 - 6) Torque [%].
 - 7) Power [kW].
 - 8) Power [HP].
 - 9) Energy [kWh].
 - 10) Motor Voltage [V].
 - 11) DC link voltage [V].
 - 12) Thermal load, motor [%].
 - 13) Thermal load, VFD [%].
 - 14) Run hours [hrs].
- s. Jam protection parameter programmable to trip drive above a current set-point with definite time delay, active only after initial acceleration of load.
- t. Selection of automatic restart on power outage and return or for restart only after the operator intervenes. Unless scheduled otherwise, provide automatic restart setting.
- u. Manual stop-start control, coordinated with hardware controls.
- v. Adjustment of running current limit protection: 10% to 110%. Unless requested otherwise by Engineer, set for 105%.
- w. Adjustment of acceleration time: 0.1 to 3,600 seconds. Unless requested otherwise by Engineer, set for 15 seconds.

- x. Selection of remote (mA) or manual control of frequency coordinated with hardware controls.
- y. Manual adjustment of frequency.
- z. Selection of action upon detection of loss of 4-20 mA signal:
 - 1) Switch the VFD to the last speed, full speed, jog speed, preset speed.
 - 2) Stop and trip.
- K. Minimum four programmable discrete inputs. Provide more if needed in order to implement all designed functions.
- L. Parameter Storage:
 - 1. Store the factory default settings in VFD resident non-volatile memory (EEPROM) so that the user can return the drive to a known state.
 - 2. Store the actual, in-use, program in VFD EEPROM.
- M. Drive and Motor Protection:
 - 1. Shutdown for:
 - a. Input overvoltage, undervoltage, or voltage unbalance,
 - b. Overheating of the drive,
 - c. Other internal drive faults,
 - d. Motor overload or fault.
 - 2. Provide dry alarm contact.
 - 3. Restart only after operator intervenes unless programmed for automatic restart on power return.
- N. Furnish controls and terminal boards for interface to other plant equipment as shown on the Drawings.
- O. Provide isolated dry contacts for alarm and control:
 - 1. Programmable as to function.
 - 2. Two Form A (SPST, NO) contacts and
 - 3. Two Form C (SPDT) contact sets.
- P. Provide other control as scheduled or shown on the Drawings.
- Q. Ethernet Communication:
 - 1. Each VFD shall be supplied with a means to communicate via Ethernet/IP network.
 - 2. Ethernet connections shall be configured in a star architecture to connect all VFD devices back to a common point of connection for the supervisory control system. Star cabling runs shall consist of a single cable from the devices back to an Ethernet switch. The powering down of a VFD device shall not affect the performance of other device communications.
- R. Approved Manufacturers: Allen-Bradley.

2.02 VFD OUTPUT FILTER FOR PROTECTION OF MOTOR WINDINGS

- A. UL listed/labeled.
- B. 3-Phase, 600V class gapped iron core inductor designed to protect VFD powered motors against excessive voltage that might be caused by interaction of VFD with long leads (between 50 and 3,000 feet) between VFD and motor by the use inductance, capacitance, and resistance to form a damped, low pass filter, limiting the dv/dT rate, which removes the steep edges from the PWM voltage waveform, protecting motors from damage due to high voltage. Filter characteristics to be coordinated with the carrier frequency.
- C. Designed to be located immediately adjacent to the output terminals of the drive and to be wired directly to the drive.
- D. Losses in Filter: Less than 1% of the motor rating.
- E. Ambient Temperature: 40°C.
- F. Enclosure: Interior to VFD enclosure or if not interior, same NEMA rating as VFD.
- G. Trans Coil, Incorporated (414-357-4480) dV/dT Guard KLC Filter, or Engineer approved substitution.
- H. Provide current rating at least equal to the current rating of the VFD.
- I. Provide a filter for each drive. Filters are not shown on Drawings.

PART 3 EXECUTION

3.01 MARKINGS

A. Furnish nameplate on each VFD identifying equipment served. Show name of equipment, tag number, and source of power.

3.02 STARTUP SERVICE

- A. Provide services of a field service representative of the VFD manufacturer to:
 - 1. Verify correctness of field installation.
 - 2. Completely test all pertinent functions.
 - 3. Adjust drive parameters.
 - 4. Place drive in service.
 - 5. Adjust/re-adjust drive parameters and/or PI controls as requested by Engineer.
 - 6. Train Owner personnel.

3.03 FLOW MEASUREMENTS AND SETTINGS DURING STARTUP

A. Determine the speed required for flow operation controls during startup.

3.04 OTHER REQUIREMENTS

- A. Enclosure: NEMA 1.
- B. Ambient:
 - 1. Altitude: 7,144 feet above MSL.
 - 2. Maximum Temperature: 40°C.
- C. Additional control features required for this project.
 - 1. Controls as shown on Drawings.
 - 2. In submittals, show all control components, not just those at the VFD. Show internal and external wiring.
 - 3. Proportional/Integral (PI) control for closed loop speed regulation, closed loop process control, or open loop torque control.
 - 4. Extra VA capacity of control power transformer where indicated.
 - 5. Provide communications port and firmware/software for connection to and correct interoperation with the plant PLC network, if applicable.
- D. Provide VFD output filter for protection of motor windings. Filters are not shown on Drawings. If enclosures are wider than the respective VFD enclosures, stagger the mounting heights or perhaps mount filters rotated if so allowed by the filter manufacturer in order to fit filters of multiple drives in the same horizontal wall width as the VFDs.
- E. Contractor to provide 1 hour of training for operations and maintenance personnel on the setup and operation of the VFD. Use the section of the O&M Manual dealing with the VFD along with any other information required to properly instruct the staff on how the drive was programmed and what to do if changes to setpoints are desired.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
5.01	Variable Frequency Drives	Lump Sum

END OF SECTION

SECTION 26 32 13.13

DIESEL ENGINE DRIVEN GENERATOR SYSTEM

PART 1 GENERAL

1.01 WORK INCLUDED

A. Engine driven standby electric generating system (EGS).

1.02 SYSTEM REQUIREMENTS

- A. Obtain the EGS from a single distributor to ensure system compatibility and service responsibility for the complete system. The highway distance from the distributor's shop and warehouse to the project site shall be less than one hundred miles unless scheduled otherwise.
- B. The manufacturer of the generator set shall be the manufacturer of either the generator or the drive engine. The generator set shall be assembled and tested at the manufacturer's factory, not at a distributor's facility.
- C. The Engineer has sized the engine generator based on the motor-starting capacity and standby rating of both Cummins and Caterpillar engine-generator systems. Due to selective operation of equipment by the plant control system, it is not possible to evaluate the required motor-starting capacity and standby rating of an engine generator solely from information shown on the One-Line Diagram. If another manufacturer desires to be considered, then they may provide a software sizing program to the Engineer free of charge minimum 2 weeks before the Bid opening date. The Engineer will make changes, if any are required, to the requirements by Addendum.
- D. Perform prototype tests on a complete and functional set, not just on components. Perform prototype testing in compliance with NFPA 110 for Level 1 systems.

1.03 SYSTEM DESCRIPTION

- A. The generating system includes, but is not limited to, a diesel engine driven generator set with starting battery and battery charger, automatic transfer switches, control devices, and other equipment as scheduled to provide a complete, operable system.
- B. Ratings:
 - 1. As scheduled.
- C. As a minimum, comply with the requirements of NFPA 110, Standard for Emergency and Standby Power Systems, and with standards referenced therein. Where the

requirements of this specification are more stringent than NFPA 110, comply with this Specification.

1.04 SUBMITTALS

- A. Include submittal information of the following sections in a single binder:
 - 1. Section 26 32 13.13 Diesel Engine Driven Generator System.
 - 2. Section 26 36 23 Automatic Transfer Switches.
 - 3. Other Sections if so scheduled.
- B. EG set prototype test reports.
- C. Complete descriptive catalog cuts tailored specifically for this project. Indicate applicable information by means of arrows or line-out non-applicable.
- D. Drawings:
 - 1. Dimensional Drawings.
 - 2. External connection diagrams to show interconnects between different pieces of equipment.
 - 3. Include engine, generator, batteries, battery charger, and fuel system.
 - 4. Equipment weights.
- E. Data sheets for batteries. Manufacturer's literature and ratings for battery charger.
- F. Furnish a statement from the manufacturer certifying that the distributor is a factory authorized distributor. This authorized distributor shall have been an authorized distributor for the manufacturer for at least 5 full years, shall be regularly engaged in sales and service of engine driven generators, shall have been assigned full service responsibility for the manufacturer's engine driven generator systems in his area for at least 5 years, shall maintain an adequate stock of spare parts at his warehouse to perform maintenance on all the equipment and supplies under this specification, shall employ at least two factory trained personnel within the specified maximum distance from the project site who specialize in and regularly perform on-site maintenance of engine driven generator systems.
- G. Factory test reports.
- H. Certification that the control panel meets the requirements of NFPA 110.
- I. Dimensions of radiator core and the flow of cooling air, in cubic feet per minute, required for proper cooling of the engine and generator. Certify that the generation system will perform properly after necessary derating and that it will not overheat when operated for 1 hour at rated load and when waste heat is ducted outside. Ensure both the inlet and outlet louvers are of adequate cross-sectional area to handle the air flow without undue suction pressure. Furnish calculations and published derating factors.

- J. Engine mechanical data at varying loads up to full load, including heat rejection, exhaust gas flows, combustion air and ventilation air flows, noise data, fuel consumption, etc.
- K. Generator electrical data including temperature and insulation data, cooling requirements, excitation ratings, voltage regulation, voltage regulator, efficiencies, waveform distortion, and telephone influence factor.
- L. Generator resistances, reactances, and time constants.
- M. Generator current decrement curve.
- N. Emissions data at 50%, 75%, and 100% for CO and NOX. Other information to show that the engine is eligible to be permitted by the State and/or local air quality control authority.
- O. Permit to Construct, granted by State and or local authority.
- P. Field test procedure and test reporting form.

1.05 OPERATIONS AND MAINTENANCE (O&M) MANUAL

- A. Bind in one binder or in a set of properly labeled binders, information for:
 - 1. Engine Generator Set.
 - 2. Automatic Transfer Switches.
 - 3. Equipment in other Sections if so scheduled.
- B. Schematics and Internal Connection Diagrams:
 - 1. Engine, including jacket water and/or oil heater.
 - 2. Generator.
 - 3. Automatic Transfer Switch.
 - 4. Battery Charger.
 - 5. Other associated equipment, such as, but not limited to, fuel system.
- C. Field corrected external connection diagrams showing interconnects between different pieces of equipment.
- D. Manufacturer's standard instructions for engine, generator, and system consisting of operating and maintenance manuals, parts books, and warranty data.
- E. Completed field test report.
- F. Copy of Permit to Construct and of Permit to Operate.

1.06 EXTRA MATERIALS

A. Furnish a 1-year supply of air, fuel, and oil filters.

1.07 WARRANTY

A. Provide a single 5-year warranty which covers parts, expendables made unusable by a defect, labor, testing, travel time, and travel expenses. Multiple warranties for components and assemblies will not be acceptable. Running hours shall not be a limiting factor to the warranty.

PART 2 PRODUCTS

2.01 1800 RPM ENGINE-GENERATOR

A. Engine:

- 1. Type: Stationary, liquid cooled, turbocharged, aftercooled.
- 2. Four cycle compression ignition.
- 3. Fuel: Number 2 diesel fuel.
- 4. Air, fuel, and oil filters.
- 5. Mounting: Structural steel base capable of maintaining proper component alignment during shipping, installation, and operation.
- 6. Vibration Isolators: Adjustable spring-type, with side movement snubbers, under the engine-generator steel base.
- 7. Lubrication: Full pressure oil to bearings, full flow filters placed for convenient servicing with spring-loaded bypass valve.
- 8. Starting System:
 - a. Starting: Capacity to crank engine to allow full diesel starting with overcrank timer relay set for 75 seconds.
 - b. Batteries: Lead acid, specifically designed for starting service.
 - c. Charging alternator: Minimum 30A.
 - d. 10A line powered charger, specifically designed for batteries furnished.
- 9. Engine Heaters:
 - a. As a minimum, provide a convection heater to maintain the coolant at minimum 32°C temperature for fast starting and rated load acceptance at the minimum schedule ambient temperature.
 - b. As scheduled or shown on the Drawings.
- 10. Exhaust system: Critical grade silencer with raincap, drain valves on silencer and exhaust piping low points. Factory install blanket type insulation on exposed exhaust components up to flexible coupling. Distributor furnish same type of insulation system for field insulation of other exposed exhaust components less than eight feet above slab. Maximum surface temperature of external surface of insulation: 150°F.

11. Cooling System:

- a. Engine-driven circulation pump.
- b. Thermostat.
- c. Integral fan and radiator.
- d. 50/50 mix of propylene glycol and clean water.
- e. Mount engraved NP on control panel and by radiator cap: USE PROPYLENE GLYCOL COOLANT.

12. Fuel System:

- a. Dual canister-type fuel filters of the flow, pressure drop, and micron rating used as standard by the engine manufacturer.
- b. Also provide a primary fuel filter/water separator ahead of the above fuel filters.
- c. Fuel Piping: Black iron, not galvanized.
- d. Fuel Hose: Rated 100 PSIG at 300°F.

13. Frequency Control:

- a. Electronic governor with magnetic pickup on flywheel. Loss of signal causes engine shutdown.
- b. Isochronous with manual speed adjustment capability.
- c. Steady state speed regulation: $\pm 0.25\%$ or better.

14. Additional Equipment:

- a. Low coolant temperature alarm.
- b. As scheduled.
- 15. Comply with the emission requirement of EPA (Tier 2, 3, 4) as follows:
 - a. 0 to 55 bkW: Tier 4.
 - b. 56 to 559 bkW: Tier 3.
 - c. 560 and larger bkW: Tier 2.

B. Generator:

- 1. Alternator:
 - a. Design: Revolving field, 4-pole, drip-proof, brushless.
 - b. Stator: Skewed to prevent slot harmonics, Class F varnish impregnated.
 - c. Rotor:
 - 1) Direct coupled to engine with flexible drive disc, unless scheduled otherwise.
 - 2) Damper windings.
 - d. Exciter: Brushless, 3-Phase rotor with weather protected rectifiers; manual reset field circuit breaker or equivalent protection.
 - e. Windings insulated with Class H epoxy resin in compliance with NEMA MG1-1.65.
 - f. Winding Temperature Rise: Maximum 130°C over 40°C ambient (NEMA Class F).
 - g. Voltage Regulator: Solid state, temperature compensated with three phase true RMS sensing, immune to problems that might otherwise be caused by non-linear loads such as solid-state starters or adjustable frequency drives.
 - h. Permanent magnet generator for source of excitation. System capable of supporting a 300% fault for 10 seconds.

- i. Bearing: Double sealed, prelubricated ball bearing.
- j. Cooling: Direct drive centrifugal blower.
- k. Other Features: As scheduled.

2. Performance:

- a. Waveform Deviation Factor: Less than 0.07 line-to-line.
- b. Random Voltage Variation: No greater than \pm 0.5% of mean value for constant loads from no load to full load.
- c. Total Harmonic Distortion: Less than 5% as tested per IEEE 115.
- d. Telephone Influence Factor: Less than 50 per NEMA MG1-22.43.
- e. Alternator Temperature Rise: Within NEMA MG1-22.40, Class F limits as tested per IEEE 115.
- 3. Generator Output Circuit Breaker:
 - a. UL listed.
 - b. Type, frame, and trip as recommended by generator manufacturer unless shown otherwise in Schedule or on Drawings.

2.02 CONTROLS AND INSTRUMENTATION

- A. Engine generator control panel, mounted on engine-generator, illuminated, containing all instrumentation, and control. Labeled under UL 508 or equal standard of other nationally recognized testing laboratory.
- B. DC Engine Controls and Instrumentation:
 - 1. "RUN-STOP-REMOTE" selector switch with Remote Start-Stop Terminals.
 - 2. Oil pressure gage.
 - 3. Coolant temperature gage.
 - 4. Charge rate ammeter; battery voltage.
 - 5. Running time meter.
 - 6. Emergency stop terminals,
 - 7. Emergency Stop Pushbutton: Maintained mushroom head.

C. Safety Indications and Shutdowns:

- 1. Comply with NFPA 110 Table 3-5.5.2(d):
 - a. Provide control panel-mounted visual indicators for the functions listed in the Table.
 - b. Provide shutdown of engine for functions listed in the Table.
 - c. Provide individual contacts for external connection for operation of remote audible devices shown in Table.
 - d. Comply with other requirements of Table.
 - e. For Level 1 systems, provide remote annunciation panel. Also provide if so scheduled, whether a Level 1 system or not.
- 2. Visual indication and alarm repeating contacts for high fuel level, low fuel level, and fuel tank leak.
- 3. Lamp test button.
- 4. Annunciator silence/reset.

- 5. Provide four SPDT dry contacts to indicate that the engine is running. Contact ratings: NEMA B300 and P600.
- 6. Provide other functions as scheduled.

D. AC Controls and Instrumentation:

- 1. Digital Metering of Generator AC Output:
 - a. True RMS, 0.5% accuracy.
 - b. Volts, Amps, and Frequency.
 - c. kW, percent power, kVA, kVAR, Power Factor.
 - d Kwh
- 2. Phase selector switch for volts and amps.
- 3. Voltage adjustment rheostat.

2.03 FACTORY TESTS

A. Test the engine-generator at the factory, under load, for proper performance and functioning of component parts and control circuits.

2.04 FUEL TANK

- A. Steel, double containment, and suitable for supporting entire engine-generator assembly.
- B. Locate fill and vent connections where shown on Drawings or where marked by Engineer on submittal.
- C. Capacity: Shall be at least 133% of the quantity needed to meet the runtime required for the EG Class as required by NFPA 110. EG Class as scheduled.
- D. Provide level gage. Span the level gage for the capacity specified in the above Paragraph. Provide engraved nameplate which shows "Level gage reading of 'X' is equal to 133% of design capacity, which is 'X1' hours of fuel" and "Level gage reading of 'Y' is equal to the design Class, in hours, of fuel remaining," and "Level gage reading of 'Z' is equal to low alarm level." Provide another nameplate which says, "Fill the tank to the level of the tank full float."
- E. Provide low alarm float, tank full float, and tank leak float. Set the low alarm float equal to the level required to meet the EG Class. Set the tank full float to 133% of the level required to meet the EG Class.

PART 3 EXECUTION

3.01 AIR QUALITY PERMITS

A. File for and obtain Permit to Construct.

- B. File for and obtain Permit to Operate.
- C. If the particular installation is exempt from State and local air quality requirements, quote the section of law/regulation which exempts it.

3.02 INSTALLATION

- A. Install the engine-generator set, including all connections as indicated on Drawings, in the Specifications, and in accordance with the manufacturer's instructions.
- B. Insulate exhaust system components.

3.03 SITE TESTING

- A. Supply fuel for testing.
- B. Supply load-bank and other necessary test equipment, none of which will become the property of the Owner.
- C. Schedule for Testing:
 - 1. Propose only after the test procedure has been favorably reviewed by the Engineer.
 - 2. Propose minimum 7 working days in advance. Include proposed starting time and estimated total time required for completion of testing.
 - 3. If so required by the Authority Having Jurisdiction (AHJ) or by NFPA 110, also notify the AHJ.
- D. Follow testing methods as recommended by the Field Service Representative of the engine-generator set manufacturer.
- E. Unless otherwise stated in writing, the Engineer and the Owner will witness the testing. Provide a block on the test form for the Engineer and the Owner to initial to signify having witnessed but not necessarily approved the testing.
- F. Perform the following minimum testing. Perform other testing if so scheduled.
 - 1. Acceptance testing as required by NFPA 110 Paragraph 5-13 Installation Acceptance. Tailor testing to the NFPA 110 Level (1 or 2) of the system specified.
 - 2. If testing at factory was performed at unity power factor, perform field test with a reactive load bank at 80% power factor. If testing at factory was performed at 80% power factor, field testing may be performed at unity power factor.
 - 3. Perform a final test to show that the system starts all available facility loads, plus sufficient additional load from the load bank to reach the scheduled rating and operate continuously (minimum 2 hours) without overheating. Record time, kW, oil temperature, and coolant temperature at 15 minute intervals.

3.04 TRAINING

- A. Provide the services of a Field Service Representative to train Owner personnel.
- B. Provide the following minimum training. Provide other training if so scheduled.
 - 1. Classroom training as scheduled. The Owner will provide a room for this training.
 - 2. Field training as scheduled.
 - 3. Allow one, 4 hour session for classroom training and one, 1 hour session for field training.
 - 4. Provide basic training on operations and alarms. Concentrate on preventive and corrective maintenance.

3.05 FUEL

A. Fill fuel tank before testing. Refill to at least the tank full float level after NFPA 110 Installation Acceptance testing required by Paragraph 3.02 is successfully completed. Demonstrate full condition to Owner. Perform final test with facility loads and other testing as scheduled. Refilling of the tank is required after that testing only if the tank level becomes less than the low level alarm.

3.06 SCHEDULE

- A. Ambient Conditions:
 - 1. 7,145 feet above mean sea level.
 - 2. Minus 20° to plus 40°C (at radiator inlet) at 5% to 95% relative humidity.
- B. NFPA 110 Classification:
 - 1. Type 10.
 - 2. Class 18.
 - 3. Level 2.
- C. Communications between engine control panel and Owner's Plant Control System: Modbus TCP.
- D. Engine Jacket Water Heater:
 - 1. Maintain coolant temperature at minimum 32°C. Maintain oil temperature at minimum temperature recommended by the engine manufacturer.
 - 2. Use 240V single phase heating element.
 - 3. Provide factory installed circuit breaker and thermostat of correct size for the heater.
 - 4. Factory install heater of proper kW rating.
 - 5. The Drawings show a 208V 20A feeder. Include in the Bid the cost, if any, of changing it to match the requirement of the heater furnished and/or of providing power for two heaters.

- E. Batteries: Inside generator weatherproof enclosure.
- F. Sound Attenuated and Weather Protective Enclosure:
 - 1. Factory installed non-walk-in weather protective enclosure with residential grade exhaust system. Exhaust silencing system housed within the enclosure. Approved for use with UL 2200 listed generator set packages. Durable 14 gage cold rolled steel weather-resistant enclosure externally mounted emergency stop button for safe operation. Rust-free stainless steel hinges and locks and zinc-plated hardware. Radiator sight gage to provide easy verification of coolant level. Lockable, gasketed doors provide secure access to fuel fill, oil fill, coolant, and battery. Enclosure designed for spreader-bar lifting to ensure safety. Lube oil, coolant, and fumes disposal lines terminated on the base frame. Sound attenuation: Maximum 87 dB at 23 feet when at 100% load.
 - 2. Provide more than the standard factory screening over vent openings and at other possible points of rodent entry into the engine, the generator, or associated enclosure such that the largest opening is 1/4 inch square. Use compression bushings where cables from the engine enter raceways, control panels or other electrical enclosures.
- G. EG Set:
 - 1. 277/480V 3-Phase, 4 wire.
 - 2. Output circuit breaker(s): See Drawings.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	<u>Pay Item</u>	Pay Unit
5.05	Generator System	Lump Sum

END OF SECTION

SECTION 26 33 53

STATIC UNINTERRUPTIBLE POWER SUPPLY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. True on-line double-conversion uninterruptible power supply.
- B. Software and accessories for communications with a personal computer.

1.02 SUBMITTALS

- A. Catalog cuts for hardware and software.
- B. Dimension drawings.
- C. Exact battery manufacturer, type, model, and quantity. If batteries are labeled as being a product of the system manufacturer but are in fact manufactured by a different company, provide the same information for the actual manufacturer.

1.03 OPERATIONS AND MAINTENANCE (O&M) MANUALS

- A. Manufacturer's O&M Manual.
- B. Original, printed, bound manual. Xerographic copies are not acceptable.
- C. If so published, provide two copies on CD in AdobeTM .pdf format.
- D. Include manuals for hardware and software.
- E. Provide interface software on CD.
- F. Exact battery manufacturer, type, model, and quantity. If batteries are labeled as being a product of the system manufacturer but are in fact manufactured by a different company, provide the same information for the actual manufacturer.

1.04 EXTRA MATERIALS

A. Fuses: Two complete sets.

PART 2 PRODUCTS

2.01 UNINTERRUPTIBLE POWER SUPPLY

A. Standards:

- 1. UL and CSA listed/labeled.
- 2. EMC: Comply with FCC Class B
- 3. Surge Suppression: Tested to withstand IEEE\ANSI C62.41 Category B wave.

B. Architecture:

- 1. Double-conversion.
- 2. Rectifier/battery charger.
- 3. Inverter which operates continuously, supplying all of the load power.
- 4. Output isolating transformer.
- 5. Static bypass switch.
- 6. Designed to completely isolate the output power from outages, sags, surges, spikes, brownouts, line noise, frequency variation, switching transients, and harmonic distortion.

C. Environmental:

- 1. Except for Batteries: 0° to 40°C.
- 2. Batteries: 0° to 25°C.
- 3. 0 to 90% relative humidity.
- 4. Maximum Noise Produced:
 - a. 45 bDA with input present,
 - b. 50 dBA while operating on battery.

D. Electrical Input:

- 1. 120V RMS nominal.
- 2. 80 to 144V without using battery.
- 3. Power Factor: Greater than 0.95.
- 4. Frequency: 55 to 65 Hz.
- 5. Maximum Current: As required in the Schedule.

E. Electrical Output:

- 1. 120V RMS nominal, single phase.
- 2. Voltage Regulation, Input Present: $\pm 3\%$ of nominal.
- 3. Voltage Regulation, Input Absent: \pm 3% of nominal.
- 4. Efficiency 89% to 92%, load-dependent.
- 5. Frequency:
 - a. 57 to 63 Hz, following input.
 - b. 59 to 61 Hz, input absent.
- 6. Load Crest Factor (Peak Over RMS): up to 3 to 1.
- 7. Output VA and Watt Rating: As required in the Schedule.

- F. Operation when powered from a generator:
 - 1. Must operate completely normally from 57 to 63 Hz.
 - 2. Must operate properly, perhaps on inverter, while still charging battery, from 55 to 65 Hz.

G. Batteries:

- 1. Sealed. Maintenance free.
- 2. Hot-swappable.
- 3. Minimum run-time on battery: as required in the Schedule.

H. Physical:

- 1. Steel case.
- 2. Fan-cooled.
- 3. Suitable for mounting on one edge, such as when on or below as desk.
- 4. Suitable for mounting flat, such as in a rack or one a shelf.
- 5. Line cord with NEMA 5-15P cap.
- 6. Six NEMA 5-15R output receptacles.
- 7. LED indicators for input present, nominal percent load, battery failure, no ground connection, high temperature, overload, on battery.

I. Miscellaneous:

- 1. Execute full system self-test on power up.
- 2. Automatic operation of static bypass for high load and/or UPS failure.
- 3. RS-232 communications port: standard, complete with 6' cable.
- 4. In and out jacks for protection of 10/100 Base-T network cables, tested to UL497A.
- 5. Relay outputs for alarm and for shutdown.
- J. Companies which may have products which meet this specification: Powerware, Toshiba, MGE.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install as shown on the Drawings.
- B. If the UPS is providing power to a personal computer, connect communications cable, install UPS software on the PC, and configure:
 - 1. Provide warning of impending UPS shutdown,
 - 2. Then shut down the PC before the UPS shuts down.
- C. If the UPS is providing power to a programmable logic controller, connect UPS output alarm and impending shutdown contacts as inputs to the PLC.

- D. Install nameplate with the below information:
 - 1. Identification number, such as UPS-2.
 - 2. Input voltage, phase, frequency.
 - 3. Output voltage, phase, frequency.
 - 4. Battery voltage, battery quantity, and bank voltage.
 - 5. Load(s) served.

3.02 SCHEDULE

- A. Maximum 1800 VA input while supplying rated output watts and recharging the batteries from flat.
- B. Rated Output: 1500 VA/1050 Watts.
- C. Run-time on battery when new:
 - 1. 700 VA/490W: 25 minutes.
 - 2. 1000 VA/700W: 16 minutes.
 - 3. 1500 VA/1050W: 8 minutes.
- D. Run time after batteries have been in service:
 - 1. Minimum run time at 67% load after 32 months of service: 82% of new.
 - 2. Minimum run time at 67% load after 58 months of service: 70% of new.
 - 3. Minimum run time at 67% load after 69 months of service: 42% of new.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
5.05	Static Uninterruptable Power Supply	Lump Sum

END OF SECTION

SECTION 26 36 23

AUTOMATIC TRANSFER SWITCHES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Automatic transfer switches (ATS).

1.02 SUBMITTALS

- A. Complete manufacturer's catalog cuts and rating sheets.
- B. Enclosure Drawings.
- C. Short circuit withstand and close rating, as tested in combination with the upstream protective device furnished for this project.
- D. Third-party ISO 9001 2000 certificate for factory.

1.03 OPERATION AND MAINTENANCE DATA

- A. Catalog cuts and rating sheets.
- B. Schematic diagrams.
- C. Internal connection diagrams.
- D. Manufacturer's O&M Manual.
- E. Complete parts manual.
- F. Factory test report.

1.04 QUALITY ASSURANCE

- A. Furnish ATS from a factory which is ISO 9001 2000 certified.
- B. Furnish ATS which comply with the requirements of:
 - 1. IEC 947-6-1: Low-voltage Switchgear and Controlgear, Multifunction equipment, Automatic Transfer Switching Equipment.
 - 2. NFPA 70 National Electrical Code.
 - 3. NFPA 99 Essential Electrical Systems for Health Care Facilities.
 - 4. NFPA 110 Emergency and Standby Power Systems.
 - 5. NEMA Standard ICS10-1993 (formerly ICS2-447) AC Automatic Transfer Switches.
 - 6. CSA C22.2, No. 14 M91 Industrial Control Equipment.

- 7. IEEE 472: (ANSI C37.90A): Ringing wave immunity.
- 8. EN55011, Class B Radiated Emissions.
- 9. EN55011, Class B Conducted Emissions.
- 10. IEC 1000-4-5 (EN 61000-4-5): AC Surge Immunity.
- 11. IEC 1000-4-4 (EN 61000-4-4): Fast Transients Immunity.
- 12. IEC 1000-4-2 (EN 61000-4-2): Electrostatic Discharge Immunity.
- 13. IEC 1000-4-3 (EN 61000-4-3): Radiated Field Immunity.
- 14. IEC 1000-4-6: Conducted Field Immunity.
- 15. IEC 1000-4-1: Voltage Dip Immunity.
- 16. Transient Withstand: Provide ATS which pass the voltage surge withstand test requirements of IEEE 472 and the voltage impulse withstand test requirements of NEMA ICS-1-109.
- C. Furnish ATS which are listed under UL 1008, Standard for Transfer Switch Equipment, and which are factory labeled in accordance with that standard.

1.05 SOURCE

- A. Provide ATS from a factory authorized distributor of the switch, having full-time, local personnel who are trained in the repair of the ATS furnished and having a stock of spare parts for the type of ATS furnished.
- B. If an engine-generator is furnished for this project, then provide ATS:
 - 1. Furnished, fully supported, and warranted by the engine-generator manufacturer and
 - 2. From the distributor who furnishes the engine-generator.
- C. If no engine-generator is furnished for this project then acceptable manufacturers are:
 - 1. Caterpillar.
 - 2. Cummins-Onan.
 - 3. Zenith GE.
 - 4. Engineer reviewed equivalent.

PART 2 PRODUCTS

2.01 RATINGS

- A. Voltage: As scheduled.
- B. Designed, tested, and third-party certified to carry 100% of rated current continuously in the enclosure supplied, in ambient temperatures of -40° to +60°C, relative humidity up to 95% (non-condensing), and altitudes up to 3000 Meters. Minimum ampacity: as scheduled or as shown on Drawings.

- C. Withstand and Closing Ratings:
 - 1. Provide ATS with short-circuit withstand and close capability as scheduled, when used with the overcurrent protective devices of the ampacity shown on Drawings and of the type actually furnished for the project.
 - 2. Label the ATS in accordance with UL 1008, including 1-1/2 and three cycle, long-time ratings as required in UL 1008.

D. Enclosure:

- 1. NEMA Type: As scheduled.
- 2. Meet wire bending requirements of the NEC.
- 3. Space available for transfer switches may be limited, as shown on Drawings. Switches with enclosures which do not fit in space shown will not be acceptable.

2.02 MAIN CONTACTS

- A. Specifically designed for transfer switch service.
- B. Designed so an overload or short circuit tends to force the contacts closed.
- C. Main and arcing contacts: Visible without major disassembly and without disconnection of power conductors in order to facilitate inspection and maintenance.
- D. Where a 4-pole switch is required, furnish a neutral pole which:
 - 1. Has the same withstand and operational ratings as the other poles, or
 - 2. Hreaks last and makes first to minimize neutral switching transients.
- E. Provide connection lugs which are suitable for the number and size of conductors shown on Drawings.

2.03 AUXILIARY CONTACTS

- A. Engine Start Contact:
 - 1. Gold-plated, 10A at 24 VDC.
 - 2. Single pole double throw.
 - 3. Provide time delay in control panel.
- B. ATS Position Switches:
 - 1. Operated directly by the main shaft of the main contacts.
 - 2. One closed in "Normal" and one closed in "Emergency".
 - 3. Rated 480V, 10A.
- C. Provide other 10A contacts if so scheduled:
 - 1. Additional position switches.
 - 2. Fan Contact: Closed with engine running, SPST.
 - 3. Source Availability:
 - a. SPST, closed when normal power is available.
 - b. SPST, closed when emergency power is available.

2.04 OPERATING MECHANISM

- A. Mechanically lock contacts in position without the use of permanent magnets or latching solenoids.
- B. Mechanisms which utilize friction as the means of transmitting force from the operating mechanism to the contacts are not acceptable.
- C. Inherently double-throw, moving all contacts simultaneously, including the neutral contact (if furnished).
- D. Provide a manual operating handle for maintenance purposes.

2.05 CONTROL PANEL

- A. Operate correctly at ambient temperatures from -40° to $+60^{\circ}$ C.
- B. Provide optically isolated logic inputs, high isolation transformers for AC inputs, and relays on all outputs, to provide optimum protection from line voltage surges, RFI and EMI.
- C. Mount separately from the mechanism and connect to mechanism and potential source by plug-in cable(s).
- D. Solid-state with electronic timing.
- E. Provide field adjustable time delay functions:
 - 1. Time delay on momentary dips in normal source:
 - a. If so scheduled: 0 to 5 minutes, factory set at .5 minutes.
 - b. If so scheduled: 0 to 10 seconds, factory set at 2 seconds.
 - 2. Time delay on transfer to emergency for controlled loading of generator: 0 to 1 minute, factory set at 0 minutes.
 - 3. Time delay on retransfer to normal: 0 to 30 minutes, factory set at 20 minutes.
 - 4. Time delay on engine shutdown after retransfer to normal 0 to 5 minutes, factory set at 3 minutes.
 - 5. If so scheduled, provide a programmed delay in neutral position, field adjustable from 0 to 60 seconds.
- F. Provide close differential type voltage sensors, providing at least the following capabilities:
 - 1. Three phase RMS sensing accurate to 1% voltage and 0.2% frequency.
 - 2. Normal source sensing:
 - a. Under-Voltage Condition:
 - 1) Dropout field adjustable from 75% to 98% of nominal voltage, factory set to 94%.
 - 2) Pickup field adjustable from 85% to 98% of nominal voltage, factory set to 97%.
 - b. Voltage Unbalance: 1% to 12%, factory set to 4%.

- c. Loss of phase.
- d. Wrong phase rotation.
- 3. Standby Source Sensing:
 - a. Under-Voltage Condition:
 - 1) Dropout field adjustable from 75% to 98% of nominal voltage, factory set to 75%.
 - 2) Pickup field adjustable from 85% to 98% of nominal voltage, factory set to 93%.
 - b. Voltage Unbalance: 1% to 12%, factory set to 4%.
 - c. Loss of phase.
 - d. Wrong phase rotation.
 - e. Frequency pickup field adjustable from 90 to 100% pickup, factory set to 95%.
- G. Provide Hand Controls:
 - 1. Pushbutton to bypass retransfer delay.
 - 2. Test switch to simulate failure of normal source. Three position switch or equivalent function with two switches:
 - a. With Load.
 - b. Normal.
 - c. Without Load.
- H. Unless scheduled otherwise, provide seven-day exercise clock, including with/without load selector switch.
- I. Provide, as a Minimum, Front Panel LED Indicators:
 - 1. Normal and emergency position indicator lamps.
 - 2. Normal and emergency source available lamps.
 - 3. Provide lamp test button.
- J. If so scheduled, provide one pre-transfer contact that opens 5 seconds before the switch transfers from normal to emergency and one pre-transfer contact that opens 5 seconds before the switch transfers from emergency to normal.
- K. Provide Terminal Board Points for:
 - 1. Remote test/peak shave operation.
 - 2. Transfer inhibit to the emergency source.
 - 3. Forced transfer to neutral, if so scheduled.
- L. Provide at Least the Following Metering:
 - 1. Frequency Meter.
 - 2. 3-Phase ammeter with phase selector switch.
 - 3. 3-Phase voltmeter with phase selector switch.
- M. Provide terminal blocks for all field-wiring connections.
- N. Provide other features and capabilities as scheduled.

2.06 FACTORY TEST

- A. Have the complete ATS factory tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency, and time delay settings are in compliance with the specification requirements.
- B. Provide certified copies of test results.

PART 3 EXECUTION

3.01 MARKING

- A. Furnish multiple nameplates for each ATS.
 - 1. Nameplate on face of enclosure with name of switch, name of normal source, name of standby source, and name of equipment served.
 - 2. Nameplates inside enclosure, adjacent to respective conductors, engraved with:
 - a. Name of normal source.
 - b. Name of standby source.
 - c. Name of equipment served.

3.02 TESTING

A. Test as part of the overall standby power system as required by the NEC for legally required standby systems.

3.03 SCHEDULE

- A. Main contacts rated minimum 600 VAC. Controls and sensing system: suitable for operation on 480 VAC 3-Phase 3-wire or 4-wire systems except where shown as 208V on Drawings.
- B. Switched Poles:
 - 1. Three for 480V.
 - 2. Four for 208V.
- C. Neutral Bar:
 - 1. 480V: Not required.
 - 2. 208V: Connection to switched pole.
- D. Minimum Ampere Rating:
 - 1. As Shown on Drawings
- E. Minimum short circuit withstand and close rating:
 - 1. 42 kA for 480V switches
 - 2. 10 kA for 208V switches
- F. Enclosure: NEMA 1.

- G. Time delay before engine start on momentary dips in normal source: 0 to 10 seconds.
- H. Time delay in neutral.
- I. Utility Available Contact; Generator Available Contact.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
5.05	Automatic Transfer Switches	Lump Sum

END OF SECTION

SECTION 26 43 13

SURGE PROTECTIVE DEVICES FOR LOW VOLTAGE SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surge protective devices for low voltage electrical power systems.

1.02 SUBMITTALS

A. Manufacturer's literature, including rating information.

1.03 OPERATIONS MAINTENANCE (O&M) MANUAL

A. List of suppressors used on this project with manufacturer's name, SPD type, part (catalog) number, and (for each part so provided) serial number. The use of a generic or typical part number will not be acceptable. Provide the part number which was used to order the part with all choices and options included. If a part number is given on a nameplate on the actual part, then include that number on this list. If the ordering number and the nameplate number differ, include both numbers and explain the difference.

PART 2 PRODUCTS

2.01 SURGE PROTECTIVE DEVICES (SPD): COMMON REQUIREMENTS

- A. Comply with the requirements of:
 - 1. UL 1449 Third Edition.
 - 2. IEEE C62.41: Location/exposure Categories below refer to this standard.
 - 3. IEEE C62.45: For test methods.
 - 4. ISO 9001: 2000 certified.
- B. Testing:
 - 1. Performed by an independent testing laboratory.
 - 2. Test as a complete unit. Testing of the surge current capacity of a single MOV or SAD and extrapolation of overall rating from that is not acceptable.
- C. Voltage: As shown on Drawings.
- D. Surge Capacity: As shown on Drawings or Schedule.
- E. Protection modes for units installed at service equipment and at the transformer or first panelboard of a separately derived system: line to neutral and line to ground.

- F. Protection modes for units installed downstream of the above units: Line to neutral, line to ground, and neutral to ground.
- G. Repetitive Impulse: 5,000 hits.
- H. Response Time: Less than 1 nanosecond.
- I. Voltage Protection Rating, (VPR 3kA): Not more than shown in the following table using tests as defined in UL1449 Third Edition.

<u>Voltage</u>	<u>Type</u>	<u>L-N</u>	<u>L-G</u>	<u>N-G</u>	<u>L-L</u>	<u>In</u>	<u>SCCR</u>	MCOV
208/120	1	700	700	700	1000	20 kA	200 kA	150
480/277	1	1200	1200	1200	1800	20 kA	200 kA	320
480V Delta	1	-	1800	-	2000	20 kA	200 kA	550
240/120	2	330	-	330	700	10 kA	200 kA	150

- J. Environmental:
 - 1. Temperature: Minus 25°C to plus 60°C.
 - 2. Humidity: 0% to 95%, non-condensing.
- K. Internally protected against short-circuit and overload. Suitable for connection to the circuit which it is protecting by means of a molded-case switch.
- L. Warranty:
 - 1. Type 1: 10-year full replacement warranty.
 - 2. Type 2: 5-year full replacement warranty.
- M. Enclosure as shown on Drawings.
- N. Hard-wired.
- O. Where sine wave tracking is required in "Type" paragraphs below, provide hybrid design incorporating filters, capacitors, or other technology in addition to MOVs and SADs to remove low voltage high frequency disturbances at any phase angle that will limit the let-through voltage of an A1 Ring Wave voltage relative to the applied 60 Hz. voltage to not more than shown in the following table.
- P. Other Features:
 - 1. LED indication of operational state of suppressor for each phase/mode.
 - 2. Modular plug-in suppressor units for easy replacement.
 - 3. Symmetrically balanced metal oxide varistors (MOV).
 - 4. As required in "Type" paragraphs below.
 - 5. As shown on Drawings or Schedule.

2.02 TYPE

- A. Surge Capacity of 250 kA and greater:
 - 1. High surge current device designed for service equipment and rated for location/exposure Category C3.
 - 2. Features: Dry form C contact for external alarm indication.
- B. Surge Capacity greater than 100 kA and less than 250 kA:
 - 1. High surge current device designed for service equipment and rated for location/exposure Category C3.
 - 2. Features: Dry form C contact for external alarm indication.
 - 3. Sine wave tracking.
- C. Surge Capacity of 100 kA or less:
 - 1. Sine wave tracking.
 - 2. Dry form C contact for external alarm indication, only if shown on the Drawings or Tag List.

PART 3 EXECUTION

3.01 INSTALLATION OF HARD-WIRED SPD

- A. Plan the installation in advance so that an SPD is installed immediately adjacent to (above, left, right, or below) the protected equipment.
- B. Connect to circuit being protected by means of a molded case switch (non-automatic circuit breaker) or circuit breaker as shown on the Drawings.
- C. Connect SPD with minimum #8 stranded wire or as shown on Drawings, whichever is greater. If manufacturer recommendation is different, the Engineer will resolve conflicts.
- D. Make connecting conductors as short as practical: Maximum 24 inches. Sharp bends in conductors are not acceptable. If the configuration of the SPD is such that shorter lead length can be achieved by mounting the enclosure rotated 90 or 180 degrees from "normal" then do so if allowed by the manufacturer of the SPD. Do not mount with hinge on bottom.

3.02 SCHEDULE

- A. Type and surge capacity as shown below unless shown otherwise on Drawings.
 - 1. 480V Switchboards: Type 1, 250 kA surge capacity.
 - 2. 480V MCCs: Type 1, 150 kA surge capacity.
 - 3. 480V Panelboards: Type 1, 150 kA surge capacity.
 - 4. 208/120V Panelboards: Type 2, 80 kA surge capacity.
 - 5. 240/120V Panelboards: Type 2, 80 kA surge capacity.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.Pay ItemPay Unit1.25, 5.05Surge SuppressorsLump Sum

END OF SECTION

SECTION 26 50 10

LED LUMINAIRES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Luminaires, lamps, mounting hardware, and accessories for interior and exterior lighting applications as specified and/or as shown in the Luminaire Schedule and/or Drawings.

1.02 SUBMITTALS

- A. For luminaires which are listed by manufacturer and type and/or catalog number in the Luminaire Schedule or Drawings, provide:
 - 1. Bill of Material:
 - a. Type Number.
 - b. Manufacturer's name and model name.
 - c. Complete catalog number.
 - d. Driver voltage and current.
 - e. Catalog number.
 - 2. Cut sheets for each luminaire.
- B. For manufacturers, type, and catalog numbers not listed in the Luminaire Schedule or Drawings:
 - 1. Comply with Section 01 25 00 Substitution Procedures.
 - 2. Unless waived in writing by the Engineer, provide pre-wired sample for Engineer review, which will be returned, or prepare a presentation to engineer on proposed luminaires.
 - a. Pre-wired with 15A, 120 VAC plug.
 - 3. NRTL certification and verification.
 - 4. Lighting layout showing performance of proposed luminaires which shall meet minimum maintained fc levels as shown on the in the Schedule or on Drawings.
 - 5. IES photometric files.
 - 6. Supporting data for L_{xx} value with respect to site conditions.
 - 7. All data as required in Paragraph A above.

1.03 OPERATION AND MAINTENANCE DATA

- A. Bill of Material, meeting the requirements of Paragraph 1.02 A., for all luminaires. If some items were allowed as substitutions, add them to the Bill of Material. It is not necessary to provide cut sheets or literature except as required below for replacement parts.
- B. Manufacturer's maintenance data, including replacement parts list. Provide illustrations of parts and their location in the luminaire assembly.

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1.04 CATALOG NUMBERS

- A. Recognize that a particular catalog number shown below or in the Schedule may not exactly represent the features required in the description below or in the Schedule, such as:
 - 1. Type of driver for a multi-level or diming luminaire.
 - 2. Battery backup provisions.
 - 3. Integral photocell.
 - 4. Integral motion detection.
- B. Provide luminaires having all required features and show complete, detailed catalog numbers and options in the submittal.

PART 2 PRODUCTS

2.01 LED LUMINAIRES

- A. Voltage: 120 VAC unless shown otherwise in the Schedule or on Drawings.
- B. Modular Design: Capable of replacing driver, LED light bars, and accessories independently for failure replacement or upgrades.
- C. CRI: 70 minimum.
- D. Driver Current: 350 mA unless shown otherwise in the Schedule or on Drawings.
- E. Temperature: 3500K unless shown otherwise in the Schedule or on Drawings.
- F. Foot Candle (FC) Levels: As recommended by IESNA or as shown in the Schedule or on Drawings, whichever is greater.
- G. Mounting: As shown on Drawings.
- H. Proper UL listings for dry/damp, wet, and hazardous (wet locations and vapor tight NEMA 4X) locations.
- I. Driver:
 - 1. Power Factor: > .90.
 - 2. Total Harmonic Distortion (THD): <20%
 - 3. Integral surge suppression protection in accordance with IEEE C62.41.2 and ANSI 62.41.2.

2.02 BATTERY BACKUP LUMINAIRES

A. Where shown in the Luminaire Schedule and/or Drawings, furnish self-diagnostic battery system for standby operation.

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- B. Provide a minimum 1300 lumens per luminaire of illumination for 90 minutes during a power outage.
- C. Furnished, installed in the driver channel, and wired by luminaire manufacturer. Indicator lights easily visible from below.

2.03 OCCUPANCY SENSOR

- A. Wall-mounted with manual override.
- B. Single-point or three-way as required on Drawings.
- C. Infrared and ultrasonic motion sensors, plus photocell.
- D. Cooper OSW-DT or Engineer reviewed equivalent.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's recommendations and Drawings. If not available from the manufacturer of the specific equipment and not shown on the Drawings, install according to the best trade practice.
- B. Furnish fittings, hangers, stems, parts, etc., as required for proper installation.
- C. Securely support luminaires so that they are level and in vertical and horizontal alignment unless specifically shown otherwise on Drawings.
- D. Clean luminaires, install lamps, and test systems prior to acceptance by the Engineer.

3.02 SCHEDULE

A. Provide luminaires which comply with the requirements of this Section and with the requirements of the Luminaire Schedule on the Drawings.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	<u>Pay Item</u>	<u>Pay Unit</u>
1.25, 5.05	Luminaires	Lump Sum

END OF SECTION

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SECTION 31 10 00

REMOVALS

PART 1 GENERAL

1.01 WORK INCLUDED

A. This work includes the removal and disposal of all obstructions, materials, and resultant debris required for the completion of construction.

1.02 REFERENCES

A. Manual on Uniform Traffic Control Devices (MUTCD).

1.03 QUALITY ASSURANCE

- A. Conduct removal operations to prevent damage to adjacent property, buildings, and other facilities.
- B. Any damage to adjacent property or facilities shall be promptly repaired at no additional cost to the Owner.

PART 2 PRODUCTS

2.01 EXPLOSIVES

A. The use of explosives for removals is prohibited.

PART 3 EXECUTION

3.01 REMOVAL

- A. Remove all items shown on Drawings to be removed.
- B. Contractor shall not remove any other items without approval from Engineer.
- C. Excavation created during removal operations shall be barricaded in accordance with MUTCD.
- D. Contractor shall perform miscellaneous excavating, backfilling, and reshaping of slopes as required.

3.02 DISPOSAL

A. Contractor shall haul and dispose of all debris, rubbish, broken concrete, broken asphaltic concrete, rocks, and other material removed.

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- B. Disposal: In accordance with applicable State and Federal Regulations.
- C. Burning of debris and rubbish will not be permitted on the project site.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
1.06, 1.07, 1.08, 2.03, 2.04, 3.06, 3.07, 3.08, 3.09	Removal and Disposal of Material and Debris Prior to Earthwork	Linear Feet
1.25, 4.01, 5.02	Removal and Disposal of Material and Debris Prior to Earthwork	Lump Sum

END OF SECTION

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SECTION 31 22 00

GRADING

PART 1 GENERAL

1.01 WORK INCLUDED

A. This work shall consist of shaping road beds and side ditches to subgrade preparation to the depths indicated on the Drawings.

1.02 REFERENCE STANDARDS

- A. American Society for Testing and Materials International:
 - 1. ASTM D1556 Density of Soil in Place by the Sand-Cone Method.
 - 2. ASTM D1557 Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 - 3. ASTM D2167 Density of Soil in Place by the Rubber-Balloon Method.
 - 4. ASTM D2216 Laboratory Determination of Moisture Content of Soil.
 - 5. ASTM D6938 In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.03 QUALITY ASSURANCE

- A. Testing Laboratory:
 - 1. Contractor will provide material testing for quality control during earthwork operations.

1.04 JOB CONDITIONS

A. Do not construct embankments when atmospheric temperature is below 35°F.

PART 2 PRODUCTS

2.01 BORROW

- A. Borrow shall consist of materials obtained from approved borrow areas designated by the Engineer for the construction of embankments.
- B. Provide free of vegetation.

2.02 WASTE

A. Disposal of excess excavation shall be the responsibility of the Contractor. Excess material to be placed in location reviewed by Engineer.

2.03 EXCAVATION

A. Includes excavation, removal, backfill, and satisfactory disposal of all materials encountered in the work.

2.04 EMBANKMENT

A. Embankment construction shall consist of the formation of embankments with suitable material from on-site excavation.

PART 3 EXECUTION

3.01 GENERAL

- A. Excavation and embankments for the roads shall be finished to the contours, shapes, dimensions, and elevations shown on the Drawings.
- B. No materials shall be wasted without permission from the Engineer.
- C. Perform clearing operations prior to beginning excavation, grading, and embankment operations.

3.02 SUBGRADE PREPARATION

A. See Section 31 23 13 – Subgrade Preparation.

3.03 GRADING

- A. Provide uniform slopes and rounded changes in slope, free of low spots.
- B. The degree of grade control shall not deviate from true grade and profile more than one-half inch as measured by a ten-foot straightedge.
- C. Drainage:
 - 1. Provide and maintain positive surface water drainage around and away from open excavations.
 - 2. Keep opened excavations dry.
 - 3. Remove free water in excavations promptly.

3.04 EMBANKMENT

- A. Embankments shall meet the compaction requirements specified in Subsection 3.05.
- B. No frozen material, brush, sod, or unsuitable material shall be placed in the embankments.
- C. In the distribution of embankment material, avoid lenses differing substantially from the surrounding material.

D. Deliver materials to the embankment in such a manner as to result in a well and uniformly compacted embankment.

3.05 EMBANKMENT AND BACKFILL COMPACTION

A. General:

- 1. Compact in eight-inch loose horizontal layers.
- 2. Use moistened material when necessary.
- 3. Layers shall be uniformly compacted before a succeeding layer is placed.
- 4. Add water in sufficient quantity to obtain the specified compaction.
- 5. Do not allow free water to stand on an embankment surface.
- 6. Compaction shall be accomplished by approved methods and equipment.

B. Degree of Compaction:

- 1. Optimum density will be determined in accordance with ASTM D1557.
- 2. Perform compaction as follows:

Description	Percent of Maximum Dry Density to Be Not Less Than	Variation of Optimum Moisture
Embankment and backfill under roads, lift station, or where otherwise scheduled	95	+2
General area grading not included in the above	90	+2

3.06 FIELD QUALITY CONTROL

- A. Field control of density of in-place material will be determined in accordance with any of the following methods:
 - 1. Nuclear Method, ASTM D6938.
 - 2. Rubber-Balloon Method, ASTM D2167.
 - 3. Sand-Cone Method, ASTM D1556.
- B. Field control of moisture content will be determined in accordance with either of the following methods:
 - 1. Nuclear Method, ASTM D6938.
 - 2. Laboratory Determination, ASTM D2216.
- C. In-place density and moisture tests to be taken at intervals to be determined by the Engineer.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.Pay ItemPay Unit1.25, 5.02GradingLump Sum

END OF SECTION

SECTION 31 22 01

FILLS AND BERMS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Final Grade and Berms Construction and Compacting

1.02 DISPOSAL REQUIREMENTS

- A. Refuse:
 - 1. Location and method approved by the appropriate state agency.
 - 2. Contractor's responsibility.

1.03 REFERENCES

- A. ASTM D1556 Standard Method for Density of Soil in Place by the Sand-Cone Method
- B. ASTM D1557 Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))

PART 2 PRODUCTS

2.01 MATERIALS

- A. Ordinary Fill:
 - 1. Clean, free of organic or frozen matter.
 - 2. Acceptable U.S.C.S. Materials: GW, GP, SW, SP, GM, SM, or GC.
- B. All suitable material from the site resulting from excavation works to be used for filling and embanking.

PART 3 EXECUTION

3.01 SITE PREPARATION

- A. Clearing and Grubbing: Eliminate standing and decayed vegetation, rubbish, and unsuitable materials.
- B. Surfaces to be reasonably smooth and free from irregular changes.

3.02 BERM CONSTRUCTION

A. Typical section as shown on Drawings.

- B. Stones larger than 4" maximum diameter not to be placed any closer than 24" from the water side of the embankment.
- C. Material to be placed in horizontal layers of maximum 8" in loose depth for the full width of the embankment's cross section.
- D. Only dry, mechanical compaction allowed.
- E. Compaction to be not less than 95% of the maximum density determined in accordance with ASTM D1557.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	<u>Pay Unit</u>
4.01, 5.02	Fills and Berms	Lump Sum

END OF SECTION

SECTION 31 23 00

EXCAVATION, BACKFILL, AND COMPACTION FOR STRUCTURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This Section includes furnishing labor, equipment, and incidentals necessary for excavation, backfill, and compaction for structures.

1.02 RELATED SECTIONS

A. Section 03 30 00 – Cast in Place Concrete.

1.03 REFERENCES

- A. ASTM C131 Resistance to Degradation of Small Size Coarse Aggregates.
- B. ASTM C136 Sieve Analysis of Fine and Coarse Aggregates.
- C. ASTM D4318 Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
- D. ASTM D1557 Standard Test Method for Moisture Density Relations of Soil and Soil-Aggregate Mixtures Using 10-16 rammer and 18-inch drop.
- E. ASTM D4253 Standard Test Method for Maximum Index Density of Soils Using a Vibratory Table.

1.04 EXISTING CONDITIONS

A. These specifications are prepared using the information contained in the geotechnical report prepared for this project by Geo-Test, Inc. dated September 2, 2014.

1.05 JOB CONDITIONS

A. Use all means necessary, such as moistening of surfaces to prevent the spread of dust and creating a nuisance for adjacent areas.

1.06 SUBMITTALS

- A. Laboratory Test Results for Select Fill, Ordinary Fill, and Pea Gravel:
 - 1. Moisture-density relationships (ASTM D698).
 - 2. Gradation (ASTM C136).
 - 3. Liquid limit, plastic limit, plastic index (ASTM D4318).

1.07 **QUALITY ASSURANCE**

- Unless otherwise noted, all compaction will be to a density of not less than 95% of A. ASTM D698 maximum dry density. The moisture content of the soil at the time of compaction shall be within two percent of the optimum moisture content.
- В. Installers must be licensed in the State of New Mexico.

PART 2 **PRODUCTS**

2.01 **BACKFILL**

All structural fill shall meet the requirements for structural fill as outlined in A. Section 2.02 of these Specifications. All structural fill shall be non-expansive and shall meet the specifications for structural fill outlined in the geotechnical report.

2.02 STRUCTURAL FILL

Structural fill shall meet the following requirements as determined in accordance with A. ASTM D422:

Sieve Size (Square Openings)	Percent Passing by Weight
1 inch	100
3/4 inch	70 - 100
No. 4	35 - 85
No. 200	0-10

B. The structural fill material shall be free from roots, grass, other vegetable matter, clay lumps, rocks larger than 3 inches in any dimension, or other deleterious. Structural fill shall not have a plasticity index greater than 3.

2.03 **BORROW**

When the quantity of suitable material required for embankments is not available A. within the limits of the jobsite, the contractor shall provide sufficient materials to construct the embankments to the lines, elevations and cross sections as shown on the drawings from borrow areas. The contractor shall obtain from owners of said borrow areas the right to excavate material, shall pay all royalties and other charges involved, and shall pay all expenses in developing the source including the cost of right-of-way required for hauling the material.

PART 3 **EXECUTION**

3.01 **GENERAL**

Prior to beginning work, carefully inspect the entire site. The Drawings do not A. purport to show all objects existing on the site. Verify with the Engineer all objects to be removed and all objects to be preserved.

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- B. Locate all active utility lines transversing the site, designate them and determine the requirements for their protection.
- C. Approval: All scarification and compaction of existing subgrade shall be approved by the Engineer before placing any fill. The placing of fill before such a notice is given and before review by the Engineer is a valid reason for rejecting the fill. Placing concrete or reinforcing before compacted fill is approved by the Engineer is a valid reason for rejecting the concrete so placed or for causing all reinforcing in place to be removed.
- D. Compaction: All fill shall be spread in layers not exceeding 8 inches, watered as necessary and compacted. Moisture content at the time of compaction shall be within 2% of the optimum moisture content. Compaction of the fill shall be accomplished by mechanical means only to obtain a density of not less than 95% of maximum dry density for the building pad, slabs and other structural areas. Optimum moisture content and maximum dry density for each soil type used shall be determined in accordance with ASTM D698. Where vibratory compaction equipment is used, it shall be the Contractor's responsibility to insure that the vibrations do not damage nearby buildings or other adjacent property.
- E. Weather Limitations: Controlled fill shall not be constructed when the atmospheric temperature is below 35°F. When the temperature falls below 35°F, it shall be the responsibility of the Contractor to protect all areas of completed surface against any detrimental effects of ground freezing by methods approved by the Engineer. Any areas that are damaged by freezing shall be reconditioned, reshaped, and compacted by the contractor in conformance with the requirements of this specification without additional cost to the owner.
- F. Testing and field density tests shall be performed by an independent testing laboratory. The cost for testing and re-testing shall be borne by the Contractor.

3.02 BUILDING EXCAVATION

A. Support of Excavations:

- 1. The Contractor is required to submit a detailed plan showing the design of shoring, bracing, sloping, or provisions for worker protection from the hazard of caving ground during the excavation of any trench or trenches 5 feet or more in depth. The plan shall be submitted by the Contractor for review by the Engineer in advance of any excavation.
- 2. Lateral and sub-adjacent supports shall be required wherever structures or improvements adjacent to the excavation may be damaged by such excavation.
- 3. The sides of all excavations shall be supported in manner set forth in the rules, orders, and regulations prescribed by OSHA.
- 4. Shoring for the support of excavation shall remain in place until the structure is capable of safely resisting full earth loads. When shoring is no longer required in place to protect the structure or construction operations, the shoring may be removed or may be left permanently in place. If it is feasible to remove the shoring and the Contractor elects to do, the shoring sheeting and bracing shall

- be carefully removed so that there shall be no caving, lateral movement or flowing of the subsoils. While being withdrawn, all voids left by the sheeting and bracing shall be carefully filled with sand, and compacted as directed by the Engineer.
- 5. If the shoring is to be left in place, it shall not act as a barrier to the natural movement of groundwater. If the shoring system is not inherently permeable enough, additional openings shall be made ahead of the backfilling operations, open size, number, and location subject to review by the Engineer. The Contractor's excavation plan submitted before excavation is started shall indicate whether shoring is to be removed or left in place and the proposed cut off elevations below finish grade.
- 6. Any damage to any existing improvements of any kind resulting from a lack of adequate shoring, bracing, and sheeting shall be the responsibility of the Contractor. Necessary repairs or reconstruction shall be at Contractor's expense.
- B. Excavated materials that are unsuitable for backfilling shall be disposed of at an approved site.
- C. Protect all excavation from frost and excessive drying-out. Cut back side slopes as require to prevent slumping, or shore and brace excavations as necessary to prevent cave-ins.
- D. The Contractor shall keep all excavations free from water during excavation and concrete foundation work.
- E. Any over-excavation of footing less than 6 inches shall be backfilled with a lean concrete. Over-excavation greater than 6 inches shall be backfilled with fill meeting the requirements set herein and compacted to 98% of maximum dry density as measured by Standard Proctor (ASTM D698).
- F. Backfilling: Do not begin backfilling until construction below finish grade has been completed, inspected, forms removed, and excavation cleaned of trash and debris. Do not place backfill in wet or frozen areas. Do not place backfill on or against foundations prior to 7 days after completion of the walls. As far as practicable, bring backfill evenly on each side of the foundation and slope to drain away from building.

3.03 FOUNDATIONS

- A. Footings and on grade concrete slabs shall be placed on properly densified native soils or compacted structural fill as required above. The fill shall extend laterally from edge of footing a distance equal to the depth of the structural fill beneath the footings.
- B. Non-expansive and select fill shall be placed in eight inch lifts and compacted to not less than 98% of maximum dry density (ASTM D698).

C. Prior to placement of fill, exposed subgrade shall be scarified to a minimum depth of eight inches, moistened or aerated to be at or above optimum, and compacted to not less than 98% of maximum dry density (ASTM D698).

3.04 FINISH GRADING

A. Grading shall be generally smooth to slopes indicated by the Drawings and well compacted.

3.05 FIELD QUALITY CONTROL

- A. The Contractor shall be responsible for the cost of initial testing for compliance with the specifications. Costs for retests shall be borne by the Contractor.
- B. Sample Testing: Test results from representative samples of proposed Engineered (structural) fill material shall be submitted to the Engineer two weeks prior to intended use. This testing shall be for specification compliance.
- C. A sample of material shall be taken for each 250 cubic yards placed or each day's placement, whichever is greater, and tested for moisture-density relationship, gradation, and PI. Material not in compliance shall be removed and replaced, in accordance with the specifications, by the Contractor at no cost to the Owner. One moisture-density curve shall be prepared for each type of material used, as determined by the gradation and plasticity index.
- D. Compaction tests shall be performed at a rate of one test for each 250 S.Y./lift placed, but not less than two tests per day's work per lift. Testing shall be performed in accordance with the requirements of ASTM D698. Areas represented by non-compliance with the test requirements shall be reworked and retested by the Contractor at no cost to the Owner. Final test reports shall be supplied to the Owner no more than two working days after the tests are completed. Non-complying tests shall be brought to the attention of the Engineer and Owner at the time they are performed.

PART 4 PAYMENT

4.01 PAYMENT

Payment will be made under:

Bid Item No.	Pay Item	Pay Unit
4.01, 5.01	Excavation, Backfill, and Compaction	Lump Sum
	for Structures	_

END OF SECTION

SECTION 31 23 01

EXCAVATION AND FILL FOR SITE WORK, AND VAULTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Site Excavation, Filling and Backfilling
- B. Precast Utility Structure Excavation, Filling, and Backfilling
- C. Compaction of Fill and Backfill
- D. Finish Grading.

1.02 RELATED WORK

- A. Section 31 23 00 Excavation, Backfill, and Compaction for Structures
- B. Section 31 23 33 Trenching and Backfilling

1.03 REFERENCES

- A. ASTM C33 Standard Specification for Concrete Aggregates
- B. ASTM C136 Sieve Analysis of Fine and Coarse Aggregates
- C. ASTM D1557 Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))
- D. ASTM D4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils

1.04 SUBMITTALS

- A. Section 01 33 23 Shop Drawings, Product Data, and Samples:
 - 1. Laboratory Test Results for Select Fill, Ordinary Fill, and Pea Gravel:
 - a. Moisture-density relationships (ASTM D1557).
 - b. Gradation (ASTM C136).
 - c. Liquid limit, plastic limit, plasticity index (ASTM D4318).

1.05 PROTECTION

- A. Protect trees, shrubs, lawns, and other features remaining as a portion of final site.
- B. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from equipment and vehicular traffic.

- C. Protect above and below grade utilities which are to remain.
- D. Notify Engineer of unexpected subsurface conditions and discontinue affected work in area until notified to resume work.
- E. Protect bottom of excavations and soil adjacent to and beneath foundations from frost.
- F. Grade excavation top perimeter to prevent surface water run-off into excavation.
- G. Protect structure walls, foundation, and similar features from structural stress during backfilling operations.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Material removed from excavations may be used for fill or backfill provided such material meets the requirements for fill and backfill specified in this Section. Some blending of materials may be necessary.
- B. Exclude debris, large rocks, roots, organic material, expansive material, and other deleterious materials.
- C. Provide additional fill materials if necessary from off-site locations obtained by Contractor.
- D. Do not use any materials containing any contaminants that may endanger public health. Do not use mine tailings.
- E. Do not use any materials which have not been reviewed by the Engineer.

2.02 MATERIALS

A. Select Fill:

- 1. Clean, well graded, and relatively cohesionless material free of organic or frozen matter.
- 2. Largest rock or clod dimension: 1 inch.
- 3. Plasticity index less than 8.
- 4. Maximum percent passing sieve (unless otherwise reviewed by Engineer):
 - a. #10, 50%.
 - b. #40, 30%.
 - c. #200, 15%.

B. Ordinary Fill:

- 1. Clean, free of organic or frozen matter.
- 2. Largest rock or clod dimension: 3 inches.

3. Normally acceptable are Unified Soil Classification System Classified Materials: GW, GP, SW, SP, GM, SM, or GC.

C. Normal Backfill:

- 1. Excavated earth or sand thoroughly mixed to create uniform material.
- 2. Free of trash, debris, organic, or frozen matter.
- 3. Largest rock or clod dimension: 2 inches.

D. Pea Gravel:

- 1. Mineral aggregate graded 0.25 inch to 0.38 inch.
- 2. Free of soil, clay and shale; free of organic, frozen debris, or foreign matter.

E. Sandfill:

- 1. Clean, well-graded material conforming to requirements of ASTM C33 for fine aggregate.
- F. Moisture Barrier: 10 mil minimum polyethylene sheet.

PART 3 EXECUTION

3.01 GENERAL

- A. The type of bearing material and the thickness and extent of structural fill (if required) are shown on the Drawings.
- B. Interior non-structural slabs-on-grade are to be supported on granular fill not less than 6 inches thick on structural fill not less than 1 foot thick. See Drawings for location where sand fill over polyethylene moisture barrier is required over granular fill.
- C. Do not place or compact fill or backfill when the atmospheric temperatures are below 35°F. Protect completed fill or backfill areas from freezing. Recondition, reshape, and recompact to the requirements of this Section without additional cost to the Owner any areas which are damaged by freezing.

3.02 SHEETING, SHORING AND BRACING

- A. Provide sheeting, shoring, and bracing where required to hold walls of excavation and to protect workers and existing construction. Contractor shall be responsible for proper sizing and placement of Work.
- B. Remove sheeting, shoring and bracing in manner to avoid damage to disturbance to Work. Leave sheeting and shoring in place where removal will endanger Work, adjacent construction or personnel. If sheeting or shoring is to be left in place, remove all traces of sheeting or shoring to a minimum depth of 2'-0" below finish grade unless otherwise reviewed by the Engineer.

3.03 CLEARING AND GRUBBING

A. General: Clearing and grubbing are required for all areas shown on the plans to be excavated or where fill is to be constructed.

B. Clearing:

1. Remove and dispose of trees and other vegetation, downed timber, snags, brush, and rubbish within areas to be cleared.

C. Grubbing:

- 1. Remove stumps, matted roots, and roots larger than 2 inches in diameter from within 6 inches of the surface of areas on which fills are to be constructed, and within 18 inches of finished subgrade of roadways.
- 2. Areas disturbed by grubbing shall be filled as specified in this Section for embankment.

3.04 PREPARATION

A. Excavation:

- 1. Identify required lines, levels, contours, and datum.
- 2. Identify all underground utilities and other facilities. Stake and flag locations.
- 3. Identify and flag surface and aerial utilities.
- 4. Maintain and protect existing utilities remaining which pass through work area.

B. Backfilling:

- 1. When necessary, compact subgrade surfaces to density requirements for backfill material.
- 2. Cut out soft areas of subgrade not readily capable of in situ compaction. Backfill with select fill and compact to density equal to requirements for subsequent backfill material.

3.05 EXCAVATION

- A. Earth excavation shall consist of the excavation and removal of suitable soils for use as embankment as well as the satisfactory disposal of all vegetation, debris, and deleterious materials encountered within the area to be graded and/or in a barrow area.
- B. Excavate soil to the extent required for structure foundations, construction operations, and other work. See Drawings for extent of excavation required beneath and adjacent to structures.
- C. Barricade open excavations, keep spoil piles out of the way of the Owner's personnel and otherwise maintain safe access by the Owner's employees to the Owner's facilities during construction.
- D. Do not undercut existing construction.

- E. Do not permit surface water to enter open excavations. Provide barriers and positive drainage away from excavations as necessary. Remove promptly any water which may enter excavations from any source.
- F. Machine slope banks.
- G. After excavations are complete, notify Engineer for inspection of completed excavation. Do not begin placement of fill or begin other construction operations until excavation is reviewed by Engineer.
- H. Fill unauthorized over excavated areas beneath structures with select fill and compact to density required for subsequent fill or backfill. If unauthorized excavation will result in structure being supported partly on select fill and partly on native material, extend excavation under entire structure and fill as specified below. Fill unauthorized overexcavated areas away from structures with fill of the type specified for subsequent fill compacted to the density specified.
- I. Dispose of all excess excavated material and material unsuitable for backfilling generated by construction activities, off-site or as directed by Owner, unless otherwise stated in Contract Documents at no additional cost to Owner. Properly dispose of all materials in accordance with regulatory requirements.

3.06 SUBGRADE TREATMENT

A. At areas to receive structural fill, scarify the exposed native soils to a depth of not less than 12 inches. Add or remove water as necessary to bring the scarified material to optimum moisture content (within -0, +2 percentage points). Compact the scarified soil to not less than 95% of maximum dry density as determined by ASTM D1557.

3.07 FILLING AND BACKFILLING

- A. Provide all fill material required to complete Work, either from on-site excavations or imported from off-site, at no additional cost to Owner.
- B. Backfill areas to contours and elevations shown on Drawings using unfrozen materials.
- C. Place fill under structures and elsewhere as shown on the Drawings. Fill all unauthorized or excess excavations to the elevations shown or specified.
- D. Backfill systematically, as early as possible, to allow maximum time for natural settlement. Do not backfill over porous, wet, or spongy subgrade surfaces.
- E. Backfilling Around Structures:
 - 1. Backfill after concrete has attained sufficient strength to withstand backfill pressures without detrimental effects.

2. Prevent displacement of construction during backfilling operations; backfill opposite sides simultaneously.

F. Placement:

- 1. Maintain surfaces free of water, debris, and other deleterious materials.
- 2. Place backfill and fill materials in successive horizontal layers not more than 8 inches in loose depth.
- 3. Place material at optimum moisture content (\pm two percentage points).
- 4. Material too dry or too wet shall be moistened or aerated to extent necessary to bring moisture content to within specified limits.

G. Compaction:

- 1. Compact fill and backfill using appropriate equipment as needed to achieve the densities specified below. Densities are expressed as percentages of the maximum dry density as determined by ASTM D1557.
- 2. Do not use heavy equipment in areas where existing construction may be damaged by the use of such equipment. Repair or replace without additional cost to the Owner, any damage to existing construction caused by earthwork operations.
- H. Slope grade away from building minimum 2 inches in 10 feet unless noted otherwise. Fill depressions and provide for positive drainage away from buildings and structures.
- I. Make changes in grade gradual. Blend slopes into level areas. Finish grade to smooth uniformly sloping surfaces to elevations required for drainage.
- J. Finish surface by grading to provide finished appearance.
- K. Place polyethylene moisture barrier at locations shown on the Drawings. Overlap not less than 6 inches at all joints; tape joints securely. Protect from damage during placement of sand fill. Repair any rips or tears. Place not less than 3 inches of sand fill over polyethylene moisture barrier beneath slabs-on-grade where shown on Drawings.

3.08 TOLERANCES

- A. Top Surface of Backfill: ± 2 inches.
- B. Top Surface of Fill Beneath Structures: -1 + 0 inches.

3.09 FIELD QUALITY CONTROL

A. Section 01 45 23 – Testing Laboratory Services.

B. Test Schedule:

- 1. One field density test for each 250 square yards of prepared subgrade.
- 2. One field density test for each 100 cubic yards of fill or for each layer of fill, whichever results in the greater number of tests.
- 3. Or where directed by Engineer.
- C. If tests indicate that work does not meet specified requirements, remove work, replace and retest at no cost to Owner.

3.10 SCHEDULE OF FILL AND BACKFILL

<u>Area</u>	<u>Type of</u> <u>Material</u>	<u>Degree of</u> <u>Compaction</u>
Beneath footings and slabs more than 10 inches thick and for a distance outside their perimeters equal to the depth of fill	Select fill	95%
Beneath slabs less than 10 inches thick; pavements (except roadways) unless otherwise shown on Drawings	Select fill	90%
General fills and embankments on the site	Ordinary fill	90%
Non-structural areas except as otherwise shown on Drawings or directed by the Engineer	Ordinary fill	85%
Backfill behind walls and below or adjacent to additional construction	Select fill	95%
Backfill behind retaining walls	Ordinary fill	90%
Backfill except as described above	Normal backfill	90%
Where indicated on Drawings	Select fill	95%
Fill within treatment structures, fill beneath interior slabs on grade over moisture barrier	Sand fill	95%

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.Pay ItemPay Unit3.23, 4.03, 5.02, 5.04Non-Structural Fill and BackfillLump Sum

END OF SECTION

SECTION 31 23 13

SUBGRADE PREPARATION

PART 1 GENERAL

1.01 WORK INCLUDED

A. Preparing the completed subgrade prior to placement of subsequent pavement section components to the grade and dimensions indicated on the Drawings. This is inclusive of all processing, shaping, compacting, watering, protecting and any removal and replacement of unsuitable material to prepare the subgrade satisfactorily for completion of the pavement section.

1.02 REFERENCES

- A. American Society for Testing and Materials International:
 - 1. ASTM D1556 Density of Soil in Place by the Sand-Cone Method.
 - 2. ASTM D1557 Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 - 3. ASTM D2167 Density of Soil in Place by the Rubber-Balloon Method.
 - 4. ASTM D2216 Laboratory Determination of Moisture Content of Soil.
 - 5. ASTM D6938 In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.03 QUALITY ASSURANCE

- A. Testing Laboratory:
 - 1. Contractor shall provide material testing for quality control during subgrade preparation.

PART 2 PRODUCTS

2.01 SUITABLE MATERIALS

- A. Suitable materials shall consist of materials obtained on site reviewed by the Engineer for the purpose of subgrade preparation.
- B. Any underlying soft or otherwise unsuitable material shall be removed and replaced with suitable material.
- C. Provide free of vegetation.

2.02 WASTE

A. Disposal of excavated materials shall be the responsibility of the Contractor. Excess material to be placed in location designated by Owner or Engineer.

PART 3 EXECUTION

3.01 PREPARATION

- A. Excavations and embankments for the roads and site grading shall be finished to the shapes, dimensions, and elevations shown on the Drawings.
- B. Perform clearing operations prior to beginning excavation, grading, and embankment operations.
- C. Processed, watered, and compacted to not less than 90% of modified Proctor density (ASTM D1557) at optimum moisture content $\pm 2\%$, to a depth of 12" minimum.
- D. Material that cannot be processed satisfactorily to meet these specifications shall be considered unsuitable.

3.02 GRADING

- A. Provide uniform slopes and rounded changes in slope, free of low spots.
- B. The degree of grade control shall not deviate from true grade and profile more than one-half inch as measured by a ten-foot straight edge.
- C. Drainage:
 - 1. Provide and maintain positive surface water drainage around and away from open excavations.
 - 2. Keep opened excavations dry.
 - 3. Remove free water in excavation promptly.

3.03 FIELD QUALITY CONTROL

- A. Sample and Test:
 - 1. At intervals not to exceed 200 feet.
 - 2. At locations designated by the Engineer.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	<u>Pay Unit</u>
5.02	Roadway Subgrade Preparation	Lump Sum

END OF SECTION

SECTION 31 23 18

ROCK EXCAVATING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This Section includes requirements for rock excavation in trenches, pits, and open excavations.

1.02 CLASSIFICATION OF ROCK EXCAVATION

- A. Excavation to required subgrade elevations or trench dimensions will be classified as either "rock excavation" or "unclassified excavation."
 - 1. **Rock Excavation** includes all materials which, in the opinion of the Engineer, require barring, wedging and/or special impact tools such as hydraulic rock hammers, jack hammers, sledges, chisels, or similar devices specifically designed for use in cutting or breaking rock for removal from their original beds and which have compressive strengths in their natural undisturbed state in excess of 300 psi. Boulders or masonry larger than one cubic yard in volume are classed as rock excavation.
 - 2. **Rock Excavation Field Tests:** Rock excavation is material that meets any one of the following field test criteria:
 - a. <u>Ripping Test:</u> Material that cannot be broken down by one pass with a single tooth ripper mounted on a crawler-type tractor in low gear with a minimum net flywheel power rating of 255 hp.
 - b. <u>Seismic Test:</u> Material that has a seismic velocity greater than 6,000 feet/second. Submit the qualifications of the person performing and interpreting the seismic testing for Engineer approval at least 14 days before testing. Perform the Ripping Test to resolve differences in material classification if seismic velocities fall below 6,000 feet/second.
 - c. <u>Handling Test:</u> Rock with a volume greater than 1 cubic yard that cannot be readily broken down with excavation equipment.
 - 3. Unclassified Excavation includes excavation of pavements and other obstructions visible on surface; underground structures, utilities, and other items indicated to be demolished and removed; together with soil and other materials encountered that are not classified as rock or unauthorized excavation. Unclassified Excavation includes excavation done with intermittent drilling or ripping performed solely to increase production, but not necessary to permit excavation of material encountered.

1.03 RELATED WORK

A. Section 01 29 00 – Payment Procedures

1.04 VERIFICATION

- A. If verification is required, Contractor shall employ a geotechnical firm to perform rock excavation field tests and verify quantity and depth of rock excavation at no additional cost the Owner. These field tests are not part of material testing specified under Section 01 45 23 Testing Laboratory Services.
- B. The quantity of detached rocks and boulders shall be measured before they are incorporated into earth haul. Rock material that is not measured and is incorporated into the earth haul will be considered Unclassified Excavation.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SITE CONDITIONS

- A. Classification and Quantity: Make investigations and determinations necessary to determine the classification and quantities of rock excavation and the methods to be used to excavate these materials.
- B. Determination of Classification: If difficult excavation conditions are encountered within defined limits, they will be classified as "Rock Excavation" if mutually agreed upon by the Contractor's superintendent and the Owner's Resident Project Representative at the time the condition is encountered, and the Contractor will be paid at the rock excavation unit bid price. If the Contractor's Superintendent and the Owner's Resident Project Representative do not mutually agree on the classification, the Contractor shall demonstrate to the Engineer's satisfaction that the areas in question meet one of the Rock Excavation Field Tests as specified herein.

3.02 BLASTING

A. Blasting of rock is not permitted.

3.03 ROCK EXCAVATION – MECHANICAL METHOD

- A. Excavate rock using mechanical methods.
 - 1. Cut away rock at bottom of excavations to form level bearing that follows natural strata. Form with sharp steps.
 - 2. Remove final layers carefully to provide sound and unshattered base for footings and foundations as needed.
 - 3. Remove boulders and fragments that may slide or roll into excavated areas.

PART 4 PAYMENT

4.01 MEASUREMENT

A. Unit of Measurement for Rock Excavation in Trenches: Linear foot of trench, or as specified otherwise in the Bid Form.

4.02 PAYMENT ITEMS

A. Payment for ROCK REMOVAL and DISPOSAL will be at the Contract unit price for Rock Excavation. The unit price will be full compensation for labor, material, equipment, and work required for verification, drilling, excavation, loading, dumping, and spreading rock material; forming embankments; shaping and trimming slopes and surfaces; and replacing with specified fill.

Bid Item No.	Pay Item	Pay Unit
1.08, 2.04, 3.09	Rock Excavation	Linear Feet

END OF SECTION

SECTION 31 23 33

TRENCHING AND BACKFILLING

PART 1 GENERAL

- 1.01 WORK INCLUDED
 - A. Trenching, Backfilling, and Compacting for Buried Pipes and Manholes.
 - B. Bedding of Buried Pipes.
 - C. Pipe Marking Systems.

1.02 REFERENCES

- A. ASTM C12 Installing Vitrified Clay Pipe Lines.
- B. ASTM D256A Determining the Izod Pendulum Impact Resistance of Plastics, Method A.
- C. ASTM D638 Tensile Properties of Plastic.
- D. ASTM D695 Compressive Properties of Rigid Plastics.
- E. ASTM D790 Flexural Properties of Unreinforced and Reinforced Plastics. and Electrical Insulating Materials.
- F. ASTM D1557 Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
- G. ASTM D1593 Non-Rigid Vinyl Chloride Plastic Film and Sheeting.
- H. ASTM D2321 Underground Installation of Flexible Thermoplastic Sewer Pipe.
- I. ASTM D2583 Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.
- J. ASTM D2774 Underground Installation of Thermoplastic Pressure Piping.
- K. ANSI/AWWA C150/A21.50 Thickness Design of Ductile-Iron Pipe.
- L. ANSI/AWWA C151/A21.51 Ductile-Iron Pipe, Centrifugally Cast, for Water, or Other Liquids.
- M. ANSI/AWWA C600 Installation of Ductile-Iron Water Mains and Their Appurtenances.
- N. ANSI/AWWA C605 Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fitting for Water.

O. OSHA Regulations, 29 CFR 1926 Subpart P – Excavations.

1.03 SUBMITTALS

- A. Section 01 33 23 Shop Drawings, Product Data, and Samples:
 - 1. Testing laboratory results on bedding materials to demonstrate compliance with specifications.
 - 2. Product data for identification tape, marker posts, tracer wire system, and electronic marker device system, if scheduled.

1.04 JOB CONDITIONS

- A. All trenching is unclassified.
- B. Protect adjacent structures and surrounding areas.
- C. Work to remain within available easements.
- D. Weather:
 - 1. No backfill placement during freezing weather.
 - 2. No frozen materials, ice, or snow in backfill or fill.
 - 3. No backfill or fill on frozen surfaces.

1.05 REGULATORY REQUIREMENTS

A. Comply with OSHA Standard 29 CFR Part 1926, Subpart P – Excavations, during all excavation, trenching, and shoring operations.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Bedding Materials:
 - 1. Bedding materials are those materials located a maximum of 8 inches below bottom of pipe to bottom or spring line of pipe, depending on bedding class or condition required.
 - 2. Material shall be granular and free flowing:
 - a. Maximum particle or clump size:
 - 1) Plastic Pipe: 8 inch Diameter and Smaller: 0.25 inches.
 - 2) All other Pipe: 0.75 inches.
 - b. Portion Passing No. 200 Sieve: 50% maximum.
 - c. Free from refuse, organic material and frozen soils.
 - 3. Materials require prior written approval.
 - 4. Concrete: Division 03.

B. Initial Backfill Materials:

- 1. Initial backfill material is that material placed above the bedding material, around and over the pipe to 12 inches over the top of the pipe.
- 2. Material to be defined and required by applicable ASTM standard for installation for bedding class or type required or scheduled.

- 3. In no case shall initial backfill material contain particles or clumps with any dimension greater than:
 - a. Plastic Pipe: 8 inch Diameter and Smaller: 0.25 inches.
 - b. All Other Pipe: 0.75 inches.
- 4. If not otherwise defined, same as bedding material.

C. Backfill Materials:

- 1. Backfill materials are those materials placed in the trench between the initial backfill material and the top of the trench.
- 2. Material to be as defined and required by applicable ASTM Standard for installation for bedding class or type required or scheduled.
- 3. Backfill shall have no particles or clumps having a dimension larger than 6 inches within 3 feet of the top of the pipe.

D. Materials Not Allowed:

1. All pipe bedding, initial backfill, and backfill material shall be clean and free of roots, vegetable or organic material, frozen material, mine tailings, or any contaminants that could endanger public health.

E. Identification Tape:

- 1. Identification tape shall consist of high visibility, color coded inert polyethylene tape that is impervious to all known alkalis, acids, chemical reagents, and solvents found in the soil.
- 2. The tape shall have the following properties:
 - a. Minimum overall thickness: ASTM D1593: Plain, 4.0 mils; detectable, 4.5 mils.
 - b. Minimum tensile strength (longitudinal): ASTM D638: Plain, 1500 psi; detectable, 4,544 psi.
 - c. Maximum imprint length: 36 inches
 - d. Width: 3 inches for plain tape without metallic foil stripes.
 - e. Detectable Tape Metallic Foil Stripes: Permanently laminated to the polyethylene tape so that tape may be more readily located using a metal detector. Refer to Part 3 for application of use. Width: 6 inches.
- 3. Tape to meet the APWA Uniform Color Code for utilities.
- 4. Imprinted message, "Caution Buried Utility Line Below", printed with black letters on APWA approved colors.
- 5. Acceptable Manufacturers:
 - a. Seton Identification Products, Branford, CT, or Engineer reviewed equivalent.

F. Tracer Wire System:

- 1. Provide tracer wire system as shown on the Drawings and as specified herein.
- 2. Install single run of tracer wire on top of pipe.
- 3. Secure wire to pipe every 10 feet with pipe wrap tape (tape required to hold wire in place during backfill).
- 4. Bring wire to surface at every valve box, vault, hydrant, manhole, every 1,000 linear feet, and where shown on Drawings.
- 5. Terminate wire at surface using a tracer terminal box.

- 6. All tracer system components such as terminal box cover, wire insulation, and connectors shall be in accordance with APWA Uniform Color Code for utilities.
- 7. Tracer Wire: #12 AWG, UL listed, 30V single conductor, tracer wire, with 30 mil high density polyethylene (HDPE) insulation.
 - a. Copper-clad annealed high carbon 1055 grade steel wire, break load 452 lbs. steel core shall be manufactured in the United States. Copperhead Industries LLC, High Strength HS-CCS, or Engineer reviewed equivalent.
 - b. Solid strand copper, Agave Wire LTD, Paige Tracer, or Engineer reviewed equivalent.
 - c. If tracer wire is scheduled to be used on utilities installed by horizontal directional drilling, refer to Section 33 05 23.13 Utility Horizontal Directional Drilling.
- 8. Pipe Wrap Tape:
 - a. Material: 10 mil all weather polyvinyl film.
 - b. Durability: Resistant to moisture and corrosive soil.
 - c. Adhesion: Adheres to metal and plastic, and conforms to irregularities in substrate surface.
 - d. Elongation: 245 percent.
 - e. Tensile Strength: 30 psi.
 - f. Width: 2 inches.
 - g. Printed Identification Marking: UPC code, and mil thickness.
 - h. Acceptable Manufacturer: Northtown Company, or Engineer reviewed equivalent.
- 9. Tracer Terminal Box:
 - a. Copperhead Industries, LLC, Snake Pit Magnetized Tracer Boxes, or Engineer reviewed equivalent.
 - 1) Light Duty Box: Locate next to structures and not subject to direct damage (such as adjacent to a fire hydrant).
 - 2) Roadway Box: Locate in or adjacent to road and subject to road traffic.
 - 3) Concrete/Driveway Box: Locate in areas of concrete pavement.
- 10. Corrosion-Resistant Wire Connectors:
 - a. Direct bury twist-on wire nuts, prefilled with dielectric silicone. For use when connecting between spools (2 conductors max.). Copperhead Industries, LLC, Agave Wire LTD, or Engineer reviewed equivalent.
 - b. Direct bury lugs, prefilled with dielectric silicone. For use when connecting to terminal electrical box. Copperhead Industries, LLC, Agave Wire LTD, or Engineer reviewed equivalent.
 - c. Acceptable for use in place of wire nuts and/or lugs, Copperhead Industries, LLC, twist locking, watertight connectors, with dielectric silicone, or Engineer reviewed equivalent.
- 11. Test for electrical continuity after installation in accordance with manufacturer's recommendations using manufacturer's cable tracing equipment. Provide test reports to Engineer for review.

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G. Underground Cable Tracing Equipment:

- 1. Receiver Details:
 - a. Active Frequencies (Hz): 491, 982, 8.44k, 9.82k, 35k, 82k, 83k (North America).
 - b. Passive Frequencies (Hz): 50, 60, 100, 120, RF (14k-21k).
 - c. Extended and special frequency sets available.
 - d. Depth Display Accuracy: 0-10 feet ±(5%+2 inches) under ideal field conditions
 - e. 10-20 feet: $\pm 10\%$ under ideal field conditions.
 - f. Depth Range: Maximum 20 feet (600 cm).
 - g. Gain Adjustment Automatic & manual with pushbutton centering.
 - h. Controls: Four-way navigation key and soft keys.
 - i. Display Indicators: Frequency Audio volume, battery condition, Guidance Compass, Distortion, Alert, Signal Select, signal strength, Distance Sensitive Left/Right.
 - j. Guidance, menu softkey, frequency softkey.
 - k. Line ID: Signal Select, Guidance Compass, Distortion Alert.
 - 1. Display: 1/4 VGA Bright Color.
 - m. Antenna: Distance Sensitive Left/Right Guidance.
 - n. Data Acquisition: Internal data logging memory.
 - o. Operating Temperature: $-4^{\circ}F$ to $+122^{\circ}F$ ($-20^{\circ}C$ to $+50^{\circ}C$).
 - p. Battery Type: Rechargeable battery pack for transmitter.
 - q. Battery Life: 30 hours continuous.
 - r. Battery Check: Continuous display.
 - s. Regulatory Compliance: FCC, CE.
 - t. Environmental: IP54.

2. Transmitter:

- a. Output Frequencies (Hz): 491, 982, 8.44k, 9.82k, 35k, 82k, 83k
- b. Extended and special frequency sets available.
- c. Output Power: Variable to 10W.
- d. Simultaneous Output: Up to three active frequencies.
- e. Controls: Frequency select, measurement units (mA, Volts, Ohms, Watts), output power, Signal Select, menu, 4-way navigation, select, SFL, On/Off.
- f. Display Indicators: Battery status, audio volume, output mode, frequency setting, and frequency output, percent output in SFL or induction mode, output graph, loop resistance graph.
- g. Display: 1/8 VGA monochrome.
- h. Battery Type: Rechargeable battery pack for transmitter.
- i. Battery Life: 6 12 hours continuous use, depending on power level and line conditions.
- j. Operation Temperature: $-4^{\circ}F$ to $+122^{\circ}F$ ($-20^{\circ}C$ to $+50^{\circ}C$).
- k. Regulatory Compliance: FCC, CE.
- 1. Environmental: IP54.
- 3. Included Accessories: Receiver, transmitter, connection cables, ground stake, ground cable, carrying case, rechargeable battery pack for transmitter, and ground fault locating kit.

4. Manufacturer: Amprobe® AT-5005 Professional or Engineer reviewed equivalent.

H. Utility Marker Posts:

- 1. Description: Flexible, single piece marker having flat cross-section with three reinforcing ribs and pointed end.
- 2. Material: Composite flexible glass fiber-reinforced polymer with UV-resistant outer shell, serviceable from -40°F to 140°F.
- 3. Physical Properties:
 - a. Tensile Strength, ASTM D638: 30,000 psi min.
 - b. Tensile Elongation, ASTM D638: 2% min., 10% max.
 - c. Compressive Strength, ASTM D695: 30,000 psi min.
 - d. Notched Izod Impact Strength, ASTM D256A: 50 ft.-lb./in. min.
 - e. Barcol Hardness, ASTM D2583: 50 min.
 - f. Flexural Strength, ASTM D790: 30,000 psi min.
 - g. Flexural Modulus, ASTM D790: 1,000,000 psi min.
- 4. Dimensions: 3.75" wide x 5' 2" long.
- 5. Color: Standard APWA color code, integral pigment.
- 6. Decal: Standard, non-reflective message for utility to be identified, standard APWA background color, UV-resistant, factory installed.
- 7. Accessories: Flexible anchor barb, factory installed.
- 8. Acceptable Manufacturers: Carsonite Division of Ametek, Inc. or Engineer reviewed equivalent.
- 9. Refer to Part 3 for application of use.
- 10. Contractor shall coordinate with Owners Representative to acquire and affix Santa Fe County detail to marker post.

PART 3 EXECUTION

3.01 INSPECTION

A. Field verify location of underground utilities and obstructions.

3.02 CLEARING AND GRUBBING

- A. General: Clear and grub all areas within the construction limits that will be disturbed by trenching or stockpiling.
- B. Clearing: Remove and dispose of trees and other vegetation, downed timber, snags, brush, and rubbish within areas to be cleared.
- C. Grubbing: Remove stumps, matted roots, and roots larger than 2 inches in diameter from areas to be excavated and from within 6 inches of surface of areas to receive stockpiled material. Do not allow grubbed material to mix with trench backfill.

D. Disposal:

1. Haul and dispose of all debris, rubbish, vegetation, broken concrete, broken asphaltic concrete, rocks, and other material to be removed.

- 2. Properly dispose of material in accordance with applicable state and federal regulations.
- 3. Burning of debris and rubbish will not be permitted on the project site.

3.03 DEWATERING

- A. Provide and maintain adequate dewatering equipment to remove and dispose of surface and groundwater entering excavations, trenches, and other parts of the Work.
- B. Keep excavation dry during subgrade preparation and continuously thereafter until the structure to be built or the pipe to be installed is completed to the extent that no damage from hydrostatic pressure, flotation or other cause will result.
- C. Dewater excavations which extend to or below groundwater by lowering and keeping the groundwater level beneath such excavation at least 12 inches below the bottom of the excavation.
- D. Divert surface water or otherwise prevent it from entering excavated areas or trenches to the extent practical without damaging adjacent property.
- E. Contractor is responsible for the condition of any pipe or conduit he uses for drainage; all drainage pipes, ditches, etc. shall be left clean and free of sediment.

3.04 BLASTING

A. Blasting is not allowed.

3.05 SHEETING

A. If used, cut off at top of pipe and leave in place unless removal is specifically reviewed by Engineer.

3.06 STABILIZATION

- A. Thoroughly compact and consolidate trench bottoms so they remain firm, dense, and intact during required construction activities.
- B. Remove all mud and muck during excavation.
- C. Reinforce trench bottom with crushed rock or gravel if it becomes mucky during construction activities.
- D. Allow no more than 1/2-inch depth of mud or muck to remain on trench bottoms when pipe bedding material is placed thereon.
- E. Where trench bottoms-out in rock, rock is to be removed to 8-inches below bottom of pipe and replaced with bedding material.

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3.07 TRENCH EXCAVATION

- A. Slope, bench, or support all trenches in conformance with OSHA Excavation Regulations, and follow all specified safety requirements.
- B. Do not open more trench in advance of pipe laying than is necessary to expedite the Work; not more than 400 feet, unless otherwise authorized by Engineer.
- C. Except where jacking and boring is indicated on the Drawings, specified or permitted by Engineer, excavate trenches by open cut from the surface.
- D. Alignment, Grade, and Minimum Cover:
 - 1. Establish alignment and grade or elevation from offset stakes.
 - 2. Excavate trenches so pipes can be laid straight at uniform grade without dips or bumps, between the terminal elevations indicated on the Drawings.
 - 3. Comply with pipe specification sections regarding vertical and horizontal alignment and max joint deflection.
 - 4. Water lines to have minimum bury as shown on the Drawings, and in general, grade shall follow surface contours unless otherwise shown on the Drawings.

E. Limiting Trench Widths:

- 1. Excavate to a width which will provide adequate working space and pipe clearances for proper pipe installation, jointing, embedment.
- 2. If needed to reduce earth loads to prevent sloughing cut banks back on slopes which extend not lower than 1 foot above the top of the pipe.
- 3. Trench widths and minimum clearances between installed pipe and trench wall:

Pipe Size	Minimum Trench Width	Minimum Clearance	Maximum Trench Width at Top of Pipe
18" or less	O.D. plus 16"	8"	O.D. plus 24"
Larger than 18"	O.D. plus 24"	12"	O.D. plus 24"

F. Mechanical Excavation:

- 1. Do not use where its operation would damage trees, buildings, culverts, or other existing property, structures, or utilities above or below ground; hand-excavate only in such areas.
- 2. Use mechanical equipment of a type, design, and construction and operated so that:
 - a. Rough trench bottom elevation can be controlled.
 - b. Uniform trench widths and vertical sidewalls are obtained from 1' above the top of the installed pipe to the bottom of the trench.
 - c. Trench alignment is such that pipe is accurately laid to specified alignment and is centered in the trench with adequate clearance between pipe and trench sidewalls.
 - d. Do not undercut trench sidewalls.

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G. Cuts in Existing Paved Surfaces:

- 1. Applies to streets, sidewalks, curbs, driveways, and other existing paved surfaces.
- 2. No larger than necessary to provide adequate working space.
- 3. Cut a clean groove not less than 1-1/2 inch deep along each side of trench or around perimeter of excavation area.
- 4. Remove pavement and base pavement to provide shoulder not less than 6" wide between cut edge and top edge of trench.
- 5. Do not undercut trenches, resulting in bottom trench width greater than top widths.
- 6. Make pavement cuts to and between straight or accurately marked curved lines parallel to trench centerline or limits of excavation.
- 7. Where the trench crosses existing paved surfaces, remove and replace the paved surface between saw cuts as specified for pavement.

H. Excavation Below Pipe:

- 1. Except as otherwise required, excavate trenches below the underside of pipes as indicated on the Drawings to allow placement of granular pipe bedding material.
- 2. Where excavating in earth for 6-inch and smaller pipe, Contractor has the following options for excavating trench bottoms:
 - a. Excavate below pipe subgrade and place granular embedment.
 - b. Grade trench bottom to provide uniform and continuous support between bell holes or end joints.

I. Excavation for Bell Holes:

- 1. Excavate to provide adequate clearance for tools and methods of pipe installation.
- 2. Do not allow any part of bells or couplings to contact the trench bottom, walls, or granular embedment when pipe is joined.
- J. Excavated Material: Place stockpiled excavated materials in a manner that will not obstruct work or endanger personnel or the public.
 - 1. Excavated materials shall not obstruct sidewalks or driveways for extended periods of time.
 - 2. Excavated materials shall not obstruct hydrants, valve pit covers, valve boxes, or other utility controls.
 - 3. Excavated materials shall not obstruct gutters, unless other temporary provisions have been made for street drainage.
 - 4. Excavated materials shall not obstruct natural drainage ways.
- K. Surplus Excavated Material: Excavated material in excess of that needed to backfill to the limits indicated in the Contract Documents shall be properly disposed off-site in compliance with regulatory requirements at no additional cost to the Owner.

3.08 PIPE BEDDING

A. Class D per ASTM C12.

- B. Class C per ASTM C12.
- C. Class B per ASTM C12.
- D. Crushed Stone Encasement per ASTM C12.
- E. Class A-I: ASTM C12 Class A-1 using plain concrete.
- F. Class A-II: ASTM C12 Class A-1 using reinforced concrete; No. 4 A-36 steel reinforcing bars parallel to pipe with steel area not less than 0.4% of the area of concrete above top of pipe.
- G. Class A-III: ASTM C12 reinforced concrete encasement; 3000 psi concrete; No. 4 A-36 steel reinforcing bars; reinforcing parallel to pipe with steel area not less than 0.4% of the area of concrete above and below pipe; reinforcing bars wrapped around parallel bars at 36" maximum spacing.
- H. Bedding class or type as scheduled.
- I. Carefully place bedding in accordance with ASTM C12 to provide uniform and continuous support to pipe barrel, except at bell holes in all cases. No bridging will be allowed.

3.09 MANHOLE SUBGRADE

- A. Subgrade Material: Use same bedding class as specified for adjacent pipe bedding.
- B. Compaction: 90% ASTM D1557.

3.10 TRENCH BACKFILL

- A. Material as defined by applicable reference for installation for type of pipe used.
- B. Bedding, Initial Backfill, and Backfill: If native materials cannot meet the requirements of Part 2 specified herein or if the specified field compaction cannot be obtained, Contractor shall import suitable material at no additional cost to the Owner.
- C. Bedding: Carefully "shovel-slice" or tamp bedding so that the material fills and supports the haunch area under the pipe without voids.
- D. Initial Backfill: Place in layers that do not exceed 8 inches in height of backfill material in its uncompacted state.
- E. Backfill: Place in layers heights suitable to enable the Contractor to achieve the specified compaction throughout the full depth of backfill using Contractor's selected means and methods and without damaging the pipe.
- F. Paved Traveled Areas:
 - 1. 90% ASTM D1557 compaction.
 - 2. Top 12 inches below subgrade, 95 percent ASTM D1557 compaction.

- G. Unpaved Traveled Areas and Treatment Plant/Pump Station Sites:
 - 1. 90% ASTM D1557 compaction.
- H. Untraveled Areas: Compacted to at least undisturbed natural density but not less than 85% ASTM D1557.
- I. Water Settled Backfill: Use only where permitted by Engineer:
 - 1. Where permitted, apply to obtain effective settlement with a minimum of water.
 - 2. Do not permit trench to overflow.
 - 3. Do not settle by water puddling until after trench has been backfilled to ground surface.
 - 4. Introduce water above the pipe embedment through a long pipe nozzle so disturbance of granular embedment or compacted material is held to an absolute minimum.
 - 5. Add backfill material to compensate for settlement below surface grade and settled during puddling operations.
- J. Install identification tape in backfill 24 inches directly above top of all buried pipe, unless otherwise scheduled or shown on Drawings. Use tape with metallic foil stripes for all non-metallic pipes.
- K. Install Utility Marker Posts as Follows:
 - 1. Install posts in untraveled areas over centerline of pipe at each horizontal bend made with fittings and at 300 feet intervals between bends.
 - 2. Install face of posts perpendicular to centerline of pipe and facing the downstream direction.
 - 3. Bury posts 18 inches deep.
- L. Upper 18-inches of trench shall contain no particles larger than 6 inches in any dimension.
- M. Surface Finish:
 - 1. For placement of paving or gravel surfacing, subgrade where applicable.
 - 2. Match existing and surrounding contours.
 - 3. Graded finished appearance.
- 3.11 FIELD QUALITY CONTROL
 - A. Section 01 45 23 Testing Laboratory Services.
 - B. Section 01 71 23 Field Engineering.
 - C. Test Schedule unless otherwise directed by the Engineer:
 - 1. Minimum of one field density test for each compacted layer of trench backfill for each 250 linear feet of trench in traveled areas.
 - D. Minimum of one field density test for each compacted layer of trench backfill for each 500 linear feet of trench in untraveled areas.

E. Minimum of two field density tests for each compacted layer of trench backfill at each road crossing.

3.12 PIPE BEDDING SCHEDULES

- A. Cast or Ductile Iron Pipe:
 - 1. Minimum Bedding Class:

Pipe	Trench Depth	Bedding
<u>Diameter</u>	To Top of Pipe	<u>Class</u>
14" or less	5' or less	D
	5' – 12'	C
	More than 12'	В
Larger than 14"	12' or less	C
	More than 12'	В

- B. PVC, HDPE, and Other Plastic Type Pipes:
 - 1. As recommended by manufacturer.
 - 2. Minimum bedding class:
 - a. Trench depth to top of pipe less than 10'; Class C
 - b. Trench depth to top of pipe 10' or more; Class B.
 - 3. Gravity sewer lines bedded to meet maximum deflection requirements given with pipe specifications.

3.13 PIPE MARKING SCHEDULE

- A. Identification Tape: All pipes.
- B. Tracer Wire System: All pipes.
 - 1. Cable Tracing Equipment: Provide.
 - 2. Payment for Tracer Wire in Place: Refer to Section 01 29 00 Payment Procedures, Paragraph 1.03.A.3.f.
- C. Utility Marker Posts: All pipes.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
1.06, 1.07, 1.10, 2.03, 2.06, 3.06, 3.07, 3.08, 3.11	Trenching and Backfilling/Identification	Linear Feet
5.03	Trenching and Backfilling/Identification	Lump Sum

END OF SECTION

SECTION 31 23 23.33

FLOWABLE FILL BACKFILL

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Trench Backfilling.
- B. Bedding of Buried Pipes.

1.02 REFERENCES

- A. American Society for Testing and Materials International (ASTM):
 - 1. ASTM C31 Making and Curing Concrete Test Specimens in the Field.
 - 2. ASTM C94 Ready-Mixed Concrete.
 - 3. ASTM C138 Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
 - 4. ASTM C143 Slump of Hydraulic-Cement Concrete.
 - 5. ASTM C150 Portland Cement.
 - 6. ASTM C172 Sampling Freshly Mixed Concrete.
 - 7. ASTM C192 Making and Curing Concrete Test Specimens in the Laboratory.
 - 8. ASTM C231 Air Content of Freshly Mixed Concrete by the Pressure Method.
 - 9. ASTM C260 Air-Entraining Admixtures for Concrete.
 - 10. ASTM C558 Moisture-Density Relations of Soil-Cement Mixtures.
 - 11. ASTM C618 Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
 - 12. ASTM C685 Concrete Made by Volumetric Batching and Continuous Mixing.
 - 13. ASTM D1633 Compressive Strength of Molded Soil-Cement Cylinders.

1.03 SUBMITTALS

- A. Product data for cement and admixtures.
- B. Flowable fill mix design.
- C. Testing laboratory results on mix design to demonstrate compliance with specifications.

PART 2 PRODUCTS

2.01 MATERIALS

A. Bedding Materials: Refer to Section 31 23 33 – Trenching and Backfilling.

- B. Backfill Material Flowable Fill:
 - 1. Backfill materials are those materials placed in the trench between the bedding material and the top of the trench.
- C. Materials Not Allowed: Refer to Section 31 23 33 Trenching and Backfilling.
- 2.02 CONCRETE MIX BACKFILL MATERIAL (Lean Backfill, Digable Material For Filling Excavations)
 - A. Comply with ASTM C94, and ASTM C150, Portland Type I-II, low alkali.
 - B. Portland Cement Content: Quantity sufficient to meet specified compressive strength range.
 - C. Compressive Strength:
 - 1. Compressive strength requirement shall be fully achieved in time indicated.
 - 2. Compressive Strength at 28 Days: 35 psi minimum, 60 psi maximum when sampled and tested as specified in Part 3.
 - 3. Concrete shall not exceed maximum compressive strength because it shall be capable of being excavated with a backhoe tractor without any problems.
 - 4. Concrete that does not meet the specified strength in the specified time is not acceptable regardless of what strength it may later demonstrate, and at the Engineer's sole discretion:
 - a. Shall be removed and replaced at the Contractor's sole expense, or
 - b. May be allowed to remain as part of the project, but the Contractor will not be paid for the total in-place cost of the concrete.

D. Admixtures:

- Batching method and time of introduction shall be in accordance with the manufacturer's recommendations for compliance with this specification.
- 2. Use of a water reducing admixture is optional.
- 3. Calcium chloride shall not be used.
- 4. Air Entraining Admixture: ASTM C260, 2% to 5% air.

E. Combined Aggregate Gradation:

SCREEN SIZE	<u>% PASSING</u>
	400
1 inch	100
3/4 inch	95-100
3/8 inch	82-100
no. 4	70-100
no. 8	55-85
no. 16	38-60
no. 50	6-30
no. 100	2-10

- F. Slump: 5 to 8 inches.
- G. Fly Ash: Class "C" or "F" fly ash as specified in ASTM C618 may be proportioned in the cementitious material as required to improve pumpability.

PART 3 EXECUTION

3.01 INSPECTION

A. Refer to Section 31 23 33 – Trenching and Backfilling.

3.02 BATCHING, MIXING AND DELIVERY

- A. Ready-Mixed Concrete: ASTM C94.
- B. Field Batched Concrete: ASTM C685.
- C. Delivery Ticket: Deliver to Owner's Field Representative prior to unloading at site.
 - 1. Name of flowable fill supplier.
 - 2. Delivery ticket number.
 - 3. Date of delivery.
 - 4. Name of Contractor.
 - 5. Name or location of project.
 - 6. Design mix number.
 - 7. Volume of flowable fill in load.
 - 8. Time loaded.
 - 9. Batched weight of cement, fly ash, fine aggregate, coarse aggregate.
 - 10. Batched weight or volume of admixtures and water.
 - 11. Reading of mixer drum revolution counter at start of mixing.
 - 12. Certification that materials delivered are same brand, type and source as those defined in the design mix authorized by the Engineer.
 - 13. Target proportions of the design mix.
 - 14. Weight or volume of water added at the job site.
 - 15. Signature and name of person who authorized addition of water after leaving the batch plant, and affiliation to the project.

3.03 PLACING

- A. Secure utility pipe from movement and flotation.
- B. Place flowable fill uniformly without voids or segregation.
- C. Place flowable fill in lifts not exceeding 4 feet in height. Do not place over previous lift until previous lift has been placed for at least 2 hours.

- D. Do not place flowable fill on frozen material, in standing water, or during rain. Protect flowable fill from flooding or disturbance for at least 24 hours after placement.
- E. Place flowable fill only when ambient temperature is at least 35°F and rising. When ambient temperature at the time of placement is less than 40°F, the temperature of the flowable fill placed shall not be less than 50°F.

3.04 APPLICATION OF LOAD

- A. Do not place any load on flowable fill until it exceeds a penetration resistance of 12 psi.
 - 1. Penetration resistance will be considered acceptable if a person weighing at least 150 pounds, by using his body weight as an axial load on a 3-1/2-inch x 3-1/2-inch wooden block, cannot penetrate the material more than 1 inch.

3.05 FIELD QUALITY CONTROL

- A. Field quality control is required to insure compliance with the project requirements.

 All portions of the field quality control sampling and testing shall be performed by the testing laboratory selected by the Contractor and accepted by the Engineer.
- B. Field quality control testing shall include but not be limited to the following:
 - 1. Sampling: ASTM C172.
 - 2. Test Sample:
 - a. Frequency: One for each 150 CY or each day's placement, whichever is greater.
 - b. Field Tests:
 - 1) Slump: ASTM C143.
 - 2) Air Content: ASTM C231.
 - 3) Unit Weight: ASTM C138.
 - 4) Temperature
 - c. Compression Tests:
 - 1) Sample: Do not use material from the field tests.
 - 2) Molds: 4-inch diameter x 4.5-inch high, free-draining at base, ASTM D 558.
 - 3) Initial Field Curing: 24 +/- 4 hours in mold, ASTM C31.
 - 4) Laboratory Curing: After initial curing, extrude from mold and cure in laboratory per ASTM C192, do not cure in curing tank.
 - 5) Number of Specimens: Four; test one at 1 day, one at 7 days, and two at 28 days.
 - 6) Compression Testing: ASTM D1633.
 - 3. Reporting:
 - a. Written report to Engineer within 4 days of completion of a test.
 - b. Non-complying Test Results: Notify Engineer within 1 working day after completion of a test.

3.06 SCHEDULE

A. Backfill with lean backfill and cement slurry mix where indicated on Drawings.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
3.24	Flowable Lean Backfill	Cubic Yard

END OF SECTION

SECTION 31 34 00

SUBSURFACE GRAVEL DRAIN

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The construction of subsurface gravel drain shall consist of furnishing and placing gravel encased in filter cloth at the end of the drain pipe. Dimensions of the gravel sump shall be as shown on the Drawings.
- B. References:
 - 1. ASTM C 136, Sieve Analysis of Fine and Coarse Aggregates

1.02 SUBMITTALS

- A. Section 01 33 23 Shop Drawings, Product Data, and Samples:
 - 1. Laboratory test results demonstrating stone meets specified values.
 - 2. Product data for filter fabric.

PART 2 PRODUCTS

2.01 GRAVEL

A. Gravel shall be sound and durable, free of clay, humus, coatings, or other objectionable matter, and of such characteristics that it will not disintegrate when subjected to the action of water. Gravel shall conform to the following gradation when tested in accordance with ASTM C 136:

Sieve Size	Percentage of Weight Passing
1"	100
3/4"	90-100
3/8"	20-55
No. 4	0-10
No. 200	0-2

2.02 FILTER CLOTH

A. Filter Fabric: Needle punched non-woven polypropylene geotextile, inert to biological degradation, and with property values as listed below:

Fabric Property	Unit	Test Method	Min. Average Value
Weight	oz/yd2	ASTM D-5261	4.8
Thickness	mils	ASTM D-5199	40

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Fabric Property	Unit	Test Method	Min. Average Value
Grab Tensile Strength	lbs	ASTM D-4632	120
Grab Tensile Elongation	%	ASTM D-4632	50
Trapezoidal Tear Strength	lbs	ASTM D-4533	50
CBR Puncture Strength	lbs	ASTM D-6241	310
Apparent Opening Size (AOS)	US Std. Sieve	ASTM D-4751	70
Permittivity	Sec-1	ASTM D-4491	1.7
Water Flow Rate	gpm/ft2	ASTM D-4491	135
UV Resistance, at 500 hrs.	% Strength	ASTM D-4355	70
	Retained		

- B. Fabric specifically designed for drainage applications.
- C. Manufacturer:
 - 1. Mirafi No. 140N Drainage Fabric, Mirafi Inc., Charolette, North Carolina
 - 2. Or Engineer reviewed equivalent.

PART 3 EXECUTION

3.01 PREPARATION OF GROUND SURFACES

- A. The bed for gravel sump shall be shaped and trimmed to provide even surfaces.
- B. Specified filter cloth shall be placed on earth bed prior to placement of pipe and gravel.

3.02 FILTER CLOTH PLACEMENT

A. The surface to receive the cloth shall be prepared to a relatively smooth condition free of obstructions, depressions, and debris. The cloth shall not be laid in a stretched condition but shall be laid loosely. The cloth shall be placed so the edges overlap a minimum of 12 inches, with securing pins inserted through both layers. Cloth damaged or displaced before or during installation or placement of the overlaying gravel shall be replaced or repaired to the satisfaction of the Engineer at no additional cost to the Owner.

3.03 PLACING GRAVEL

A. Carefully place gravel around pipe without damaging the pipe. Do not drop gravel directly on pipe from a height greater than 15 inches.

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PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.Pay ItemPay Unit5.02Subsurface Gravel DrainLump Sum

END OF SECTION

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SECTION 31 37 16

RIPRAP SURFACE TREATMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The construction of riprap surface treatment shall consist of furnishing and placing stone, with or without grout, with or without wire mesh, or sacked concrete riprap. The depth and type of riprap shall be as shown on the construction plans.

1.02 REFERENCES:

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T 96 Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - 2. AASHTO T 103 Soundness of Aggregates by Freezing and Thawing (Procedure A Total Immersion in Water).
 - 3. AASHTO T 104 Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate.
- B. American Society for Testing and Materials International:
 - 1. ASTM C127 Relative Density (Specific Gravity) and Absorption of Coarse Aggregate.

1.03 SUBMITTALS

- A. Submit in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples:
 - 1. Certify that materials comply with specification requirements.

PART 2 PRODUCTS

2.01 STONE

- A. Sound and durable, free from seams and coatings, and of such characteristics that it will not disintegrate when subjected to the action of water. Riprap stone or rock shall meet the following criteria:
 - 1. Specific gravity of 2.65, as determined by ASTM C127. If available rock does not meet this density, then the size and depth of riprap shall be increased according to the following table:

Specific Gravity	Percent Increase in Size and Depth
2.65	0
2.60	5
2.50	15
2.40	25

- 2. Los Angeles abrasion wear of not more than 50 percent as determined by AASHTO T 96.
- 3. Soundness loss of not more than 21 percent, as determined by AASHTO T 104.
- 4. Freeze thaw loss of not more than 10 percent after 12 cycles, per AASHTO T 103, Procedure A.
- 5. The size and gradation of riprap stone shall be as designated on the Drawings, and as further designated in the Table at the end of this Section.
- 6. Stone shall be of shapes which will form a stable protection structure of the required depth. Rounded boulders or cobbles shall not be used on slopes steeper than 2 to 1 unless grouted. Angular shapes may be used on any slope. Flat or needle shapes will not be acceptable unless the thickness of the piece is more than 1/3 the length.
- 7. Waste concrete may be used if the pieces are sound, free from coatings, meet the size requirements specified for stone, and is specifically approved on the Drawings.

CLASSIFICATION AND GRADATION OF ORDINARY RIPRAP

Riprap Designation	% Smaller Than or Equal To Given Size by Weight	Minimum Dimension Inches	Km* Inches
Type L	100 35-55	12** 9	9
(Light)	10	2	

^{*}km = mean particle size

2.02 FILTER CLOTH

- A. Non-Woven Polyester Geotextile, such as:
 - 1. Mirafi No. 140N Drainage Fabric, Mirafi Inc., Charlotte, North Carolina
 - 2. or ENGINEER reviewed equivalent.

PART 3 EXECUTION

3.01 PREPARATION OF GROUND SURFACES

- A. The bed for riprap shall be shaped and trimmed to provide even surfaces.
- B. Specified filter cloth shall be placed on earth bed prior to placement of stone.
- C. Earth surface shall be shaped and trimmed to conform to the construction plans prior to the placement and compaction of the gravel type of filter material.

^{**}At least 30% of all stones by weight shall be this dimension.

3.02 PLACING FILTER CLOTH

A. The surface to receive the cloth shall be prepared to a relatively smooth condition free of obstructions, depressions, and debris. The cloth shall not be laid in a stretched condition but shall be laid loosely with a long dimension perpendicular to the channel centerline. The cloth shall be placed so the upstream edge overlaps the downstream edge a minimum of 12 inches, with securing pins inserted through both layers at no greater than two-foot intervals. Cloth damaged or displaced before or during installation or placement of the overlaying riprap shall be replaced or repaired to the satisfaction of the ENGINEER at the CONTRACTOR'S expense.

3.03 PLACING RIPRAP STONE

- A. When the required riprap is less than 20 inches in depth, stone shall be placed by hand unless otherwise authorized by the ENGINEER. Stone shall be placed to provide a minimum of voids. The larger stone shall be placed in the toe return, foundation course, and on the outer surface of the riprap. Stones shall be placed with their longitudinal axis normal to the face of the embankment and so arranged that each rock above the foundation course has at least a 3 point bearing on the underlying stones. Bearing on smaller stones used to chink voids will not be acceptable. Interstices between stones shall be chinked with small stones and spalls. The finished surface shall be even and tight and shall not vary from the planned surface by more than 3 inches per foot of depth. When the required riprap is 20 inches or more in depth, the stone may be placed by dumping and spread in layers by bulldozers or other suitable equipment.
- B. Riprap shall be placed to its full design thickness (depth) in one operation.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	<u>Pay Item</u>	Pay Unit
4.01, 5.01	Riprap at Retention Pond and Swale	LS

END OF SECTION

SECTION 32 11 23

AGGREGATE BASE COURSES

PART 1 GENERAL

1.01 WORK INCLUDED

A. Placement of crushed aggregate base course to the depths and grade as indicated on the Drawings.

1.02 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T 11 Amount of Material Finer Than 75-um (No. 200) Sieve in Mineral Aggregates by Washing.
 - 2. AASHTO T 27 Sieve Analysis of Fine and Coarse Aggregates.
 - 3. AASHTO T 89 Determining the Liquid Limit of Soils.
 - 4. AASHTO T 90 Determining the Plastic Limit and Plasticity Index of Soils.
 - 5. AASHTO T 96 Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine.
 - 6. AASHTO T 104, Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate.
- B. American Society for Testing Materials International:
 - 1. ASTM D1557 Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 - 2. ASTM D6938 In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.03 OUALITY ASSURANCE

- A. Allowable Tolerances:
 - 1. Thickness: In place compacted thickness will not be acceptable if exceeding \pm 1", from thicknesses shown on Drawings.
 - 2. Surface Smoothness:
 - a. Test finished surface of base course for smoothness, using a 10 ft. straightedge applied parallel to and at right angles to centerline of roadway.
 - b. Check surfaced areas at intervals directed by Engineer.
 - c. Surfaces will not be acceptable if exceeding 3/8" in 10 ft.
- B. Testing Laboratory:
 - Contractor will provide material testing for quality control during crushing and laying operations.

C. Sieve Analysis:

1. The grading of the combined aggregates shall be within the designated limits, and shall not vary from the high percentage passing area on one sieve to the low percentage passing on an adjacent sieve. The material shall be uniformly graded from coarse to fine as indicated by a plot on a standard power gradation chart, and reviewed by the Engineer.

1.04 SUBMITTALS

A. Certificates:

- 1. Provide certificates.
- 2. Certify that materials comply with specification requirements.
- 3. Signed by material manufacturer and Contractor.

B. Samples:

. Provide samples of materials to laboratory for testing prior to placing.

PART 2 PRODUCTS

2.01 MATERIALS

A. Aggregate for Base Course:

- 1. Coarse Aggregate: Sound, angular crushed stone, crushed or screened gravel.
- 2. Fine Aggregate: Well graded natural sand or stone screenings.
- 3. The several aggregate fractions shall be sized, uniformly graded, and combined in such proportions that the resulting composite mixture meets the following requirements when tested in accordance with AASHTO T 11 and T 27:

Sieve Size	Percentage of Weight Passing
1"	100
3/4"	80-100
No. 4	30-60
No. 10	20-45
No. 200	3-10

- 4. Resistance to Abrasion: Wear of 50% or less as determined by AASHTO T 96.
- 5. Soundness (coarse aggregate): Loss of 18% or less as determined by AASHTO T 104 (Magnesium Sulfate).
- 6. Liquid Limit: 25 or less as determined by AASHTO T 89.
- 7. Fractured faces: 50% or more of all plus No. 4 sieve material shall have 2 fractured faces (minimum).
- 8. Plasticity Index: 6 or less as determined by AASHTO T 90.

PART 3 EXECUTION

3.01 PREPARATION

A. Proof Roll:

- 1. Proof roll prepared subgrade surface using heavy, rubber-tired rollers.
- 2. Check for unstable areas.
- 3. Check for areas requiring additional compaction.

B. Loose and Foreign Material:

- 1. Remove loose and foreign material from compacted subgrade surface immediately before placing aggregate base course.
- 2. Use power brooms or blowers, and hand brooming as required.
- 3. Do not displace subgrade material.

C. Moisture Content:

1. Do not place aggregate base course when the moisture content of the top 6 inches of subgrade exceeds +2% optimum as determined by ASTM D1557.

3.02 MIXING AND PLACING

- A. Provide a homogeneous mixture of unsegregated and uniformly dispersed materials as placed in position for compacting.
- B. Plant and equipment shall be adequate in all respects.
- C. Mix and place base course materials by the following method:
 - 1. Stationary Plant Method:
 - a. Mix base course material and water in an approved mixer.
 - b. Add water during mixing operation in the amount necessary to provide the optimum moisture content for placement ± 2 percentage points.
 - c. After mixing, transport the base course material to the job site while it contains the proper moisture content.
 - d. Without delay, spread the base course material uniformly on the subgrade so that when compacted, it will conform to the finish thickness.

3.03 SHAPING AND COMPACTING

A. Compacted Thickness:

- 1. Maximum compacted thickness of any one layer: 6 inches.
- B. Compact to not less than 96% of maximum dry density as determined by ASTM D1557.
- C. Start rolling at the edge and proceed toward the center, except on superelevated curves, roll from the lower to the upper side.

D. Continue blading, wetting, and rolling until a dense, smooth, unyielding, and well-bonded base course is obtained for the full width and depth.

3.04 FIELD QUALITY CONTROL

- A. Field control of density of in-place material will be determined in accordance with Nuclear Method, ASTM D6938.
- B. Field control of moisture content of in-place material will be determined in accordance with Nuclear Method, ASTM D6938.
- C. Sample and Test:
 - 1. Each layer of base course.
 - 2. At intervals not to exceed 200 linear feet.
 - 3. Sampled after base course has been mixed, laid down and initial compaction operation has begun.
 - 4. At locations directed by the Engineer.

3.05 SCHEDULE

A. New Mexico Department of Transportation crushed aggregate base course gradation I or II may be used for this project in place of the gradation and material properties specified in Part 2. Gradation and material properties must be current and certified by the New Mexico Department of Transportation. Thickness shall be as indicated on the Drawings.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	<u>Pay Unit</u>
1.25, 5.02	Aggregate Base Course	Lump Sum

END OF SECTION

SECTION 32 12 02

ASPHALTIC CONCRETE SURFACE COURSE

PART 1 GENERAL

1.01 WORK INCLUDED

A. Placement and compaction of asphaltic concrete to the dimensions, thicknesses, and grades shown on the Drawings.

1.02 RELATED WORK

- A. Section 01 33 23 Shop Drawings, Product Data, and Samples
- B. Section 01 45 23 Testing Laboratory Services
- C. Section 31 22 00 Grading
- D. Section 31 23 13 Subgrade Preparation
- E. Section 32 11 23 Aggregate Base Courses

1.03 REFERENCES

A. New Mexico Department of Transportation Standard Specifications for Highway and Bridge Construction.

1.04 SUBMITTALS

A. Certificates:

- 1. Provide certificates of compliance.
- 2. Certify that materials comply with specification requirements.
- 3. Signed by asphalt concrete producer and Contractor.

B. Samples:

1. If required by the Engineer, provide samples of materials to laboratory for testing.

1.05 QUALITY ASSURANCE

- A. Qualifications of Asphalt Concrete Producer:
 - 1. Use only materials which are furnished by a bulk asphalt concrete producer regularly engaged in production of hot-mix, hot-laid asphalt concrete.

B. Testing Laboratory:

1. Contractor shall provide material testing for quality control during all phases of paving operations.

C. Allowable Tolerances:

- 1. Thickness: Thicknesses shall be as shown on Drawings.
- 2. Surface Smoothness:
 - a. Test finished surface of each bituminous pavement structure course for smoothness, using a 10-foot straightedge applied parallel to and at right angles to centerline of paved areas.
 - b. Check surfaced areas to intervals directed by Engineer.
 - c. Surfaces will not be acceptable if exceeding the following:
 - The asphalt concrete exceeds 3/16 inch using a 10-foot straightedge.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials:

1. Bituminous materials shall be loaded and shipped in sealed, insulated tank cars or tank trucks, completely free of all foreign matter. Bituminous materials contaminated by any foreign matter will be rejected.

1.07 JOB CONDITIONS

A. Weather Limitations:

- 1. Apply bituminous tack and prime coats only when the ambient temperature is 40°F. and when the temperature has not been below 35°F. for 12 hours immediately prior to application.
- 2. Do not apply tack and prime coat when the subgrade surface is wet or contains an excess of moisture which would prevent uniform distribution and the required penetration.
- 3. Construct each bituminous pavement structure course only when an atmospheric temperature is above 40°F. and rising, when the underlying base is dry, and when weather is not rainy, foggy, or stormy.
- B. Grade Control: Establish and maintain the required lines and grades, including crown and cross-slope, for each course during construction operations.

PART 2 PRODUCTS

2.01 MATERIALS

A. Asphaltic Concrete: Job mix formula shall conform to NMDOT Standard Specifications for Highway and Bridge Construction, Section 417 – Miscellaneous Paving, Type SP-III (Superpave III).

PART 3 EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

A. Surface Preparation, Placement, Acceptance, and Quality Control: Conform to NMDOT Standard Specifications for Highway and Bridge Construction, Section 417 – Miscellaneous Paving, Type SP-III.

3.02 CLEANING AND PROTECTION

A. Cleaning: After completion of paving operations, clean surfaces of excess or spilled bituminous materials to the satisfaction of Engineer.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
4.01	Asphalt Tank Base	Lump Sum

END OF SECTION

SECTION 33 05 07.14

UTILITY HORIZONTAL DIRECTIONAL DRILLING USING HDPE

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Furnish all labor, equipment, tools, and materials required to perform horizontal directional drilling (HDD) in a good, workmanlike manner, as indicated on the Drawings, and pull-back installation of a high density polyethylene (HDPE) potable water line as indicated on the Drawings.
- B. Coordinate with the trade that is performing the work specified under
 - 1. Section 33 12 01 Water Systems.
 - 2. Section 40 27 00 Process Pipe Systems.
- C. HDD operations include, but are not necessarily limited to, site preparation, equipment setup, pilot bore drilling, reaming and pulling product pipe through the reamed bore, and site restoration.

1.02 RELATED WORK

- A. Section 31 23 33 Trenching and Backfilling.
- B. Section 33 12 01 Water Systems.
- C. Section 40 27 00 Process Pipe Systems.

1.03 QUALITY ASSURANCE

- A. Subcontractor Experience: HDD work shall be performed by an experienced subcontractor specialized in HDD work.
 - 1. Key Personnel shall have at least four (4) years of experience with HDD projects equal in size and scope to this project.
 - 2. Equipment operators shall have performed at least three (3) directional bores of at least 12-inch pipe diameter, 1,000-foot bore length, and in similar soil conditions.
- B. Operator Training: Equipment operators shall have been trained by the equipment manufacturer. Submit documentation of training to Owner.
- C. Industry Standards: All HDD work shall conform to "Guidelines For A Successful Directional Crossing Bid Package", latest edition, published by the Directional Crossing Contractor's Association (DCCA).
- D. Product Pipe Handling: Store, handle, and install product pipe and appurtenances in accordance with pipe manufacturer's recommendations and guidelines.

Check roundness of pipe prior to accepting delivery. Do not exceed recommended pull force. Replace any portion of pipe that has been overstressed beyond the manufacturer's recommendations.

- E. Contractor Support: Provide technical support, tool suppliers and required support systems to the HDD subcontractor.
- F. Regulations: Perform all HDD work in accordance with all applicable local, state, and federal regulations.

1.04 SUBMITTALS

- A. Section 01 33 23 Shop Drawings, Product Data, and Samples:
 - 1. Prior to commencing work:
 - a. Qualifications of personnel proposed to perform HDD work, including year of experience and summary of similar past projects.
 - b. Certificates of inspection of the proposed drill pipe by the drill pipe manufacturer certifying the proposed drill pipe meets the grade and strength required for the drilling conditions indicated in the Contract Documents.
 - c. Drilling Work Plan which defines drilling procedures for each crossing, including entry and exit points, drill path and depths, drilling and reaming diameters, materials proposed to be used in the drilling operation, proposed laydown areas, pipe staging areas during pullback, site access paths, and drill pit size and locations.
 - d. Proposed schedule for performing HDD for all crossings.
 - e. Environmental Protection Plan which defines methods to contain and clean up drilling mud, cuttings, and other fluids.
 - f. Technical criteria for the compatibility of the proposed drilling mud and additive materials with the native soils and proposed source water.
 - 2. At completion of work:
 - a. As-built survey documentation showing horizontal and vertical location of installed piping based on drill head locator readings, and locations of any abandoned-in-place bores or other items.
 - b. Log of data from the locator/tracking system, including:
 - 1) Location and Depth Recorded Every Ten (10) feet.
 - 2) Position.
 - 3) Roll Angle.
 - 4) Tilt Angle.
 - 5) Temperature of Data Transmitter.
 - 6) Remaining Battery Life.
 - 7) Maximum Pull-Back Force.

PART 2 PRODUCTS

2.01 GENERAL

- A. Directional drilling equipment shall be of adequate commercial size and satisfactory working condition for safe operation.
- B. Control direction of drilling with electronic tool directional system with wireline guidance.
- C. Completely seal around entire installed product pipe with bentonite clay slurry.
- D. Provide all equipment and materials to complete the work and protect the site.
 - 1. Provide generator and portable lights to continue the work without interruption if the operation extends beyond daylight hours.
 - 2. Provide a standby vacuum truck of adequate size collect and hold drilling fluid if it is spilled or leaks to the ground surface.
- E. Transition couplings between HDPE and ductile iron pipe shall consist of HDPE flanged ends butt fused onto plain HDPE end or restrained mechanical joint adapter. HDPE end shall match pressure rating and dimension ratio of host HDPE pipe.

2.02 MATERIALS AND EQUIPMENT

- A. Directional Drilling Equipment:
 - 1. Drill Head: Employ fluid cutting technique.
 - 2. Drill Machine: Maxi-HDD size capable of installing 14-inch HDPE at a drill distance as shown on Drawings.
 - 3. Pull-Back Monitoring: Capable of measuring and recording pull-back force. **Contractor Note:** the safe pull-back load on HDPE is time dependent. Do not exceed safe load recommended by pipe manufacturer.
 - 4. Hydraulic Power System: Leak-free.
 - 5. Machine Setup: Anchor drilling machine to the ground to withstand the reaction forces required to complete the HDD installation.
- B. Drill Pipe:
 - 1. Steel Grade: API steel drill pipe, range 2, premium class or higher, Grade S-135.
 - 2. Diameter and Wall Thickness: Sufficient for torque, longitudinal loads, fluid capacities, and minimum radius of curvature required for the work.
- C. HDPE Product Pipe: Refer to Section 33 12 01 Water Systems.
- D. Bentonite Drilling Mud:
 - 1. All drilling fluids shall be adequate for the soil and groundwater conditions on this project, as determined by the HDD subcontractor.
 - 2. Totally inert and pose no environmental risk.
 - 3. Disposal: Properly dispose of all drilling fluids off-site in accordance with all local, state and federal regulations.

E. Guidance System:

1. Capable of continuously and accurately tracking pilot-hole drill head location during the pilot bore in the expected underground environment and at the depths indicated on the Drawings.

F. Accessories and Miscellaneous Items:

- 1. Tracer Wires: Attach minimum of three (3) 10-gauge solid insulated copper wires at different locations around the product pipe perimeter prior to installation. Furnish and install tracer wire in accordance with the Tracer Wire System specified in Section 31 23 33 Trenching and Backfilling.
- 2. Miscellaneous Items: Furnish and install all items for a complete and operable system, whether or not specified herein or shown on the Drawings.
- G. Quality Control: Calibrate drill rig and guidance system to verify correct depth of drill prior to HDD installation.

H. Coordination:

- 1. Submit specified items that are reviewed and accepted by the Engineer and Owner prior to commencing HDD work.
- 2. Notify Owner a minimum of three (3) work days in advance of starting HDD work.
- 3. Do not start drilling operations until an Owner's representative is on site.
- 4. Owner's and Engineer's actions do not relieve Contractor of responsibility of successfully completing HDD work in full conformance with the Contract Documents.

PART 3 EXECUTION

3.01 PREPARATION

A. Site Conditions:

- 1. Circulate drilling fluids and cuttings in a closed loop system to minimize the volume of waste fluids generated and needing to be disposed.
- 2. Provide equipment and procedures to efficiently separate cuttings from recirculated drilling mud.
- 3. Provide 12-inch high containment berms around entry and exit points.
- 4. Construct mud pits with waterproof liners.
- 5. Provide stand-by equipment and materials at the HDD site to contain, collect, and clean up all spills of drilling fluids, lubricants and fuels. Provide such items at no additional cost the Owner. Clean up all spills immediately to the satisfaction of the Owner.
- 6. Properly dispose of all drilling mud and cuttings pit off-site in accordance with all local, state and federal regulations when decommissioning a mud pit.

3.02 INSTALLATION

A. Pilot Hole:

- 1. Use an appropriately sized drill pipe and head.
- 2. Follow the pipe centerline profile indicated on the Drawings within \pm 12 inches with a smoothly curved pilot hole. Do not exceed the radius of curvature indicated on the Drawings.
- 3. Entry angle shall not exceed 15 degrees. Exit angle shall be 6 to 12 degrees to facilitate the pullback operation.
- 4. Continuously monitor location of the pilot hole drill head.
- 5. Compute x, y, and z position relative to ground surface of the pilot hole drill head every 30 feet.
- 6. Document deviations of the recorded position from the required position and promptly notify Owner or Engineer in the event that obstructions are encountered that preclude following the intended drill path.
- 7. If the pilot hole deviated more than 2% of depth over a length of 100 feet, Owner may direct Contractor to pull back and re-drill.
- 8. At no point in the drilled profile shall the radius of curvature be less than 150 times the outside diameter of the HDPE product pipe.
- 9. When requested, Contractor shall submit to the Engineer the data generated by guidance system in a form suitable for independent calculation of the pilot hole profile.
- 10. The actual exit point shall fall within a planned exit pit which shall be a rectangle measuring 20 feet wide by 100 feet long.

B. Reaming:

- 1. Do not begin reaming operation until receive written permission from the Owner.
- 2. Ream a borehole diameter a minimum of 25% greater than the outside diameter of the HDPE product pipe to accommodate the pull-back operation and removal of cuttings with minimum displacement of soil.
- 3. Select the type of reamer head based on the soil conditions encountered in drilling the pilot hole.

C. Pipe Pull-Back Operation:

- 1. Assemble and join HDPE product pipe in a continuous string on ground positioned for the pull-back operation.
- 2. Use non-abrasive rollers and side-booms or cranes to support the bottom quarter points of the pipe approximately every 20 feet to assist free movement of pipe during pull-back.
- 3. Install barrel reamer and swivel on pulling face of the product pipe.
- 4. Close the lead end of the pipe during the pull-back operation.
- 5. Pull back pipe in one, continuous operation to its final position, without interruption except to remove drill pipe.
- 6. Pull pipe nose out of hole 3% to 4% longer than the total length of the pull.
- 7. Observe pipe manufacturer's recommended relaxation time period before making connections.
- 8. Immediately correct situations that may damage the pipe and repair any damage prior to pulling.

- 9. Continuously monitor the pulling force. Do not exceed the safe load recommended by the pipe manufacturer. Install a break-away face on the pull head to limit the pull force to a safe load.
- 10. Remove and repair all buckled sections of pipe at no additional cost to the Owner.
- 11. If pulling stresses deform the pipe by more than 10%, Owner may direct Contractor to abandon the bore and re-drill.

D. Pipe Handling:

- 1. Refer to Section 33 12 01 Water Systems or Section 40 27 00 Process Pipe Systems.
- 2. Handle pipe in a manner that does not over-stress or buckle the pipe.
- 3. Use straps or slings to handle the pipe. Do not use chains or cables.
- 4. Do not allow pipe to rest on rocks or hard surfaces.

E. Handling Drilling Fluids and Cuttings:

- 1. Properly contain materials at the entry and exit points during HDD operations.
- 2. Do not allow materials to spill on the ground or discharge into arroyos.
- 3. Properly dispose of materials off site at a suitable legal disposal site. Obtain any necessary permits for disposal.

3.03 COMPLETION AND CLEANUP

- A. Do not backfill entry and exit pits until the installed pipeline has successfully passed the hydrostatic test specified in Section 33 12 01 Water Systems or Section 40 27 00 Process Pipe Systems.
- B. Decommission mud pits, backfill all pits, clean up all foreign material, and finish grade ground surface to original contours.

PART 4 PAYMENT

4.01 PAYMENT NOTES

- A. Payment for horizontal directional drilling will be made on the basis of linear feet of HDPE pipe installed applied to the unit price for the associated crossing submitted in the Bid Form.
- B. Payment for tracer wire will be made under the Pipe Detection System and Pipe Marker bid item.

4.02 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
1.17, 1.18, 1.19, 1.20, 1.21, 1.22, 1.23, 1.24, 2.09, 2.10, 2.11, 3.18	Horizontal Directional Drilling	Linear Feet
1.15, 2.12	Pull Head Rental Fee	Lump Sum
1.16, 2.13	HDD Pits	Each

END OF SECTION

SECTION 33 05 23.01

JACKING AND BORING

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Boring, drilling or jacking operations for casing for water pipe, sanitary sewer pipe, storm sewer pipe, and traffic conduit in areas where trenching is not feasible.
- B. Contractor shall maintain at all times a file at the job site containing NMDOT, railroad, or other permits required to perform the work.

1.02 RELATED WORK

- A. Section 01 71 23.17 NMDOT Utility Permit Survey Requirements.
- B. Section 31 23 33 Trenching and Backfilling.
- C. Section 33 12 01 Water Systems.
- D. Section 40 27 00 Process Pipe Systems.

1.03 SUBMITTALS

A. Section 01 33 23 – Shop Drawings, Product Data, and Samples: Product data for all materials and appurtenances specified in Part 2 PRODUCTS.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Steel Casing:
 - 1. ASTM A139 Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over), Grade B, complete joint penetration groove welds, grooved ends.
 - 2. Size and thickness:

Steel Casing Diameter Nominal / I.D.	Steel Casing Nominal Wall Thickness	Nominal Ductile Iron Carrier Pipe Size
14"/13.25"	.375"	6"
16"/15.25"	.375"	8"
18"/17.25"	.375"	10"
22"/21.00"	.500"	12"
24"/23.00"	.500"	14"

Steel Casing Diameter Nominal / I.D.	Steel Casing Nominal Wall Thickness	Nominal Ductile Iron Carrier Pipe Size
26"/25.00"	.500"	16"
30"/29.00"	.500"	18"
36"/35.00	.500"	24"
42"/41.00"	.500"	30"
Or as scheduled.		

B. Carrier Pipe:

- 1. 24" and Smaller: Ductile iron pipe, push-on joints with gasket-type integral restraint (U.S. Pipe Field Lok 350® or American Ductile Iron Pipe Fast-Grip®), as Specified in Section 33 12 01 Water Systems, or Section 40 27 00 Process Pipe Systems.
- 2. 30" and Larger: Ductile iron pipe, push-on joints, with the external mechanical restraint devices, as specified in Section 33 12 01 Water Systems, or Section 40 27 00 Process Pipe Systems.
- 3. Extend carrier pipe and restrained joints 1'-0" beyond each end of casing.

2.02 APPURTENANCES

A. Casing Spacer:

- 1. Shell and Risers: T-304 passivated stainless steel or fusion bonded thermoplastic powder coated steel, 14 gage minimum, flanges ribbed for strength, two-piece bolt-on shell, 8" wide minimum, 3 bolts per flange.
- 2. Liner: PVC or EPDM, 0.090" thick, 85-90 durometer "A", overlap edges, ribbed.
- 3. Runners: UHMW polymer or glass filled polymer, mechanically attached to risers or shell.
- 4. Fasteners: T-304 stainless steel, 5/16"
- 5. Acceptable Manufacturers:
 - a. RACI.
 - b. Engineer reviewed equivalent.

B. Casing End Seals:

- 1. Construction: Rubber seal with steel bands.
- 2. Seal: Virgin SBR Rubber.
- 3. Bands: T-304 stainless steel.
- 4. Wrap-around seam sealed with bonding cement or mastic.
- 5. Acceptable Manufacturers:
 - a. Advance Products and System, Inc., Model AC, AW, or AZ.
 - b. Engineer reviewed equivalent.

PART 3 EXECUTION

3.01 INSTALLATION

A. Water, Sewer, and Storm Drain:

- 1. Completed to the alignment and grade shown on the Construction Drawings.
- 2. Earth and/or rock augers shall not exceed the O.D. of the steel casing by more than 1/4 inch.
- 3. Use equipment for boring and insertion of steel casing capable of simultaneous operation.
- 4. Feed rate of augers and hydraulic pushing of the casing shall be the same.
- 5. Avoid loss of earth.
- 6. Excavated material shall be removed from the casing as excavation progresses and no accumulation of such material within the casing shall be permitted.
- 7. Fill voids around the outside face of the casing by grouting when operation is complete.
- 8. Grouting equipment and material shall be on the job site before boring operations are started in order that grouting around the bored casing may be started immediately after the boring operations have finished.
- 9. Carrier pipe shall be skidded through the casing on casing spacers in centered positioning.
- 10. Place casing spacers within 2 feet from each end of the casing. Place three spacers on first pipe section, then two every pipe section thereafter, at each joint, and at the center of each carrier pipe section.
- 11. Modify casing spacer placement to meet spacing manufacturer and pipe manufacturer recommendations.
- 12. Contractor to locate all underground and overhead utilities before beginning boring operations and shall repair any damage to utilities resulting thereto.
- 13. Only workmen experienced in the boring operation shall perform the work.

B. Electrical Conduit:

- 1. Use approved jacking or drilling methods.
- 2. Non-metallic conduit shall not be installed by jacking.
- 3. Non-metallic conduit shall be installed by drilling if a hole larger than the conduit is pre-drilled and the conduit is hand-installed.
- 4. Jacking or drilling pits shall be at least 2 feet from the edge of any type of any pavement, measured from the side of the pit nearest to the pavement.

C. Backfilling Entry and Exit Pits:

1. Conform to the requirements of Section 31 23 33 – Trenching and Backfilling.

3.02 FIELD QUALITY CONTROL

A. Tolerances:

- 1. Installation to be sound, tight, and true to line and grade.
- 2. Allowable tolerance as to grade and alignment of the installed casing shall not exceed 1/10 of a foot per hundred feet of casing length.

3.03 SCHEDULE

A. As shown on Drawings.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit	
3.19, 3.20	Jacking and Boring	Linear Feet	
3.21, 3.22	Casing Only	Linear Feet	

END OF SECTION

SECTION 33 05 61.01

UTILITY MANHOLES, FRAMES, AND COVERS

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Round utility and piping access manholes complete with frames, covers, and other necessary appurtenances.
- B. Manhole valve vaults.

1.02 RELATED WORK

- A. Section 03 30 00 Cast-in-Place Concrete
- B. Section 05 50 00 Metal Fabrications
- C. Section 33 05 63.01 Precast Concrete Utility Structures

1.03 REFERENCES

- A. American Society for Testing and Materials International (ASTM):
 - 1. ASTM A48 Gray Iron Castings
 - 2. ASTM C478 Precast Reinforced Concrete Manhole Sections
 - 3. ASTM C990 Joints for Concrete Pipe, Manholes, and Precast Box Sections. Using Preformed Flexible Joint Sealants

1.04 SUBMITTALS

- A. Section 01 33 23 Shop Drawings, Product Data, and Samples:
 - 1. Product data.
 - 2. Materials of construction.
 - 3. Dimensioned Drawings.
 - 4. Weights.
 - 5. Conformance to referenced standards.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Concrete: Section 03 30 00 Cast-in-Place Concrete
- B. Precast Sections:
 - 1. ASTM C478.
 - 2. Minimum wall thickness: 4".

C. Gaskets:

- 1. Description: Preformed flexible joint sealant.
- 2. Material: Butyl-rubber and/or refined hydrocarbons, resins, and plasticizing compounds.
- 3. Conformance: ASTM C990.

D. Access Covers:

1. As indicated on the Drawings and specified or referenced herein.

E. Standard Ring and Cover:

- 1. Material: Gray cast iron, ASTM A48 class 35 B.
- 2. Duty: Heavy duty, rated for H-20 truck traffic.
- 3. Clear Opening: 22" minimum, or as indicated on Drawings.
- 4. Vent: Vent opening.
- 5. Pickhole: Open.
- 6. Ring Flange: Bottom flange for built-up type installation, top flange where slab style installation is shown on Drawings.
- 7. Combined Ring and Cover Weight: 260 lb. minimum.
- 8. Cover Pattern: Word "WATER" cast into center of cover.
- 9. Seating: Covers to seat at all points on ring. Grind bearing surfaces to prevent rocking.

F. Embedded Aluminum Access Hatches:

- 1. Aluminum construction in conformance with Section 05 50 00 Metal Fabrications.
- 2. Built-in neoprene gaskets.
- 3. Spring-assisted, auto-locking stainless steel hold open arms.
- 4. Minimum clear opening: As shown on Drawings.
- 5. Frame and cover to be non-traffic rated.
- 6. Installation as recommended by the manufacturer.

PART 3 EXECUTION

3.01 FABRICATION

A. Manhole Section:

- 1. Precast
- 2. Minimum inside diameter: 48", or as indicated on Drawings or scheduled herein.
- 3. Eccentric cones for manholes 6' deep and greater.
- 4. Flat, concrete manhole covers for manholes less than 6' deep.
- 5. Cones: Same or greater reinforcement and wall thickness as manhole section.
- 6. Joints: Keylock type with preformed gaskets or mastic seal.
- 7. Manhole clear opening: 22" minimum, or as indicated on Drawings.

B. Manhole Height Adjustment:

- 1. Use precast grade adjustment rings.
- 2. 6" maximum adjustment height above cone to bottom of ring and cover if manholes require steps.

3. 12" maximum adjustment height above cone to bottom of ring and cover if manholes do not require steps.

C. Placing Precast Manhole Sections:

- 1. Clean ends of sections and apply cold bituminous mastic to both sections, or install preformed gasket.
- 2. Completed manholes shall be rigid.

D. Preformed Gaskets:

- 1. Manhole sections with chipped or cracked joints shall be rejected.
- 2. Thoroughly clean section joints.
- 3. Install gasket in conformance with manufacturer's recommendations.
- 4. Only use primer furnished by gasket manufacturer.

E. Interior Manhole Finish - Precast Section:

- 1. Remove excess mastic flush with precast sections.
- 2. Mortar in joint openings flush with precast sections.
- 3. Fill in any chipped areas.

F. Manhole Rings and Covers:

- 1. Place rings in bed of mortar on top of manholes.
- 2. Ensure no infiltration will enter manhole at this location.
- 3. Carry mortar over flange of ring.
- 4. Ring setting:
 - a. Top to be flush with all surfaces subject to foot and vehicular traffic.
 - b. Top to be 4 inches above surfaces in open, untravelled areas or as shown on Drawings.

G. Embedded Aluminum Access Hatches:

1. Hatches and other appurtenances cast into slab-style cover at precasting factory.

3.02 FIELD TESTING

A. Infiltration Testing:

- 1. No visible running or dripping water.
- 2. Repair all manholes that do not meet infiltration test.

3.02 SCHEDULE

A. As shown on Drawings.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	<u>Pay Item</u>	Pay Unit	
1.13, 2.08, 3.15	Utility Vaults for Air Valve Station	Each	
4.03, 5.04	Utility Valve Vaults	Lump Sum	

END OF SECTION

SECTION 33 05 63.01

PRECAST CONCRETE UTILITY STRUCTURES

PART 1 GENERAL

1.01 WORK INCLUDED

A. Furnish and install buried rectangular precast concrete utility vaults either monolithic or sectional, as shown on the Drawings and as scheduled herein.

1.02 WORK EXCLUDED

A. Manholes and other precast concrete structures not explicitly specified herein.

1.03 RELATED WORK

- A. Section 03 30 00 Cast-in-Place Concrete.
- B. Section 05 50 00 Metal Fabrications.
- C. Section 09 97 01 Industrial Coatings.
- D. Section 33 05 61.01 Utility Manholes, Frames, and Covers

1.04 REFERENCES

- A. American Society for Testing and Materials International (ASTM):
 - 1. ASTM A48 Gray Iron Castings.
 - 2. ASTM C990 Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
 - 3. ASTM C858 Underground Precast Concrete Utility Structures.

1.05 SUBMITTALS

- A. Section 01 33 23 Shop Drawings, Product Data, and Samples:
 - 1. Product data.
 - 2. Plans and/or elevations locating and defining all materials furnished by manufacturer.
 - 3. Conformance to referenced standards.
 - 4. Dimensions, finishes, and weights.
 - 5. Rated design loads, vertical and lateral.
 - 6. Sections and details to indicate quantities and positions of reinforcing steel, anchors, inserts, etc.
 - 7. Description of all loose, cast-in and field hardware.
 - 8. Lifting and erection inserts.
 - 9. Method of transportation and general job site requirements.

1.06 PRODUCT DESIGN CRITERIA

- A. General: Design shall be in accordance with the applicable requirements of ASTM C858.
- B. Design Load Schedule:
 - 1. Groundwater table at top of ground: See Geotechnical Report.
 - 2. Snow Load: 50 psf.
 - 3. Surface Live Load: 300 psf.

1.07 QUALITY ASSURANCE

A. Acceptable Manufacturers: Companies specializing in providing precast hydraulic structures and services normally associated with the industry for at least 5 years. When requested by the Engineer, submit written evidence to show experience, qualifications and adequacy of manufacturing capabilities for performance of Contract requirements.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Concrete:
 - 1. Shall conform to the requirements indicated and/or referenced in ASTM C858.
- B. Precast Sections:
 - 1. ASTM C858.
 - 2. Minimum wall thickness: As scheduled or as shown on Drawings.
- C. Gaskets:
 - 1. Preformed flexible joint sealant.
 - 2. Material: Butyl-rubber and/or refined hydrocarbons, resins, and plasticizing compounds conforming to ASTM C990.
- D. Castings:
 - 1. Material: Gray cast iron, ASTM A48 Class 35B.
- E. Access Covers: As indicated on the Drawings and specified or referenced herein.

PART 3 EXECUTION

3.01 FABRICATION

- A. Structural Sections:
 - 1. Precast.
 - 2. Covers: Flat, concrete covers.
 - 3. Access openings: 22" minimum clear opening.
 - 4. Pipe penetrations:
 - a. As indicated on the Drawings.
 - b. Sealed with mechanical seals (watertight rubber links).

- B. Embedded Aluminum Access Hatches:
 - 1. Aluminum construction in conformance with Section 05 50 00 Metal Fabrications.
 - 2. Built-in neoprene gaskets.
 - 3. Spring-assisted, auto-locking stainless steel hold open arms.
 - 4. Minimum clear opening: As shown on Drawings.
 - 5. Frame and cover to be non-traffic rated.
 - 6. Installation as recommended by the manufacturer.

3.02 ERECTION

- A. Installation of precast concrete shall be performed by the manufacturer or an approved erector. Members shall be lifted by means of suitable lifting devices at points provided by the manufacturer. Temporary shoring and bracing, if necessary, shall comply with manufacturer's recommendations.
- B. Members shall be properly aligned and leveled as required by the Shop Drawings.
- C. Placing Precast Sections:
 - 1. Clean ends of sections and apply cold bituminous mastic to both sections, or install preformed gasket.
 - 2. Completed structures shall be rigid.
- D. Preformed Gaskets:
 - 1. Structure sections with chipped or cracked joints will be rejected.
 - 2. Thoroughly clean section joints.
 - 3. Install gasket in conformance with manufacturer's recommendations.
 - 4. Only use primer furnished by gasket manufacturer.
- E. Interior Structure Finish Precast Sections:
 - 1. Remove excess mastic flush with precast sections.
 - 2. Fill in any chipped areas with grout.
 - 3. Fill in all lifting hook recesses with grout.
- F. Exterior Structure Finish Precast Sections:
 - 1. Cut any exposed steel lifting hooks to 1/4 inch below surface of precast section and cover exposed steel with grout. Stainless hooks may remain in place unless they create a trip hazard.
- G. Surface-Mounted Cast-Iron Access Frames and Covers:
 - 1. Place frames on top of structure with mastic seal.
 - 2. Place mortar over flange of frame.

- 3. Ensure no infiltration will enter structure at this location.
- 4. Cover to be 4 inches above surface.
- 5. Frame and cover to be non-traffic rated.
- 6. Vented covers.

3.03 FIELD TESTING

- A. Infiltration Testing:
 - 1. No visible running or dripping water.
 - 2. Repair all structures that do not meet infiltration testing.

3.04 SCHEDULE

A. PRV No. 1 Vault, Line #3.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	<u>Pay Unit</u>	
3.23	PRV Vault	Lump Sum	

END OF SECTION

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SECTION 33 11 01

PIPE EXPANSION JOINTS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Flexible pipe expansion joints for pump suction and discharge and other scheduled locations.

1.02 SUBMITTALS

- A. Product Data: Section 01 33 23 Shop Drawings, Product Data, and Samples.
 - 1. Product data.
 - 2. Materials of construction.
 - 3. Dimensions.
 - 4. Rated pressure and temperature.

1.03 SERVICE CONDITIONS

A. As scheduled

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Manufacturers:
 - 1. General Rubber Corporation, for all applications except potable water.
 - 2. Proco Products, Inc.
 - 3. Or Engineer reviewed equivalent.

2.02 POTABLE WATER SERVICE

A. On potable water applications, the elastomer in contact with potable water shall be NSF/ANSI 61 certified.

PART 3 EXECUTION

3.01 INSTALLATION

- A. As indicated on Drawings.
- B. Pipe expansion joints on pump discharge lines or on pressure lines requiring restraint: furnish limit/control rods to limit joint movement, unless indicated otherwise. Furnish the number of rods recommended by the manufacturer to resist the design surge or test pressure in the pipe.

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- C. Do not to put any stress or strain on adjacent equipment or piping.
- D. Not used to correct misalignment of piping.

3.02 SCHEDULE

- A. Sized as indicated on Drawings.
- B. Limit/control rods on pump discharge applications.
- C. Expansion Joints for Potable Water Service:
 - 1. Elastomer certified by manufacturer to be NSF/ANSI 61 certified.
 - 2. Cover Elastomer: EPDM.
 - 3. Tube Elastomer: EPDM.
 - 4. Outdoor Applications: UV resistant coating on cover equivalent to CSM (chlorosulfonated polyethylene).
 - 5. Body Style: Single super wide flowing arch design.
 - 6. Ends: Flanged ends with retaining ring, ANSI 150 lb. pattern.
 - 7. Rated Maximum Working Pressure:
 - a. 200 psi for 2" to 4".
 - b. 190 psi for 5" to 12".
 - c. 130 psi for 14".
 - d. 115 psi for 16" to 20".
 - e. 110 psi for 22" to24".
 - f. 90 psi for 26" to 30".
 - 8. Maximum System Surge or Test Pressure for Applications Needing Limit/Control Rods: On pressurized piping.
 - 9. Rated Maximum Operating Temperature: 250°F.
 - 10. Manufacturer: Proco Products Series 271, or Engineer reviewed equivalent.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	<u>Pay Item</u>	<u>Pay Unit</u>
5.01	Pipe Expansion Joints	Lump Sum

END OF SECTION

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SECTION 33 12 01

WATER SYSTEMS

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Pipes, Materials, Valves, and Appurtenances for buried potable water and non-potable water service or uses as scheduled.
- B. Installation.

1.02 RELATED WORK

- A. Section 31 23 33 Trenching and Backfilling
- B. Section 33 05 23.01 Jacking and Boring
- C. Section 33 05 07.14 Utility Horizontal Directional Drilling Using HDPE
- D. Section 33 13 13 Disinfection of Domestic Water Systems

1.03 REFERENCES

- A. American Society for Testing and Materials International (ASTM):
 - 1. ASTM A153 Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 2. ASTM A307 Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength.
 - 3. ASTM A536 Ductile Iron Castings.
 - 4. ASTM D523 Test Method for Specular Gloss.
 - 5. ASTM D1248 Polyethylene Plastics Extrusion Materials for Wire and Cable.
 - 6. ASTM D1784 Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
 - 7. ASTM D1785 Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
 - 8. ASTM D2239 Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter.
 - 9. ASTM D2241 Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
 - 10. ASTM D2464 Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
 - 11. ASTM D2466 Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
 - 12. ASTM D2467 Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
 - 13. ASTM D2564 Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
 - 14. ASTM D2672 Joints for IPS PVC Pipe Using Solvent Cement.

- 15. ASTM D2737 Polyethylene (PE) Plastic Tubing.
- 16. ASTM D3034 Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- 17. ASTM D3139 Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
- 18. ASTM D3350 Polyethylene Plastics Pipe and Fittings Materials.
- 19. ASTM E8 Test Methods for Tension Testing of Metallic Materials.
- 20. ASTM E23 Test Methods for Notched Bar Impact Testing of Metallic Materials.
- 21. ASTM F477 Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- 22. ASTM F714 Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter.
- 23. ASTM F2620 Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings.

B. American Water Works Association (AWWA):

- 1. ANSI/AWWA C104/A21.4 Cement Mortar Lining for Ductile-Iron Pipe and Fittings.
- 2. ANSI/AWWA C105/A21.5 Polyethylene Encasement for Ductile-Iron Pipe Systems.
- 3. ANSI/AWWA C110/A21.10 Ductile-Iron and Gray-Iron Fittings.
- 4. ANSI/AWWA C111/A21.11 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- 5. ANSI/AWWA C115/A21.15 Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges.
- 6. ANSI/AWWA C116/A21.16 Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fitrtings.
- 7. ANSI/AWWA C151/A21.51 Ductile-Iron Pipe, Centrifugally Cast.
- 8. ANSI/AWWA C153/A21.53 Ductile-Iron Compact Fittings.
- 9. AWWA C207 Steel Pipe Flanges for Waterworks Service, Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm).
- 10. ANSI/AWWA C213 Fusion-Bonded Epoxy Coating for the Interior of Steel Water Pipelines.
- 11. ANSI/AWWA C219 Bolted, Sleeve-Type Couplings for Plain-End Pipe.
- 12. ANSI/AWWA C228 Stainless-Steel Pipe Flange Joints for Water Service Sizes 2 In. Through 72 In. (50 mm Through 1,800 mm).
- 13. ANSI/AWWA C303 Concrete Pressure Pipe, Bar-Wrapped, Steel-Cylinder Type.
- 14. ANSI/AWWA C500 Metal-Seated Gate Valves for Water Supply Service.
- 15. ANSI/AWWA C502 Dry-Barrel Fire Hydrants.
- 16. ANSI/AWWA C504 Rubber-Seated Butterfly Valves.
- 17. ANSI/AWWA C509 Resilient-Seated Gate Valves for Water Supply Service.
- 18. ANSI/AWWA C515 Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service.
- 19. ANSI/AWWA C550 Protective Interior Coatings for Valves and Hydrants.

- 20. ANSI/AWWA C600 Installation of Ductile-Iron Mains and Their Appurtenances.
- 21. ANSI/AWWA C605 Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings.
- 22. ANSI/AWWA C700 Cold-Water Meters Displacement Type, Bronze Main Case.
- 23. ANSI/AWWA C701 Cold-Water Meters Turbine Type, for Customer Service.
- 24. ANSI/AWWA C704 Propeller-Type Meters for Waterworks Applications.
- 25. ANSI/AWWA C800 Underground Service Line Valves and Fittings.
- 26. ANSI/AWWA C900 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm), for Water Transmission and Distribution.
- 27. ANSI/AWWA C901 Polyethylene (PE) Pressure Pipe and Tubing, ³/₄ In. (19 mm) Through 3 In. (76 mm), for Water Service.
- 28. ANSI/AWWA C906 Polyethylene (PR) Pressure Pipe and Fittings, 4 In. Through 65 In. (100 mm Through 1,650 mm), for Waterworks.
- 29. AWWA Manual M23 PVC Pipe Design and Installation.
- 30. AWWA Manual M55 PE Pipe Design and Installation.
- C. National Sanitation Foundation International (NSF):
 - 1. NSF/ANSI 61 Drinking Water System Components Health Effects.
 - 2. NSF/ANSI 372 Drinking Water System Components Lead Content.

1.04 SUBMITTALS

- A. Section 01 33 23 Shop Drawings, Product Data, and Samples:
 - 1. Product data for pipe materials, including pipe size, dimensions, pressure class, and color; valves, and appurtenances.
 - 2. Non-Toxic and Lead-Free Certification: Written statement that all materials in contact with potable water or raw water supply shall be NSF/ANSI 61 compliant, and shall be lead-free, as certified by the Water Quality Association to comply with NSF/ANSI 372.
 - 3. Manufacturer's installation instructions for pipe materials.
 - 4. Layout drawings for DIP furnished with ring-type integral buried joint restraint.
- B. Section 01 78 23 Operation and Maintenance Data:
 - 1. Operation and maintenance data for valves 4 inches and larger and hydrants.

1.05 GENERAL REQUIREMENTS

- A. Pipes, fittings, and materials to be new.
- B. Use appropriate equipment and methods for unloading, reloading, hauling and laying pipe as well as proper trench excavation. Use slings with broad, well padded contact surfaces for pipe protection.

- C. All pipe of the same type shall be made by the same manufacturer. All fittings of the same type shall be made by the same manufacturer. Pipe manufacturer need not be the same as the fittings manufacturer.
- D. Provide labor, equipment, and materials for pipe field testing.

1.06 QUALITY ASSURANCE

- A. Ductile Iron Pipe and Fittings:
 - 1. Tests:
 - a. ASTM E8: Tension Testing of Metallic Materials.
 - b. ASTM E23: Impact Test.
 - 2. Marking: Cast on each pipe length.
 - a. Weight, class, nominal thickness, and casting period.
 - b. Manufacturer's name, year of production, and letters "DI" or "Ductile Iron".
- B. PVC Pipe and Fittings:
 - 1. Tests: ASTM D3034, ANSI/AWWA C900, ASTM D 1784, and ASTM D1785, as applicable.
 - 2. Marking: Indelible, in each pipe.
 - a. Nominal pipe diameter and cell classification.
 - b. Manufacturer's name or trade name, PVC, ASTM and SDR designation, AWWA pressure class, and date of production.
 - c. Service designation.
 - d. NSF-61 certified.
 - 3. Gasket rings: Marked with the manufacturer's identification, size, year of production, and classes of pipe in which they are to be used.
- C. High Density Polyethylene (HDPE):
 - 1. Tests: ASTM D2239 or ASTM D2737, ASTM F714, ANSI/AWWA C906, AWWA Manual M55, PPI Handbook of Polyethylene Pipe.
 - 2. Marking: indelible, each pipe.
 - a. Nominal pipe size and material designation.
 - b. Manufacturer's name or trade name, HDPE, ASTM and DR designation, and date of production.
 - 3. Gasket Rings: Marked with the manufacturer's identification, size, year of production, and classes of pipe in which they are to be used.
 - 4. Fusion: ASTM F 2620

PART 2 PRODUCTS

2.01 MATERIALS AND FABRICATION

- A. Ductile Iron:
 - 1. Pipe:
 - a. ANSI/AWWA C151/A21.51: ASTM A536, Grade 60-42-10.

- b. Thickness: Pressure Class 350 for pipes 12" diameter or smaller; Pressure Class 250 for pipes 14" diameter or larger unless otherwise scheduled.
- 2. Fittings: Cast from ductile iron: ANSI/AWWA C110/A21.10 full body or ANSI/AWWA C153/A21.53 short body.
- 3. Joints: ANSI/AWWA C111/A21.11:
 - a. Mechanical Joint: 350 psi working pressure.
 - b. Flange: Also ANSI/AWWA C115/A21.15 and ANSI/ASME B16.42, ductile iron; 150 lb. pattern, unless scheduled otherwise.
 - c. Bolts, Tie Bolts, and Nuts:
 - 1) Low carbon steel, ASTM A307.
 - 2) Bolts smaller than ¾-inch: With heavy hex heads for flange and T-head for MJ, and heavy hex nuts.
 - 3) Bolts ³/₄-inch and larger: With hex heads for flange and T-heads for MJ, and heavy hex nuts.
 - 4) Coating, Exposed Service: Grade B zinc coat per ASTM A153.
 - 5) Coating, Buried Service: Liquid applied fluoropolymer coating matrix consisting of lubricating compounds, UV stabilizers and coloring agents or pigments, heat cured, 0.7 to 1.0 mil total DFT.
 - d. Gaskets for mechanical joint, push-on and flanged joints:
 - 1) Conformance: ANSI/AWWA C111/A21.11.
 - 2) Material: Synthetic rubber as specified in referenced standard. Natural or reclaimed rubber not acceptable.
 - e. Lubricant: Suitable for potable water use and in conformance with ANSI/AWWA C111/A21.11.
- 4. Joint Restraint: Furnish external mechanical restraint devices, including restrained flange adaptors for exposed piping as specified herein, or integral joint restraints for buried joints if specified herein. Furnish restraint devices where scheduled or noted on Drawings, as specified in Part 2 of this Specification.
 - a. Integral Buried Joint Restraint:
 - 1) Minimum Pressure Rating: 350 psi to 18-inch, 250 psi to 24-inch, 150 psi to 30-inch.
 - 2) Gasket Type: U.S. Pipe Field Lok 350® Gasket, American Ductile Iron Pipe Fast-Grip® Gasket or Engineer reviewed equivalent.
 - 3) Ring Type: U.S. Pipe TR FLEX® Joint, American Ductile Iron Pipe Flex-Ring® Joint, American Ductile Iron Pipe Lok-Ring® Joint, or Engineer reviewed equivalent.
 - 4) For gasket-type integral restraint:
 - Pipe manufacturer shall furnish to Contractor two feeler gages capable of determining depth of gasket and presence of metal locking segments.
 - b) Contractor shall wrap bell of each restrained joint with factory furnished tape with words "Restrained Joint".

c) Pipe manufacturer shall furnish to Contractor two complete kits of extractor shims and shim holders (slotted and curved steel block used to drive the shims with a hammer) for each size of pipe used.

5. Corrosion Protection:

- a. Outside Coating (buried or submerged service):
 - 1) Pipe: Bituminous per ANSI/AWWA C151/A21.51.
 - 2) Fittings: Bituminous per ANSI/AWWA C110/A21.10 and ANSI/AWWA C153/A21.53 or fusion-bonded epoxy per ANSI/AWWA C116/A21.16.
- b. Inside Coating:
 - 1) Pipe: Cement mortar lined with asphaltic seal coat per ANSI/AWWA C104/A21.4.
 - 2) Fittings: Cement mortar lined with asphaltic seal coat per ANSI/AWWA C104/A21.4 or fusion-bonded epoxy per ANSI/AWWA C116/A21.16.
- c. Polyethylene Encasement:
 - 1) Conformance: ANSI/AWWA C105/A21.5.
 - 2) Material: ASTM D4976, Group 2.
 - 3) Configuration: Seamless tube or sheet.
 - 4) Film Requirements:
 - a) Linear Low-density Polyethylene:
 - i. Thickness: 8 mil.
 - ii. Density: 0.910 to 0.935 g/cm³.
 - iii. Tensile Strength: 3,600 psi for 8 mil, ASTM D882.
 - b) High-density, Cross-laminated Polyethylene:
 - i. Thickness: 4 mil.
 - ii. Density: 0.940 to 0.960 g/cm³.
 - iii. Tensile Strength: 6,300 psi for 4 mil, ASTM D882.
 - 5) Color: Weather-resistant black containing not less than 2 percent carbon black.
 - 6) Pipe Wrap Tape:
 - a) Material: 10 mil all weather polyvinyl film.
 - b) Durability: Resistant to moisture and corrosive soil.
 - c) Adhesion: Adheres to metal and plastic, and conforms to irregularities in substrate surfaces.
 - d) Elongation: 245%.
 - e) Tensile Strength: 30 psi.
 - f) Width: 2 inches.
 - g) Printed Identification Marking: UPC code and mil thickness.
 - h) Acceptable Manufacturer: Northtown Company, or Engineer reviewed equivalent.
 - 7) Strapping: Non-metallic, water resistant FS PPP-S-760.
 - 8) Install on buried ductile iron piping, fittings, and restraint assemblies in accordance with AWWA C105, unless scheduled otherwise.

- B. Polyvinyl Chloride (PVC):
 - 1. Water Service Condition:
 - a. Potable Water Service:
 - 1) Pipe manufactured from compounds certified by the National Sanitation Foundation (NSF).
 - 2) Color: Blue pigment.
 - b. Reclaimed Water Service:
 - 1) Color: Purple pigment.
 - 2) Marking: Continuous text, "Reclaimed Water Do Not Drink".
 - c. Non-Potable Water other than Reclaimed Water Service:
 - 1) Color: White pigment.
 - 2. Pipe and Fittings:
 - a. Pipe sizes 4 inch through 60 inch:
 - 1) ANSI/AWWA C900.
 - 2) Pressure class as scheduled.
 - a) Class 235 psi (DR 18) minimum for 12 inch and smaller if not scheduled or indicated otherwise.
 - 3) Fittings: Cast from ductile iron; ANSI/AWWA C110/A21.10, full body or ANSI/AWWA C153/A21.53, short body; mechanical joint ANSI/AWWA C111/A21.11, external mechanical restraint devices as specified herein. Encase fittings and all external restraint assemblies with polyethylene encasement per ANSI/AWWA C105, unless scheduled otherwise.
 - b. Pipe sizes 3.5 inch and smaller:
 - 1) Unless otherwise scheduled or shown on the Drawings.
 - a) ASTM D2241.
 - b) 1.5-inch and smaller: SDR 21.
 - c) 2-inch through 3.5-inch: SDR 26.
 - d) Pressure rating as scheduled; 160 psi minimum if not scheduled.
 - 2) If scheduled or shown on the Drawings:
 - a) Schedule 40 and 80 Pipe Dimensions and Workmanship: ASTM D1785.
 - b) Schedule 40 minimum unless otherwise scheduled or shown on Drawings.
 - c) Material: ASTM D1784, Class 12454-B.
 - d) Fittings:
 - i. ASTM D2466, Schedule 40.
 - ii. ASTM D2464, Schedule 80, threaded.
 - iii. ASTM D2467, Schedule 80, socket type.
 - 3. Joints:
 - a. Gasket Bell End: ASTM D3139 for plastic pressure pipes using elastomeric seals.
 - b. Gaskets: ASTM F477, elastomeric.
 - c. Solvent Cement Bell End: ASTM D2672.

- d. Solvent-Cement: ASTM D2564, NSF approved.
 - 1) Use only where specifically scheduled, shown on Drawings or reviewed by Engineer.
- 4. Joint Restraint: Furnish external mechanical restraint devices, including restrained flange adaptors, as specified herein, or integral joint restraints for buried joints if specified herein. Furnish restraint devices where scheduled, noted on Drawings, and where specified in this Specification.

C. External Mechanical Restraint Devices:

- 1. Works on principle of multiple wedging action against pipe, which increases its resistance as line pressure increases while maintaining joint flexibility. Set screw devices are not acceptable. Split non-serrated back-up rings behind bells are acceptable. Split serrated restraint rings are not acceptable, except on spigot end of bell restraint harness of C900 PVC pipe up to 12 inches. EBAA Iron Sales, Inc. or Engineer reviewed equivalent.
- 2. Gland: Ductile iron with dimensions which match standard mechanical joint bells per ANSI/AWWA C153/A21.53, ASTM A536, Grade 65-45-12.
- 3. Wedges: Heat-treated ductile iron with minimum Brinnel hardness of 370 BHN.
- 4. Wedges tightened during installation via twist-off nuts.
- 5. Devices shall be designed for the following working pressure:
 - a. 250 psi for 18" to 48" DIP, with 2:1 safety factor.
 - b. 350 psi for 3" to 16" DIP, with 2:1 safety factor.
 - c. Meets or exceeds standardized pressure rating of host PVC piping.
- 6. Devices shall be designed for the type of pipe material and pipe joint being harnessed.
- 7. An identification number shall be cast into each gland body with the following information: Date and shift of manufacture, and plant location.
- 8. All physical and chemical test results shall be made available to Engineer for review upon request by referencing the identification number.
- 9. Coating for wedges, wedge actuators, bolts, tie bolts, nuts, and related fastener and gripping components:
 - a. Surface Preparation: Cleaner wash, phosphatizing, rinse, and drying.
 - b. Coating: Liquid applied fluoropolymer-matrix consisting of lubricating compounds, UV stabilizers, and coloring agents or pigments. Heat cured. Two coats, 0.7 to 1.0 mil total DFT.
 - c. Low VOC, resin bonded and thermally cured, single film, dry lubricant, primarily formulated for use on fasteners.
 - d. Designed to prevent corrosion and facilitate make-up torque.
 - e. Provide lubricity of coating for proper dispersion of PTFE.
- 10. Coating for Cast Bodies:
 - a. Surface Preparation: Cleaner wash, phosphatizing, rinse, and drying.
 - b. Coating: Electrostatically applied TGIC polyester-based powder. Heat cured. 1.5 to 4.0 mils total DFT.

- c. Designed to prevent corrosion, impact and UV resistance.
- d. Appearance: Class 5 (orange peel) PCI smoothness standard; 75% to 85% gloss at 60 degrees per ASTM D523; pinhole free.

D. Couplings:

- 1. Use only where indicated on Drawings or reviewed by Engineer. Do not use where restrained fittings are specified.
- 2. For buried service, furnish factory-applied fusion-bonded epoxy coating in accordance with AWWA C213, and corrosion-resistant alloy bolts equivalent to Dresserloy.
- 3. Shall meet AWWA C219: Described by reference to couplings manufactured by Dresser Industries, Inc., Bradford, PA; equivalent couplings by Ford Meter Box, JCM Industries, Romac Industries, or by other manufacturers may be used:
 - a. Dresser Style 38 for exposed steel, cast iron, and ductile iron pipe, unless indicated otherwise on Drawings or scheduled.
 - b. Dresser Style 253 cast iron couplings for buried steel, cast iron, ductile iron, and asbestos cement pipe, unless indicated otherwise on Drawings.
 - c. Dresser Style 40 long couplings where long couplings are indicated.
 - d. Dresser Style 62 Type reducing couplings where reducing couplings are indicated.
 - e. Dresser Style 162 couplings for transition between different pipe materials.
 - f. Dresser Style 63 expansion coupling where expansion coupling is indicated; type as indicated on Drawings or scheduled.
 - g. Dresser Style 227 and 128 coupling with flanged adaptor where indicated on Drawings.
 - h. Dresser Style 131 dismantling joint.

E. Tapping Saddles and Service Lines:

- 1. Service Lines 3/4 inch to 3 inch:
 - a. Conformance: AWWA C901.
 - b. Resin: High density polyethylene (HDPE) PE4710 having minimum cell classification 445474C/E as rated by the Plastic Pipe Institute (PPI) and in conformance with ASTM D3350.
 - c. Wall Thickness Design:
 - 1) ASTM D2239, controlled inside diameter, SIDR-9 unless scheduled otherwise, or
 - 2) ASTM D2737, copper pipe size, SDR-9, unless scheduled otherwise,
 - 3) Contractor's option unless scheduled otherwise,
 - 4) Minimum Pressure Rating: 150 psi at 73°F.

2. Joints:

- a. Compression fittings.
- b. Compatible with heavy duty copper service fittings.
- 3. Tapping Saddles:
 - a. AWWA C900 PVC Host Pipe:
 - 1) Body Material: Bronze or brass.
 - 2) Strap Material: Type 304L stainless steel.

- 3) Style: Two strap.
- 4) Rated Working Pressure: At least 200 psig.
- 5) Outlet Seal: EPDM O-ring.
- 6) Tap Size: As indicated on Drawings.
- 7) Conformance: Applicable portions of AWWA C800.
- 8) Non-Toxic: NSF/ANSI 61 certified.
- 9) Lead Free: Certified by the Water Quality Association to comply with NSF/ANSI 372.
- 10) Acceptable Manufacturers: Mueller BR2S, Romac 202BS, Ford 202BSD, or Engineer reviewed equivalent.

b. Ductile Iron Host Pipe:

- 1) Body Material: Ductile iron, ASTM A536 with 10 to 12 mil nylon or epoxy coating.
- 2) Strap Material: Type 304L stainless steel.
- 3) Style: Two strap.
- 4) Rated Working Pressure: At least 200 psig.
- 5) Outlet Seal: EPDM O-ring.
- 6) Tap Size: As indicated on Drawings.
- 7) Conformance: Applicable portions of AWWA C800.
- 8) Non-Toxic: NSF/ANSI 61 certified.
- 9) Lead Free: Certified by the Water Quality Association to comply with NSF/ANSI 372.
- 10) Acceptable Manufacturers: Mueller DR2S, Romac 202N, Ford FCD202, or Engineer reviewed equivalent.

4. Corporation Stops:

- a. Material: Bonze or brass.
- b. Style: Ball type, suitable for use with tapping machine.
- c. Rated Working Pressure: At least 300 psig.
- d. Size: As indicated on Drawings.
- e. Conformance: AWWA C800.
- f. Threaded Connections: Compatible with tapping saddle.
- g. Non-Toxic: NSF/ANSI 61 certified.
- h. Lead Free: Certified by the Water Quality Association to comply with NSF/ANSI 372.

5. Curb Stop Valves:

- a. Material: Cast brass.
- b. Style: Ball type, full port.
- c. Rated Working Pressure: 300 psi.
- d. Size: As indicated on Drawings.
- e. Conformance: AWWA C800.
- f. Connections: Compatible with service line material.
- g. Ball: Fluorocarbon coated brass ball.
- h. Seats: EPDM molded seats with stainless steel reinforcing rings, bi-directional flow.
- i. Stem Seals: Two EPDM O-rings.
- j. Tee-Head and Stem: Solid, one piece.

- k. Tee-Head Rotation: Standard stops on body to permit quarter-turn only.
- 1. Non-Toxic: NSF/ANSI 61 certified.
- m. Lead-Free: Certified by the Water Quality Association to comply with NSF/ANSI 372.
- n. Curb Box: Cast iron box and lid with brass pentagon plug, arch style with foot piece, telescoping upper piece for grade adjustment.

F. High Density Polyethylene (HDPE) 3 inch to 54 inch:

- 1. Conformance: AWWA C906, AWWA Manual M55, PPI Handbook of Polyethylene Pipe.
- 2. Resin: High density polyethylene (HDPE) PE4710 having minimum cell classification 445474C/E as rated by the Plastic Pipe Institute (PPI) and in conformance with ASTM D3350.
- 3. Wall Thickness Design: ASTM F714, DR pipe dimension ratio based on controlled outside diameter, DIPS sizing system.
 - a. Unless scheduled otherwise, DR 11.
- 4. Joints: Thermal fusion ASTM F2620.
- 5. Connections to Other Piping and Valves: Fusion bonded HDPE Flange adapters with ductile iron back-up rings, ANSI B16.5 150 lb. flange pattern, or fusion bonded restrained MJ adapters.

2.02 APPURTENANCES

A. Fire Hydrants:

- 1. Latest revision of AWWA C502.
- 2. Mueller A-423 Super Centurion 250, Kennedy Guardian, or Engineer reviewed equivalent.
- 3. 1-1/2-inch Pentagon Bronze Operating Nut equipped with elastomer weather seal between the top casting and the operating nut.
- 4. Sealed oil reservoir will incorporate a system of forced lubrication of the thrust collar area each time the hydrant is operated.
- 5. Two 2.5 inch and one 4.5 inch nozzles with National Standard fire hose threads mechanically connected into the barrel, "O"-ring sealed and standard nozzle caps.
- 6. Steel safety stem coupling with stainless steel fasteners, and two-piece break away safety flange.
- 7. Centerline of hose nozzle will be a minimum of 18 inches above groundline.
- 8. 5-1/4 inch diameter main valve opening.
- 9. Upper valve plate shall be all bronze.
- 10. All internal surfaces of the shoe, the lower valve plate, and cap nut shall be coated with a factory applied two-part, thermosetting epoxy coating with a minimum thickness of 4 mils.
- 11. The bronze valve seat shall be threaded into a bronze drain ring or shoe bushing. The drain channel shall be all bronze.
- 12. The hydrant shall have two drain outlets above the lower flange of the hydrant shoe assembly.

- 13. 250 psi working pressure, and be certified as such by the manufacturer.
- 14. Lower barrel to shoe connection shall have a minimum of six bolts made of stainless steel.
- 15. All hydrants furnished shall have a standard 10-year warranty certified by the manufacturer.
- 16. Painted chrome yellow.

B. Offset Fire Hydrant Connector Pipe:

- 1. Joints: Fully restrained by means of split M J Glands.
- 2. Length and Offset: To suit field conditions.
- 3. Material: DIP, AWWA C153.
- 4. Interior Lining: Cement mortar AWWA C104.

C. Resilient Wedge Gate Valves 2"-24" (Buried Service):

- 1. Size as shown on Drawings.
- 2. AWWA C509 or AWWA C515.
- 3. Mueller A-2361 series or Engineer reviewed equivalent.
- 4. Fully unobstructed, oversize flow way. The sealing mechanism is withdrawn from the flow way in a full open position. No pockets in bottom of flow way to trap sediment or debris.
- 5. Anti-friction washers above and below the thrust collar portion of stem to reduce friction.
- 6. Triple O-ring seals on the stem, two above and one below the thrust collar to protect from contamination.
- 7. A symmetrical rubber encapsulated disc with no exposed iron.
- 8. Forged bronze stem for added strength and reliability.
- 9. Coating: AWWA C116 and NSF-61 certified fusion-bonded epoxy coating on all interior and exterior cast iron surfaces 10 mils nominal thickness.
- 10. 2-inch AWWA operating nut.
- 11. Ends: Mechanical joint, or as required for pipe or as shown on Drawings.
- 12. Threaded operator: Open left (counter clock-wise) unless scheduled otherwise.
- 13. Lead Free: Furnish certification as specified in Submittals section of this specification.

D. Tapping Sleeves:

- 1. Minimum working pressure: 250 psi.
- 2. Welded, fabricated type 304 stainless steel body with the following features:
 - a. Buna-N rubber gasket, gridded, 360 degree pipe coverage.
 - b. Type 304 stainless steel bolts and nuts.
 - c. Flat face steel flange per AWWA C228, Class D 150 lb. pattern per AWWA C207.
 - d. Test Plug: 3/4 inch NPT, no-lead brass.
- 3. Ford FTSS, Smith-Blair 663, or JCM 432.
- 4. Sizes as shown on Drawings.

E. Tapping Valves:

- 1. Minimum working pressure: 150 psi.
- 2. Sizes as shown on Drawings.
- 3. Mueller Type T-2360 Resilient Wedge Gate Valve; Mechanical Joint on outlet side and Flange End on opposite side, or Engineer reviewed equivalent.
- 4. AWWA C509.
- 5. AWWA C550 and NSF-61 certified epoxy coating on all interior and exterior ferrous metal surfaces 10 mils nominal thickness.
- 6. Operator: 2-inch AWWA nut.
- F. Pipe Marking Systems: Refer to Section 31 23 33 Trenching and Backfilling.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:

- 1. Install as indicated on Drawings.
- 2. Trenching, Backfilling, and Compacting: Section 31 23 33 Trenching and Backfilling.
- 3. Pipe cutting measurement taken at site.
- 4. Clean all pipe, accessories, and appurtenances before use. Thoroughly clean interior of each section of pipe after installing it in trench.
- 5. Protection of stored materials: Section 01 66 01 Product Delivery, Storage, and Handling Requirements.
- 6. Securely close the end of the pipe at the end of each day or whenever the work ceases with a watertight seal.
- 7. Take precautions necessary to prevent uplift and floating of the pipe prior to backfilling.

B. Jointing and Assembling, General:

- 1. Manufacturer's recommendations.
- 2. Lubricants: Vegetable soap solution suitable for use on potable water systems.
- 3. Prevent entrance of soil and other contaminants.
- 4. Use mechanical or push-on for exterior locations.

C. Delivery, Handling, and Storage of PVC Pipe:

- 1. All pipe shall be bundled or packaged in such a manner as to provide adequate protection of the ends during transportation to the site. Any pipe damaged in shipment shall be replaced as directed by the Engineer.
- 2. Inspect each pipe shipment prior to unloading to see if the load has shifted or otherwise been damaged. Notify Engineer immediately if more than immaterial damage is found. Check each pipe shipment for quantity and proper pipe size, color, and type.
- 3. Off-load and handle pipe in accordance with AWWA M23 and AWWA C605, and all of the Pipe Supplier's guidelines.
- 4. Off-loading devices such as chains, wire rope, chokers, or other pipe handling implements that may scratch, nick, cut, or gouge the pipe are strictly prohibited.

- 5. During removal and handling, be sure that the pipe does not strike anything. Significant impact could cause damage, particularly during cold weather.
- 6. Lower pipe from trucks carefully. Do not drop pipe.
- 7. Mark as rejected and remove at once from the work any pipe showing a crack or which has received a blow that could have caused an incident fracture, even though no such fracture can be seen.
- 8. Any scratch or gouge greater than 10% of the wall thickness will be considered significant and shall be rejected unless determined acceptable by the Engineer.
- 9. Store and place pipe lengths on level ground. Store pipe at the job site in the unit packaging provided by the Pipe Supplier. Exercise caution to avoid compression, damage, or deformation to the ends of the pipe. Keep the interior of the pipe, as well as all end surfaces, free from dirt and foreign matter.
- 10. Handle and support pipe using woven fiber pipe slings or approved equivalent. Exercise care when handling the pipe to not cut, gouge, scratch or otherwise abrade the piping in any way.
- 11. If pipe is to be stored for periods longer than ninety (90) days, the pipe and gaskets should be shaded or otherwise shielded from direct sunlight. Covering of the pipe which allows for temperature build-up is strictly prohibited. Pipe shall be covered with an opaque material while permitting adequate air circulation above and around the pipe as required to prevent excess heat accumulation.
- 12. Store and stack pipe in accordance with the Pipe Supplier's guidelines.

D. PVC Pipe Joint Assembly:

- 1. Conformance to AWWA C605 Underground Installation of Polyvinyl Chloride (PCV) Pressure Pipe and Fittings for Water:
 - a. Assemble PVC pipe in conformance with AWWA C605, Section 5.5.2 Joint Assembly, which states:
 - 1) "Pipe spigot ends are pre-marked at the factory with a circumferential insertion line. This line references how far the spigot should be inserted into the adjoining PVC pipe bell. Field-cut spigot ends shall be marked and beveled to match the manufacturer's insertion line. Pipe-to-pipe joints shall be assembled only to the insertion line. After assembly, the insertion line shall remain visible and be nearly flush with the lip of the adjoining PVC pipe bell. Joints assembled beyond the insertion line shall be considered over-assembled and may result in damaging stresses or leakage."
- 2. Field Quality Control to Prevent Over-Assembly (Over-Insertion):
 - a. If a joint is found to be over-inserted, Contractor shall expose previously assembled joints until properly assembled joints are found. All over-inserted joints shall be properly re-assembled.
 - b. Contractor is permitted to use mechanical bell stop devices that meet the following criteria:
 - 1) Designed specifically to handle pipe insertion forces to prevent insertion beyond the marked insertion line.

- 2) Incorporates a resilient expansion retention spring that allows for pipe expansion and contraction.
- 3) Ebaa Iron Mega-StopTM Series 5000 Bell Protection System, or Engineer reviewed equivalent.

E. PVC Pipe Tapping:

- 1. Tapping shall be performed using standard tapping saddles designed for use on PVC piping in accordance with AWWA C605 and as specified herein. Tapping shall be performed only with use of tap saddles or sleeves. NO DIRECT TAPPING WILL BE PERMITTED. Tapping shall be performed in accordance with the applicable sections for Saddle Tapping in accordance with Uni-Pub-08.
- 2. All connections requiring a larger diameter than that recommended by the Pipe Supplier, shall be made with a pipe connection as specified and indicated on the Drawings.
- 3. Equipment used for tapping shall be made specifically for tapping PVC pipe:
 - a. Tapping bits shall be slotted "shell" style cutters, specifically made for heavy-walled PVC pipe and designed to retain the coupon. "Hole saws" made for cutting wood, steel, ductile iron, or other materials are strictly prohibited.
 - b. Manually operated or power operated drilling machines may be used.
- 4. Taps may be performed while the pipeline is filled with water and under pressure ("wet" tap,) or when the pipeline is not filled with water and not under pressure ("dry" tap).
- F. Clean all lines by repeated flushings after installations.
- G. Disinfection: Section 33 13 13 Disinfection of Domestic Water Systems.

H. Pipe Sleeves:

- 1. For all pipes passing through concrete or masonry.
- 2. Install before concrete is placed where practical.
- 3. Sleeve seal: Watertight, modular sealing element when sleeve is placed in slabs with one side against soil.

I. Buried Pipe Anchorage:

- 1. Furnish and install anchors, joint restraint devices, or other acceptable means of preventing pipe movement whether indicated or not for:
 - a. Unlugged bell and spigot or all unflanged tees.
 - b. Y branches.
 - c. Bends deflecting 22-1/2 degrees or more.
 - d. Plugs.
 - e. Fittings in fills or unstable ground.
 - f. Above grade or exposed piping.
- J. Valves: Installed as shown on Drawings with valve boxes and blocking.
- K. Fire Hydrants: As indicated on Drawings with concrete supports.

- 3.02 FIELD QUALITY CONTROL
 - A. Ductile Iron Pipe: AWWA C600, except as specified otherwise herein.
 - B. PVC Pipe and Fusible PVC Pipe: AWWA C605 for pressure rated, and AWWA Manual M23, except as specified otherwise herein.
 - C. HDPE Pipe: AWWA C901, AWWA C906, AWWA Manual M55, and PPI Handbook of Polyethylene Pipe, except as specified otherwise herein.
 - D. All pipes and fittings tested in presence and to the satisfaction of the Engineer.
 - E. Test Conditions:
 - 1. Working Pressure: See Schedule.
 - 2. Medium: Water only. Do not test PVC, FPVC or CPVC with air because pipe failure from pressurized air may result in explosive shards.
 - 3. Unless otherwise scheduled, perform test at 50% greater than working pressure, or 150 psi, whichever is greater, for two hour minimum.

F. Procedure:

- 1. Coordinate pressure testing with filling, disinfection and flushing procedures as submitted in the Disinfection Plan submittal specified in Section 33 13 13 Disinfection of Domestic Water Systems.
- 2. Disconnect fixtures, equipment and accessories which may be damaged by test pressure.
- 3. Plug ends as required.
- 4. No installation will be accepted unless the leakage is less than the number of gallons per hour as determined by the following formula, except HDPE waterlines:
 - a. $L = (N) (D) (P^0.5) / 133,200$
 - b. Where:
 - 1) L =allowable leakage in gallons per hour.
 - 2) N = length of pipeline tested in feet.
 - 3) D = nominal diameter of pipe in inches.
 - 4) P = average test pressure during test, psig.
- 5. HDPE Waterlines: Unless scheduled otherwise, perform test at 50% greater than working pressure.
 - a. Fill Phase: Fill the restrained test section completely with water. Evacuate air from all high points.
 - b. Initial Expansion Phase: After the piping and water have equalized to a common temperature, gradually pressurize test section to test pressure, and maintain test pressure for 3 hours. During the initial expansion phase, HDPE pipe will expand slightly. Add additional water to maintain pressure. It is not necessary to monitor the amount of water added during the initial expansion phase.

- c. Test Phase: Immediately following the initial expansion phase, reduce test pressure by 10 psi, and stop adding test water. If test pressure remains steady (within 5% of the target value) for 1 hour, no leakage is indicated.
- d. Depressurization Phase: Gradually release the test pressure by controlling the release of water.
- e. Total Test Duration: Limit the time the pipe is pressurized at test pressure to 8 hours. If pipe must be pressurized again to test pressure, depressurize pipe first and allow it to relax for at least 8 hours before re-pressurizing.
- f. Supervision: Do not leave the test section unsupervised at any time during leak testing.
- 6. If leakage is indicated, locate and repair leaks.
- 7. Retest repaired joints, pipes, and fittings until system complies with above criteria for allowable leakage.
- G. Sequence for Pressure Testing:
 - 1. If an isolation valve is used to isolate a segment of pipe for pressure testing, the piping on both sides of the valve shall be installed with backfill and compaction fully completed on both sides of the valve for a minimum distance of 250 feet.

3.03 SCHEDULE

- A. The waterline shall be constructed using the following pipe materials, unless noted otherwise in the Contract Documents for specific areas:
 - 1. PVC Pipe:
 - a. Line #1 12-inch Gravity Line: C900, Pressure Class 235, DR 18.
 - b. Line #2 8-inch Gravity Line: C900, Pressure Class 235, DR 18.
 - c. Line #3 8-inch Pressure Line: C900, Pressure Class 235, DR18.
 - d. Line #3 10-inch Pressure Line: C900, Pressure Class 235, DR18.
 - 2. HDPE Pipe:
 - a. Line #1 14-inch Gravity Line Arroyo Crossing: DR11 DPS.
 - b. Line #2 8-inch Gravity Line: DR11 DIPS.
 - 3. Isolation Valves:
 - a. 12-inch Suction Line: Resilient Wedge Gate Valve, 350 psi rated pressure.
 - b. 10-inch Discharge Line: Resilient Wedge Gate Valve, 350 psi rated pressure.
 - c. 8-inch Discharge Line: Resilient Wedge Gate Valve, 350 psi rated pressure.
- B. Buried Ductile Iron Piping, Fittings, and All External Restraint Assemblies; and Buried Metal Valves and All Metal Appurtenances: Install with polyethylene encasement.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	<u>Pay Item</u>	Pay Unit
1.01 – 1.05, 1.11, 1.12, 1.14, 1.17 – 1.24, 2.02, 2.07, 2.09 – 2.11, 3.01 – 3.05, 3.12 – 3.14, 3.18	Buried Water Systems within Linear Easements and R.O.W.s	Linear Feet
1.25, 4.01, 4.04, 4.05, 5.03,	Buried Water Systems including Fire Hydrants and Buried Gate Valves within Master Meter Station, Pump Station and Storage Tank Area	Lump Sum
3.16	Fire Hydrant Assemblies	Each

END OF SECTION

SECTION 33 12 17

HYDROPNEUMATIC TANKS

PART 1 GENERAL

1.01 SUMMARY

- A. The work described by this Section of specifications consists of furnishing all equipment, materials, and labor to provide, install and test one (1) vertical bladder-type surge tank for potable water surge control as shown on the Contract Drawings and specified in the Contract Documents.
- B. Provide a complete system, including detailed design, equipment and material procurement, fabrication, installation, calibration, start-up, testing, documentation, training, and warranty.
- C. Scope of work shall include an automatic level indication system, continuous level monitoring system, outdoor weather packages for tank and piping, and associated control panels.

1.02 RELATED REQUIREMENTS

A. Section 43 23 32 – Package Booster Pump System.

1.03 SUBMITTALS

- A. Section 01 33 23 Shop Drawings, Product Data, and Samples:
 - 1. Product data of tank, bladder, controls, outdoor weather packages, and appurtenances.
 - 2. Materials of construction.
 - 3. Rated capacities and volumes.
 - 4. Design criteria and code conformance certificates.
 - 5. Layout drawings showing dimensions of all equipment; accessories, supports, connections, outlets, related piping, and parts list.
 - 6. Weight, empty and full.
 - 7. Metal thickness table.
 - 8. Warranty.
 - 9. Tank support seismic and wind calculations in conformance with applicable IBC requirements.
 - 10. Coating data.
 - 11. Surge control analysis of the system clearly showing transient analysis of the system, including graphs of station pressure versus time.
 - 12. Manufacturer's storage and installation instructions for all equipment, including heat blanket and heat trace systems, insulation, and jackets.
 - 13. Documentation confirming NSF/ANSI 61 certification.

- B. Operation and Maintenance Manuals: Section 01 78 23 Operation and Maintenance Data.
- C. Training for Owner's Personnel: Section 01 79 01 Manufacturer's Instruction of Owner's Personnel.
- D. Certification that Installation is Ready to Use: Part 3 herein.

1.04 WARRANTY

A. One year materials and workmanship warranty from date of substantial completion.

1.05 QUALITY ASSURANCE

- A. Manufacturer shall be regularly engaged in design, manufacture, and commissioning of hydropneumatic surge tanks, having a minimum of ten years of experience.
- B. Manufacturer shall be ISO 9001 certified, including engineering, design, manufacturing, and testing complete components.
- C. Vessel manufacturer shall manufacture its own vessels, bladders, and replacement bladders within the same plant as per quality control through ISO.
- D. The vessel and bladder manufacturing facility shall be NSF-61 approved for potable water service.
- E. Tanks, vessels, and bladders shall be fabricated by listed manufacturer, not contracted out.
- F. Upon request, manufacturer shall provide in-house x-rays of welds, hydrostatic test, and ASME inspection. The Engineer reserves the right to inspect the vessel manufacturing facility to confirm requirement above.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Charlatte America.
- B. Or Engineer reviewed equivalent.
- C. Any deviations from the design basis is the responsibility of the Contractor and any requirements for review of alternative designs including impacts to the product installation may result in additional engineering costs to be determined after the Bid during submittal review. Alternate designs will not be reviewed prior to Bid due to the complex nature of the equipment.

2.02 DESIGN REQUIREMENTS AND CONSTRUCTION

A. Bladder Style Hydropneumatic Tank:

- 1. Materials, Design, Shop Fabrication, and Inspection: Conform to Section VIII, Division 1, of the ASME Boiler and Pressure Vessel Code with only the plate steels in Table UCS-23 of said code being used. Provide ASME code stamp, National Board Registration number, and pressure rating on tank.
- 2. Shell: Constructed of deep-drawn carbon steel double sub-arc welded domes, and side shells with double welded seams.
- 3. Design Pressure: Design to withstand the hydrostatic operating pressure and test pressure scheduled herein with no reactive load permitted through the inlet/outlet piping.
- 4. Structural Design and Supports: Tank, supports, and anchor bolts designed to meet seismic and wind design requirements of the current IBC for local area. Seismic calculations stamped by a New Mexico registered professional engineer shall be provided.
- 5. Support Legs: ASTM A36 or ASTM A285, Grade C, welded to the tank with three (3) minimum mounting tabs for attaching to a concrete floor or slab. Bolted type extensions shall be provided to raise the tank height sufficient to clear the attached piping as shown on the Drawings.

6. Access:

- a. Top Manway for Vertical Vessel: Bolted blind flange on top of tank to allow inspection and maintenance of the bladder.
- b. Size: 24" in diameter or as limited by the ASME code.

7. Drain:

- a. Size: 4 inch.
- b. Connection: Side-mounted, flanged connection on vessel outlet.
- c. Isolation: 4-inch flanged gate valve.
- 8. Coatings: Factory furnished:
 - a. Interior:
 - 1) NSF-61 epoxy coating with a uniform layer thickness no less than 6.0 mils.
 - b. Exterior:
 - 1) Anti-corrosion polyurethane coating with a uniform layer thickness no less than 10.0 mils.

9. Accessories:

- a. Provide a 1/2" threaded connection at the top of the tank to contain a gas charging valve and pressure gauge. The precharge pressure shall be located between the shell of the tank and the bladder.
- b. Lifting Rings on top and side.
- c. ASME Safety Relief Valve: Set at 110% maximum allowable working pressure.

B. Bladder:

- 1. Material: Food grade, heavy-duty butyl rubber bladder. Bladders made of PVC or polyester will not be allowed.
- 2. Shape: Sized to conform to the inner shape of the surge vessel.
- 3. Construction: Bladder shall be manufactured by the surge vessel manufacturer.

C. Vessel Monitoring:

- 1. Provide an Automatic Level Indication System for water level in the surge tank.
- 2. Level Gauge: Flag-style Magnetic Level Gauge for visual monitoring of tank level.
 - a. Furnished with manual isolation ball valves at the top, at the bottom, and for draining the gauge.
 - b. Kobold or Engineer reviewed equivalent.
- 3. Automatic Valves: 3 two-way solenoid valves powered by a control panel such that a pushbutton on the panel face initiates a sequence that will:
 - a. Open solenoid valves installed at the top and bottom of the level gauge for 2 minutes to allow water level in the gauge to fill and then reach an equilibrium position.
 - b. Close solenoid valves at the top and bottom of the level gauge and allow the gauge to display the tank level for an additional 2 minutes.
 - c. The drain solenoid shall then be opened for 1 minute to allow water in the gauge to drain completely before re-closing.
- 4. Timer Panel: The control panel enclosure and panel face-mounted pilot devices shall be NEMA 12 rated. This panel shall be "Hydropneumatic Tank Level Indication System Panel". All solenoid valves and components in this control panel shall be designed to operate from 120VAC/1ph/60hz power. Level gauge shall be located as shown on Drawings.

D. Differential Pressure Transmitter shall be provided.

- 1. Rosemount Model 3051L/1199.
- 2. Pressure Range: -250 to 250 inches of H₂O.
- 3. Accuracy: ± 0.10 percent of span.
- 4. Taps: 1/4" 18 NPT
- 5. Temperature Limits: 40° to 185°F.
- 6. Wetted Parts: Type 316L stainless steel.
- 7. Output: 4 20 mA.
- 8. Mounting: 2" flange on vessel outlet.
- 9. Isolation: 2" flanged stainless steel ball valve.
- 10. Air Side Connection: Diaphragms and capillary tubing connected to charging connection manifold on top of tank.

E. Vessel System Outdoor Freeze Protection:

- 1. General: Surge vessel shall be provided with a heating system consisting of properly sized heat blankets with thermostatic controls, a heating control panel with indicating lights for each circuit and 2" insulation with aluminum jacket.
- 2. Installation: Blankets, thermostats, insulation, and aluminum jacket installed by vessel supplier. Mounting of heating control cabinet and field wiring, terminations, conduit runs, and other related appurtenances by Contractor.
- 3. Vessel Heating Blankets:
 - a. Moisture, chemical, and radiation resistant.
 - b. Grounded heating element laminated between two layers of 20 mil fiberglass reinforced silicone rubber.

- c. Dielectric strength of over 2000V.
- d. Silicone density 21.7 ounce per square yard per layer.
- e. Exposure temperature range -60° to 450° F.
- f. Number of blankets required is four (4) each 24" wide x 24" long, assembled in two pairs.
- g. Power requirement 208 VAC/3-Phase, 1.25 watts per square inch, and 1,440 watts per pair of blankets. Controls by supplier shall feed each leg of the 3-Phase power to each pair of blankets and to the piping heat trace.
- h. Manufacturer: BriskHeat, Model SRP-24-24-1-P-096 or Engineer reviewed equivalent.
- i. Thermostat control provided by two (2) BriskHeat thermostats (on at 35°F and off at 50°F) or Engineer reviewed equivalent.
- 4. Heat Trace for Vessel Piping and Level Gauge Assembly:
 - a. One circuit for self-regulating heat tracing shall be provided to keep level gauge and solenoid valves from freezing.
 - b. Manufacturer: BriskHeat, Model SL-B or Engineer reviewed equivalent.
 - c. Small diameter pipe insulation shall be fitted around level gauge and associated valves without obscuring view of the level gauge flags.
 - d. Power Requirement: 2,000 watts.
- 5. Vessel and Piping Insulation:
 - a. 2" semi rigid board in roll form adhered perpendicular to jacketing with low thermal conductivity ratings to 850°F.
 - b. Insulation shall resist microbial growth, be non-corrosive, and have a compressive strength of not less than 150 psf at 10% deformation per ASTM C165 and negligible linear shrinkage per ASTM C356.
 - c. Insulation shall have a moisture barrier of 40-pound kraft paper coated with one-mil thick low density polyethylene film.
 - d. Manufacturer: Knauf or Engineer reviewed equivalent.
- 6. Insulation Jacketing:
 - a. Aluminum jacketing shall be manufactured from wrought aluminum alloy 3003 or 3105 meeting ASTM B209 with an H-14 temper.
 - b. Jacketing thickness shall be 0.016" minimum with stucco embossed finish.
 - c. Manufacturer: RPR Products Insul-Mate or Engineer reviewed equivalent.

2.03 DESIGN PRESSURE

- A. Minimum Design Pressure: As scheduled.
- B. Perform hydrostatic testing in the factory.
- C. Test Pressure: As scheduled. Test Pressure shall be a minimum of 130% of the design pressure of the tank.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Manufacturer's recommendations, set level and plumb without stress on piping.
- B. As indicated on Drawings.
- C. Precharge: Set air precharge in field in accordance with manufacturer's instructions.

3.02 FIELD QUALITY CONTROL

- A. Field tested at completion of installation.
- B. Progressive sudden shutdown of pumps after pump station is running at full capacity, as determined by Engineer.

3.03 REQUIRED SUPPORT BY FIELD SERVICE REPRESENTATIVE

- A. See Section 01 75 01 Field Service Representative, for qualifications of Field Service Representative.
- B. Present to check installation, testing, and operation.
- C. Provide minimum 8 hours on site to approve the tank installation and advise the Contractor during startup, testing, and final adjustment of the tank.
- D. Provide 6 hours devoted exclusively to training of Owner's personnel on operation and maintenance per requirements of Section 01 79 01 Manufacturer's Instruction of Owner's Personnel.
- E. Furnish written report to Engineer certifying that equipment is properly installed, fully functional, ready for use, and is operating correctly.

3.04 SCHEDULE

- A. Hydropneumatic Tank, Hondo 2 Pump Station Discharge:
 - 1. Tank Configuration: Vertical, freeze protection for outdoor service.
 - 2. Minimum Capacity: 3,232 gallons.
 - 3. Outside Diameter: 98 inches.
 - 4. Height: 159 inches.
 - 5. Maximum Design Pressure: 203 psi with no reactive load permitted through the inlet/outlet piping.
 - 6. Test Pressure: 305 psi.
 - 7. Precharge Pressure Setting: 110 psi.
 - 8. Outlet Flange Size: 6 inch, ANSI class 150 lb. pattern.
 - 9. Access: Top Manway.

- 10. Site Elevation: 7,145 feet.
- 11. Ambient Temperature: 55° to 105°F.
- 12. Outlet Connections: Rubber pipe expansion joint with control rods.
- 13. Tank Outdoor Weather Package: 2-inch insulation, aluminum jacket, heating blankets and control system.
- 14. Piping Outdoor Weather Package: 2-inch insulation, aluminum jacket, heat trace and control system.
- 15. Magnetic Level Gauge: Assembly with solenoid valves and timer control panels.
- 16. Differential Pressure Transmitter.
- 17. ASME Relief Valve.
- 18. Quantity: One.
- 19. Design Basis: Charlatte Model HCA-3434-203/305-V-98.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	<u>Pay Item</u>	<u>Pay Unit</u>
5.01	Hydropneumatic Tanks	Lump Sum

END OF SECTION

SECTION 33 13 13

DISINFECTION OF DOMESTIC WATER SYSTEMS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Provide personnel, equipment, and supplies, disinfect and test all potable water systems, including water treatment systems, waterlines, water storage reservoirs, water wells, and new building system including flushing at completion of treatment.

1.02 RELATED REQUIREMENTS

- A. American Waterworks Association Standards:
 - 1. AWWA B100 Granular Filter Material.
 - 2. AWWA B300 Hypochlorites.
 - 3. AWWA C651 Disinfection Water Mains.
 - 4. AWWA C652 Disinfection of Water Storage Facilities.
 - 5. AWWA C653 Disinfection of Water Treatment Plants.
 - 6. AWWA C654 Disinfection of Wells.
 - 7. AWWA C655 Field Dechlorination.

1.03 RELATED WORK

- A. National Sanitation Foundation International (NSF):
 - 1. NSF/ANSI 60 Drinking Water Treatment Chemicals Health Effects.

1.04 QUALITY ASSURANCE

A. Regulatory Agency Requirements: Comply with applicable state requirements.

1.05 SUBMITTALS

- A. Disinfection Plan:
 - 1. Submittal Requirements:
 - a. Prior to filling water system with water, submit electronic file of Disinfection Plan to Engineer for review and comment. Flushing, disinfection and sampling procedures shall be in accordance with the referenced AWWA standards.
 - b. Address Engineer's comments and submit electronic file of Final Disinfection Plan to Engineer and NMED Drinking Water Bureau pursuant to NMAC 20.7.10.201 B.(3), NMAC 20.7.10.201 T.(2) and NMAC 20.7.10.400 F.
 - c. Do not fill system with water until NMED has approved the plan.

- d. After disinfection has been completed, submit a signed and notarized affidavit to the Engineer and NMED Drinking Water Bureau confirming that disinfection procedures have been completed according to the referenced AWWA standards.
- 2. Proposed Actions Described in Plan:
 - a. How pipes and tanks will be filled with source water. Coordinate availability of water with Owner.
 - b. Identify the sequence of filling system, chlorinating water, pressure testing and flushing system. Follow procedures specified in the referenced AWWA disinfection standards. Reference which AWWA method of chlorination will be followed.
 - c. If system will be disinfected, tested and flushed in segments, identify where and in what sequence the segments will be isolated and tested. Be aware that elevation differences may require breaking up a pipeline into segments with no more than approximately 50 psi (115 vertical feet) pressure difference within the segment.
 - d. Identify points in the system where water will be introduced, chlorine added (or swabbed), initial and residual chlorine concentrations measured, flushing water blown off, final chlorine residuals measured after flushing, and bacteriological sample points.
 - e. Identify method of measuring chlorine residual in the field.
 - f. Identify the bacteriological test lab that will be used, test method, and sampling, chain of custody, and transportation procedures.
 - g. Describe how highly chlorinated flush water will be properly disposed.

B. Test Reports: Submit two copies as follows:

- 1. Disinfection report, include:
 - a. Date issued.
 - b. Project name and location.
 - c. Treatment contractor's name, address, and phone number.
 - d. Type and form of disinfectant used.
 - e. Time and date of disinfectant injection start.
 - f. Time and date of disinfectant injection completion.
 - g. Test locations.
 - h. Initial and 24 hour disinfectant residuals in ppm for each outlet tested.
 - i. Time and date of flushing start.
 - j. Time and date of flushing completion.
 - k. Disinfectant residual after flushing in ppm for each outlet tested.
- 2. Bacteriological report, include:
 - a. Date issued.
 - b. Project name and location.
 - c. Laboratory's name, certification number, address, and phone number.
 - d. Time and date of water sample collection.
 - e. Name of person collecting samples.
 - f. Test locations.
 - g. Time and date of laboratory test start.
 - h. Coliform bacteria test results for each outlet tested.

- i. Certification that water conforms or fails to conform to bacterial standards of Federal Safe Drinking Water Act.
- j. Microbiologist's signature.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Protect against damage and contamination.
- B. Maintain caution labels on hazardous materials.
- C. Maintain storage room dry and with temperatures as uniform as possible between 60°F (15.6°C) and 80°F (26.7°C).

1.07 PROTECTION

A. Provide necessary signs, barricades, and notices to prevent any person from accidentally consuming water or disturbing system being treated.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Disinfectant:
 - 1. Free chlorine; liquid, powder, tablet or gas: Per AWWA B300.
 - 2. Certified compliant with NSF/ANSI Standard 60.

PART 3 EXECUTION

3.01 INSPECTION

- A. Prior to starting Work verify that domestic water system is completed and cleaned.
- B. Do not start Work until conditions are satisfactory.

3.02 SYSTEM TREATMENT

- A. Water Distribution and Transmission System: Per AWWA C651. Including disinfecting existing systems after repair.
- B. Water Treatment Reservoir: Per AWWA C652.
- C. Water Storage Plants: Per AWWA C653.
- D. Water Wells: Per AWWA A100 and AWWA C654.
- E. New Building Water System: Per local or State Plumbing Code.

- F. Granular Media Filters: Per AWWA, B100.
- G. Field Dechlorination: Per AWWA C655.

3.03 BACTERIOLOGICAL TEST

- A. Take samples where and when as required by referenced standards or codes.
- B. Analyze water samples in accordance with "Standard Methods for the Examination of Water and Wastewater", latest edition, published by American Water Works Association.
- C. Analyze water samples as otherwise required or allowed by referenced standards or codes.
- D. Employ the services of an independent test laboratory certified by the New Mexico Environment Department Drinking Water Bureau to perform all bacteriological testing.
- E. Payment for bacteriological testing of water wells shall be as specified in Section 33 21 00 Water Well.
- F. Payment for bacteriological testing for all other domestic water systems is considered incidental Work to the Contract Documents' Bid Items.

3.04 DISPOSAL OF HEAVILY CHLORINATED WATER

- A. Test heavily chlorinated water for chlorine residual in accordance with Appendix A of the AWWA C651.
- B. Chlorine residual of water being disposed of, shall be neutralized in accordance with AWWA C655 Field Dechlorination to meet residual acceptable for domestic use.
- C. Dispose of water flushed from water main, after neutralization to designated receiving drainage. Coordinate with Engineer.

3.05 FAILURE OF DISINFECTION AND/OR BACTERIOLOGICAL TESTS

A. If test results do not comply with criteria required by referenced standards or codes, system shall undergo redisinfection in accordance with Section 5.2 of the AWWA C651.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
1.09, 2.05, 3.10	Pipeline Filling, Chlorination, Bacteriological and Residual Testing, Reporting, Flushing, and Proper Disposal of Flushed Water.	Linear Feet
4.01, 5.01	Tank and Pipe Filling, Chlorination, Bacteriological and Residual Testing, Reporting, Flushing, and Proper Disposal of Flushed Water	Lump Sum

END OF SECTION

CERTIFICATION OF DISINFECTION OF WATER FACILITIES

I,,	, hereby certify that the facilities constructed under the		
project	were disinfected in accordance with the		
Disinfection Plan submitted under Spe	an submitted under Specification Section 33 13 13 – Disinfection of Domestic		
Water Systems and with the following	American Water Works Association (AWWA) standar	rds:	
C651 – AWWA Standard for I	Disinfecting Water Mains		
C652 – AWWA Standard for I	Disinfection of Water-Storage Facilities		
Contractor:			
Signature:			
Printed Name:			
Title:			
Date:			
Notary Certification:			
State of			
(County) of			
Signed or attested before me on	by		
SEAL	Notary Public		
	My Commission Expires:		

SECTION 33 16 13.13

STEEL ABOVEGROUND WATER UTILITY STORAGE TANKS

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Furnishing and erection of welded steel water storage tank and tank accessories.
- B. Reservoir foundation.
- C. Protective coatings for inside and outside of tank.
- D. Cathodic protection system.

1.02 RELATED WORK/REQUIREMENTS SPECIFIED ELSEWHERE

- A. Section 09 97 13.01 Coatings for Welded Steel Water Storage Tanks
- B. Section 33 13 13 Disinfection of Domestic Water Systems

1.03 REFERENCES

- A. General: The publications, manuals, standard specifications and codes listed below are a part of these specifications, the same as if fully set forth herein. Except as specifically stated otherwise, the revision or edition of each document in effect on the day that construction bids for this project are opened shall be used.
- B. American Water Works Association:
 - 1. AWWA C652: Disinfection of Water Storage Facilities
 - 2. AWWA D100: Welded Carbon Steel Tanks for Water Storage
- C. American Petroleum Institute:
 - 1. API 650: Welded Steel Tanks for Oil Storage (applies to tanks designed in accordance with Section 14 of AWWA D100).
- D. American Society of Civil Engineers (ASCE):
 - 1. ASCE Standard 7 Minimum Design Loads and Associated Criteria for Buildings and Other Structures.

1.04 SUBMITTALS

- A. Prior to fabrication, submit per Section 01 33 23 Shop Drawings, Product Data, and Samples.
 - 1. Tank and foundation design calculations including earthquake loads and shop drawings stamped by licensed professional Engineer.

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- 2. Tank layout and accessory drawings, including cathodic protection details.
- 3. Product data and calculations for cathodic protection system.
- B. Prior to start of tank painting, submit test reports per Section 01 33 23 Shop Drawings, Product Data, and Samples.
 - 1. Radiographic inspection report.
 - 2. Vacuum tests on all floor seams.
 - 3. For tanks designed per AWWA D100, Section 14, pressure tests of all shell penetrations per API 650, Section 5.3.5.
- C. Certification to Owner of Compliance with AWWA D100 (see form included in this Section): With Request for Final Payment.
- D. Cathodic protection system test report

1.05 QUALITY ASSURANCE

- A. The tank, its accessories and foundation shall be designed, fabricated and installed in accordance with the requirements of AWWA D100. At Contractor's option, the design may be a standard AWWA tank design or may be in accordance with AWWA D100 Section 14 Alternative Design Basis for Standpipes and Reservoirs.
- B. Weld testing shall be in accordance with Section 11 of AWWA D100 except that if tank design is in accordance with Section 14, testing provisions of Section 14 shall be met. Radiographic testing shall be used for welds. Vacuum tests shall be made on all floor seams. For tanks designed in accordance with Section 14 of AWWA D100, pressure tests of all tank penetrations shall be made in accordance with API 650, Section 5.3.5.
- C. Hydrostatic testing in accordance with AWWA D100.

PART 2 PRODUCTS

2.01 MATERIALS

- A. AWWA D100 unless otherwise scheduled.
- B. Concrete: Per requirements of Division 03 of the specifications.

2.02 FABRICATION

A. AWWA D100 unless otherwise scheduled or as shown on Drawings.

2.03 PROTECTIVE COATINGS

A. See Section 09 97 13.01 – Coatings for Welded Steel Water Storage Tanks.

2.04 CATHODIC PROTECTION SYSTEM

- A. General Scope: Furnish, install, and test a complete cathodic protection system to reduce corrosion of interior surfaces of welded steel water storage reservoir.
- B. Coordination: System supplier/installer contracted by storage reservoir manufacturer.

C. Supplier/installer:

- 1. Shall have a full-time service organization within 150 miles of installation unless otherwise scheduled.
- 2. On-site installing and testing supervisor, and system designer, accredited as a National Association of Corrosion Engineers (NACE) or a registered corrosion engineer.
- 3. Has installed at least 30 similar systems in the previous 5 years.

D. Galvanic Current Systems (passive systems):

- 1. Reference electrode: Equipped with a copper/copper sulfate reference electrode designed for a minimum ten-year life.
- 2. Anodes: minimum 15-year anode system design life.
- 3. Handholes and accessories:
 - a. In tank roof for anode installation or replacement.
 - b. Spaced per system design; adjusted to avoid supporting members, locations acceptable to tank manufacturer.
 - c. Hole diameter: 4 inches
 - d. Steel handhole covers with rubber gasket
 - e. Suspension insulators near handholes to allow handling and provide stop for handhole cover locking bar.
 - f. Testing handholes: three around tank perimeter, 6 inches from outer wall for testing purposes, suspension insulators not required.

PART 3 EXECUTION

3.01 INSTALLATION

A. AWWA D100.

- 1. Ring Wall Foundation: Continuous reinforced concrete ring wall per AWWA D100 Section 12.6, Type 1, unless otherwise scheduled.
- 2. Floor Plate Sand Cushion Foundation:
 - a. 4 inches of asphaltic road mix.
- 3. Existing soil on which foundation or sand cushion will rest: Unless otherwise noted in Contract Documents, scarify to a minimum depth of 12 inches, moisten to optimum moisture, and compact to a minimum of 95% of modified Proctor density.
- 4. Refer to Section 31 23 00 Excavation, Backfill, and Compaction for Structures for soil fill requirements under tank and foundation.

- B. Cathodic protection system testing and settings for galvanic current systems.
 - 1. Conduct system testing and settings when tank and cathodic protection system construction is completed and tank is filled to normal capacity.
 - 2. Complete structure-to-electrolyte potential survey of system.
 - 3. Use copper/copper sulfate reference half-cell and voltmeter with minimum input impedance of 10 megohms.
 - 4. After determining native conditions, energize and adjust rheostat so all potentials inside tank meet cathodic protection criteria specified in NACE RP 01-69.
 - 5. Conduct complete potential survey after final adjustments are made to verify system settings.
- C. Cathodic protection system report after installation: Provide five copies of system report with complete information and data including structure-to-electrolyte surveys, system output, individual anode leg outputs, and settings.

3.02 DISINFECTION

- A. AWWA C652: Chlorination Method 2 unless otherwise scheduled or reviewed by Engineer.
- B. Sampling and analysis cost paid by Contractor.
- C. Sampling done in presence of Engineer or Owner.

3.03 SCHEDULE

- A. "Section" refers to Sections within AWWA D100. Refer to Note 1 at end of list.
 - 1. Capacity: 0.24 million gallons.
 - 2. Diameter: 49 feet I.D.
 - 3. Max. water depth: 16.75 feet.
 - 4. Roof type (Section 3.6): Column and rafter.
 - 5. Snow load (Section 3.1.3): In accordance with ASCE7, but not less than 25 psf.
 - 6. Wind load (Section 3.1.4): In accordance with ASCE 7.
 - 7. Corrosion allowance (Section 3.9.1):
 - a. Floor -1/16 inches.
 - b. Walls -1/16 inches.
 - c. Roof plates -1/16 inches.
 - d. Beam and channels (web only) -1/16 inches.
 - 8. Balcony (Section 4.4.4.2): None.
 - 9. Silt stop (Section 5.2.1 and 7.2.1): 4 inches high, removable.
 - 10. Ladder (Sections 5.4.2 and 7.4.2):
 - a. Outside tank ladder: None.
 - b. Outside spiral staircase with 3 foot wide treads, risers, and railings per OSHA standards: Required.

- c. Interior ladder: Required: Aluminum not acceptable.
 - 1) Personal fall arrest system or ladder safety system per OSHA 29 CFR 1910.28: Required.
- d. Roof Ladder (Sections 5.4.2.5 and 7.4.2.3): None.
- 11. Shop inspection (Section 11.1 or note 1, whichever applies): Required.
- 12. Written weld report (Section 11.2 or note 1, whichever applies): Required.
- 13. Radiographic film/test segments (Section 11.4 or note 1, whichever applies): Property of Owner.
- 14. Inspection for complete joint penetration (Section 11.4.1.1 or note 1, whichever applies): Radiographic.
- 15. Vacuum, pressure and hydrostatic testing (Section 11.10): Required.
- 16. Foundation (Section 12): Type 1 Ringwell footings per Section 12.6.1.
- 17. Pile foundation (Section 12.7.3): Not required.
- 18. Pipe cover (Section 12.9.2): 3.0 feet.
- 19. Seismic design (Section 3.1.5 and Section 13): As required for the earthquake zone corresponding to the location of the tank.
- 20. Probe mounting means, brackets, and other welded items for control systems, electrical equipment, and other accessories: Items welded to tank prior to field coating.
- 21. Vent design air flow rate (Section 5.5 and 7.5): 150 cfm.
- 23. Frost-proof vent screen pressure-vacuum relief mechanism (Sections 5.5.2 and 7.5.2): Required.
- 24. Cathodic Protection System: Galvanic current system required.
- 25. Overflow weir box design flow rate: 200 gpm with water level not more than 6 inches above weir invert.

Note 1: Conform to the requirements of Section 14 if the structure has been designed in accordance with Section 14.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	<u>Pay Item</u>	<u>Pay Unit</u>
4.01	Water Utility Storage Tank	Lump Sum

CERTIFICATION TO OWNER OF COMPLIANCE WITH AWWA D100

To

Gentlemen:

Santa Fe County Public Works Department P.O. Box 276 Santa Fe, New Mexico 87507

We	hereby certify that	the	
	, ,		e or Reservoir)
constructed for you at and described as follows:		(Location of Stan	adpipe or Reservoir)
		(Dimensions, Capacity	y, and Type of Structure)
of the Ame Welded Ste	erican Water Works eel Tanks for Water ests indicate that the	Association Standard D100, 20 Storage" and that the results of	ance with all of the requirements 05 entitled "AWWA Standard for all such inspections, radiographs, nplies with all of the requirements
			(Name of Company)
			(Authorized Representative)
			(Date)
COUNTY	OF)) ss.	
STATE OF) 55.	
Acknowled	dged and sworn to b	efore me	
this	day of	, 20	
		, Notary P	ublic

33 16 13.13-6

END OF SECTION

SECTION 33 16 97

WATER STORAGE TANK SUBMERSIBLE MIXERS

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Furnish and install submersible mixers complete with accessories in the potable water storage tank, as shown on Drawings and as specified herein.
 - 1. The mixer(s) are required to prevent thermal stratification of water in the storage tank.
 - 2. Equipment to be furnished under this Section includes submersible mixer(s) installed in the storage tank with accessories.

1.02 RELATED WORK

- A. Section 33 13 13 Disinfection of Domestic Water Systems.
- B. Section 33 16 13.13 Steel Aboveground Water Utility Storage Tanks.

1.03 REFERENCES

- A. National Sanitation Foundation International (NSF):
 - 1. NSF/ANSI 61 Drinking Water System Components Health Effects.
 - 2. NSF/ANSI 372 Drinking Water System Components Lead Content.
- B. Occupational Safety and Health Administration (OSHA):
 - 1. OSHA Training Requirements in OSHA Standards, Workplace Safety.
- C. Underwriters Laboratories, Inc. (UL):
 - 1. UL 508A Standard for Industrial Control Panels.

1.04 SUBMITTALS

- A. Section 01 33 23 Shop Drawings and Product Data:
 - 1. Descriptive literature and product data of mixers and accessories.
 - 2. Dimensioned drawings showing details of construction.
 - 3. Materials of construction.
 - 4. List of supplied equipment.
 - 5. Manufacturer's installation recommendations.
 - 5. The weight of each item of equipment.
 - 6. Manufacturer's Warranties.
 - 7. Motor drive data and electric power source requirements.
 - 8. NSF / ANSI Standard 61 documentation.
- B. Section 01 78 23 Operation and Maintenance Data.

1.05 PROJECT SITE CONDITIONS

A. See Schedules.

1.06 QUALITY ASSURANCE

- A. Continuous Operation Equipment. The mixer shall operate continuously using 120 VAC as the power source.
- B. No Visual Defects. The mixer shall have no visual defects, and shall have high quality welds, assembly, and corrosion resistant finish.
- C. Qualified U.S. Manufacturer. The manufacturer of the mixer shall have at least eight years' experience in the production of mixers for potable water tanks, and the equipment shall be manufactured in the continental United States.
- D. Factory Startup Services. Delivery, placement, and startup services shall be available, but not included in the bid. For such additional services available, factory delivery and placement services shall be performed by full time factory employees experienced in the operation of this equipment and who have completed OSHA safety trainings applicable to this type of placement.

1.07 WARRANTIES

A. The manufacturer shall provide a written warranty to the Owner as standard covering workmanship and defects in materials for a period of 5 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 WATER STORAGE TANK SUBMERSIBLE MIXERS - GENERAL

- A. Acceptable Manufacturers:
 - 1. Medora Corporation (GridBee®).
 - 2. Or Engineer Reviewed Equivalent.

2.02 OPERATING CONDITIONS

A. See Schedule.

2.03 PERFORMANCE AND FEATURES

- A. Mixing Guarantee: Maintain thermal de-stratification of contents of entire tank within a temperature differential of 2.0°F.
- B. Complete Water Circulation Required. To meet the project objectives, the tank or reservoir circulation shall be achieved by single or multiple submerged mixer units within the tank capable of providing long distance circulation of water. The mixer(s) shall have a direct measurable flow rate where suction shall enter mixer's intake positioned within 2-inches of reservoir floor and discharging water vertically in a

sheet flow pattern to induce a large volume, low velocity flow to reach the tank water surface. The mixer design shall allow the placement to be flexible achieve the best hydraulic positioning within the tank to prevent hydraulic short circuiting. Mixers with suction not within 2-inches of tank floor are not acceptable.

- C. Minimum Tank Depth Required to Operate Mixer: Two feet. Mixers requiring more than 2 feet are not acceptable.
- D. Number of Mixer Units Required: As scheduled.
- E. Fit Through Small Hatch Opening: Each mixer shall be capable of fitting through a clear, unobstructed opening of 12 inch diameter without requiring disassembly or assembly.

2.04 MIXER CONSTRUCTION

- A. Materials of Construction: Primarily type 316 stainless steel casing and hardware.
- B. Casing Enclosure: No exposed rotating parts on mixer unit.

C. Motor:

- 1. Type: Stainless steel, submersible.
- 2. Coupling: Direct drive, no gearbox or lubrication maintenance required.
- 3. Drive: Rated for continuous, full speed operation without any speed reduction or variable speed drive.
- 4. Power Requirements: 120 VAC, 1 phase, 60 Hz.
- 5. Horsepower: See schedule.
- D. Mixer Placement System: Mixer unit capable of being placed on floor of tank by means of a retrieval chain and lowered through a roof hatch. No brackets, fixed connections, or ties required. Unit capable of being placed and retrieved without need to drain the tank or use divers.
- E. Toxic and Lead Free: All materials in contact with potable water shall be lead-free, as certified by the Water Quality Association to comply with NSF/ANSI 372, and shall be NSF 61 certified.

2.05 ACCESSORIES

- A. Retrieval Chain and Suspension Chain.
- B. Submersible Electrical Cable: Manufacturer's cable long enough to reach from Mixer to Mixer Control Box as shown on Electrical Drawings.
- C. Control Box: 120 VAC, UL 508A listed, NEMA 4X, timer, exterior H-O-A switch, exterior indicator light, locking latch, motor current monitoring output. SCADA monitoring.
- D. Chain Grab Tools.

- E. Kellem Grip Cord Strain Relief.
- F. Cord Fixture Bolt.
- G. Cord Seal Cap.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Manufacturer's recommendations.
- B. Disinfect mixer unit with chlorine spray, as required by AWWA standards referenced in Section 33 13 13 Disinfection of Domestic Water Systems.

3.02 SCHEDULE

- A. Site Conditions:
 - 1. Site Elevation: 7,145 feet above mean sea level.
 - 2. Tank Configuration:
 - a. Design Volume: 0.24 million gallons.
 - b. Inside Diameter: 49 feet.
 - c. Side Water Depth: 16.75 feet.
 - 3. Tank Construction: Above-ground steel storage tank.
 - 4. Water Service: Chlorinated potable water.
- B. Tank Mixer:
 - 1. Power Connection: 120 VAC, 1-Phase, 60 Hz.
 - 2. Maximum Motor Horsepower: 0.5 HP.
 - 3. Explosion-proof: No.
 - 4. Assembled Weight: 65 pounds.
 - 5. Model: Medora GridBee® Model GS-9 with 120 VAC SCADA monitoring control box and accessories.
 - 6. Quantity: One.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
4.02	Tank Mixer	Lump Sum

END OF SECTION

SECTION 40 27 00

PROCESS PIPE SYSTEMS

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Pipes, materials, and appurtenances for all process, pump station, and piping inside vaults and similar facilities.
- B. Installation of necessary valves and accessories.
- C. Pipe anchors and supports.
- D. Pipe insulation.

1.02 GENERAL REQUIREMENTS

- A. Pipes, Fittings, and Materials to be New.
- B. Use Appropriate Equipment Methods for Unloading, Reloading, and Handling the Pipe.
- C. Pipe, Fittings, and Appurtenances of the Same Type: Made by the same manufacturer.
- D. Provide Labor, Equipment and Materials for Field Pipe Testing.
- E. All interior valves to have flange connections except where otherwise indicated.

1.03 REFERENCES

- A. American Society for Testing and Materials International (ASTM):
 - 1. ASTM A153 Zinc Coating (Hot Dip) on Iron and Steel Hardware.
 - 2. ASTM A183 Carbon Steel Track Bolts and Nuts.
 - 3. ASTM A307 Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength.
 - 4. ASTM A536 Ductile Iron Castings.
 - 5. ASTM B633 Electrodeposited Coatings of Zinc on Iron and Steel.
 - 6. ASTM C335 Steady-State Heat Transfer Properties of Pipe Insulation.
 - 7. ASTM C356 Linear Shrinkage of Preformed High-Temperature Thermal Insulation Subjected to Soaking Heat.
 - 8. ASTM C411 Hot-Surface Performance of High-Temperature Thermal Insulation.
 - 9. ASTM C547 Mineral Fiber Pipe Insulation.

- 10. ASTM C553 Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
- 11. ASTM C585 Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing.
- 12. ASTM D1784 Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
- 13. ASTM D1785 Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- 14. ASTM D2241 Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
- 15. ASTM D2464 Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
- 16. ASTM D2466 Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
- 17. ASTM D2467 Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
- 18. ASTM D2564 Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
- 19. ASTM D2672 Joints for IPS PVC Pipe Using Solvent Cement.
- 20. ASTM D3139 Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
- 21. ASTM D3350 Polyethylene Plastics Pipe and Fittings Materials.
- 22. ASTM E8 Tension Testing of Metallic Materials.
- 23. ASTM E23 Notched Bar Impact Testing of Metallic Materials.
- 24. ASTM E84 Surface Burning Characteristics of Building Materials.
- 25. ASTM F477 Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- 26. ASTM F714 Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter.
- 27. ASTM F2620 Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings.

B. American Water Works Association (AWWA):

- 1. ANSI/AWWA C104/A21.4 Cement Mortar Lining for Ductile-Iron Pipe and Fittings.
- 2. ANSI/AWWA C105/A21.5 Polyethylene Encasement for Ductile-Iron Pipe Systems.
- 3. ANSI/AWWA C110/A21.10 Ductile-Iron and Gray-Iron Fittings.
- 4. ANSI/AWWA C111/A21.11 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- 5. ANSI/AWWA C115/A21.15 Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges.
- 6. ANSI/AWWA C116/A21.16 Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fitrtings.
- 7. ANSI/AWWA C151/A21.51 Ductile-Iron Pipe, Centrifugally Cast.
- 8. ANSI/AWWA C153/A21.53 Ductile-Iron Compact Fittings.
- 9. AWWA C200 Steel Water Pipe-6 inch (150 mm) and Larger.
- 10. AWWA C203 Coal-Tar Protective Coatings and Linings for Steel Water Pipe.
- 11. AWWA C207 Steel Pipe Flanges for Waterworks Service, Sizes 4 inch Through 144 inch (100 mm Through 3,600 mm).

- 12. ANSI/AWWA C208 Dimensions for Fabricated Steel Water Pipe Fittings.
- 13. ANSI/AWWA C209 Cold-Applied Tape Coatings for Steel Water Pipe, Special Sections, Connections, and Fittings.
- 14. ANSI/AWWA C213 Fusion-Bonded Epoxy Coating for the Interior of Steel Water Pipelines.
- 15. ANSI/AWWA C219 Bolted, Sleeve-Type Couplings for Plain-End Pipe.
- 16. ANSI/AWWA C228 Stainless-Steel Pipe Flange Joints for Water Service, Sizes 2 inch through 72 inch (50 mm Through 1,800 mm).
- 17. ANSI/AWWA C600 Installation of Ductile-Iron Mains and Their Appurtenances.
- 18. ANSI/AWWA C604 Installation of Buried Steel Water Pipe, 4 inch (100mm) and Larger.
- 19. ANSI/AWWA C605 Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings.
- 20. ANSI/AWWA C606 Grooved and Shouldered Joints.
- 21. ANSI/AWWA C900 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 inch Through 60 inch (100 mm Through 1,500 mm), for Water Transmission and Distribution.
- 22. ANSI/AWWA C906 Polyethylene (PR) Pressure Pipe and Fittings, 4 inch Through 65 inches. (100 mm Through 1,650 mm), for Waterworks.
- 23. AWWA Manual M23 PVC Pipe Design and Installation.
- 24. AWWA Manual M55 PE Pipe Design and Installation.
- C. National Sanitation Foundation International (NSF):
 - 1. NSF/ANSI 61 Drinking Water System Components Health Effects.
 - 2. NSF/ANSI 372 Drinking Water System Components Lead Content.

1.04 SUBMITTALS

- A. Section 01 33 23 Shop Drawings, Product Data, and Samples:
 - 1. Product Data for pipe materials, including pipe size, dimensions, pressure class, restraint devices, and appurtenances.
 - 2. Manufacturer's installation instructions.
 - 3. Layout drawings for DIP furnished with ring-type integral buried joint restraint.
 - 4. Layout drawings for pipe furnished with grooved and shouldered joints showing locations of rigid and flex style joints.
 - 5. Non-Toxic and Lead-Free Certification: Written statement that all materials in contact with potable water or raw water supply shall be NSF/ANSI 61 compliant, and shall be lead-free, as certified by the Water Quality Association to comply with NSF/ANSI 372.

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1.05 QUALITY ASSURANCE

A. Ductile Iron Pipe and Fittings:

- 1. Tests:
 - a. ASTM E8: Tension Testing of Metallic Materials.
 - b. ASTM E23: Impact Test.
- 2. Marking: Cast on each pipe length.
- 3. Weight, class, nominal thickness, and casting period.
- 4. Manufacturer's name, year of production, and letters "DI" or "Ductile Iron".

B. PVC Pipe and Fittings:

- 1. Tests: ASTM D3034, ANSI/AWWA C900, ASTM D1784, and ASTM D1785, as applicable.
- 2. Marking: Indelible, in each pipe.
 - a. Nominal pipe diameter and cell classification.
 - b. Manufacturer's name or trade name, PVC, ASTM and SDR designation, AWWA pressure class, and date of production.
 - c. Service designation.

C. High Density Polyethylene (HDPE):

- 1. Tests: ASTM D3035, ANSI/AWWA C906, AWWA Manual M55, PPI Handbook of Polyethylene Pipe.
- 2. Marking: indelible, each pipe.
 - a. Nominal pipe size and material designation.
 - b. Manufacturer's name or trade name, HDPE, ASTM and DR designation, and date of production.
- 3. Gasket Rings: Marked with the manufacturer's identification, size, year of production, and classes of pipe in which they are to be used.
- 4. Fusion: ASTM F2620.

PART 2 PRODUCTS

2.01 MATERIALS AND FABRICATION

A. Ductile Iron:

- 1. Pipe:
 - a. ANSI/AWWA C151/A21.51: ASTM A536, Grade 60-42-10.
 - b. Thickness: Pressure Class 350 for pipes 12 inch diameter or smaller; Pressure Class 250 for pipes 14 inch diameter or larger unless otherwise scheduled.
- 2. Fittings: Cast from ductile iron: ANSI/AWWA C110/A21.10 full body or ANSI/AWWA C153/A21.53 short body.
- 3. Joints: ANSI/AWWA C111/A21.11:
 - a. Mechanical Joint: 350 psi working pressure.
 - b. Flange: Also ANSI/AWWA C115/A21.15 and ANSI/ASME B16.42, ductile iron; 150 lb. pattern, unless scheduled otherwise.

- c. Bolts, Tie Bolts, and Nuts:
 - 1) Low carbon steel, ASTM A307.
 - 2) Bolts smaller than 3/4 inch: With heavy hex heads for flange and T-head for MJ, and heavy hex nuts.
 - 3) Bolts 3/4 inch and larger: With hex heads for flange and T-heads for MJ, and heavy hex nuts.
 - 4) Coating, Exposed Service: Grade B zinc coat per ASTM A153.
 - 5) Coating, Buried Service: Liquid applied fluoropolymer coating matrix consisting of lubricating compounds, UV stabilizers and coloring agents or pigments, heat cured, 0.7 to 1.0 mil total DFT.
- d. Gaskets for mechanical joints, push-on and flanged joints:
 - 1) Conformance: ANSI/AWWA C111/A21.11.
 - 2) Material: Synthetic rubber as specified in referenced standard. Natural or reclaimed rubber not acceptable.
 - 3) High Temperature Air Service Piping: Viton rubber rated for 350°F.
- e. Lubricant: In conformance with ANSI/AWWA C111/A21.11.
- 4. Joint Restraint: Furnish external mechanical restraint devices, including restrained flange adaptors for exposed piping as specified herein, or integral joint restraints for buried joints if specified herein. Furnish restraint devices where scheduled or noted on Drawings, as specified in Part 2 of this Specification.
- 5. Thickness: Pressure Class 350 for pipes 4-12 inch and Pressure Class 250 for pipes ≥ 14" unless otherwise scheduled.
- 6. Corrosion Protection:
 - a. Outside Coating (buried or submerged service):
 - 1) Pipe: Bituminous per ANSI/AWWA C151/A21.51.
 - 2) Fittings: Bituminous per ANSI/AWWA C110/A21.10 and ANSI/AWWA C153/A21.53 or fusion-bonded epoxy per ANSI/AWWA C116/A21.16.
 - b. Outside Coating, Exposed Service (not submerged): Prepare surface with SSPC-SP6-commercial blast cleaning and shop coat with rust inhibiting modified alkyd shop primer equivalent to Tnemec Series 4 Versare Primer or Sherwin-Williams Kem Kromik Universal Metal Primer. Field coat in accordance with Section 09 97 01 Industrial Coatings, Service Conditions F8, unless scheduled otherwise.
 - c. Outside Coating, Exposed Service (submerged): Prepare surface with SSPC-SP10-near-white blast cleaning and shop coat with rust inhibiting modified alkyd shop primer equivalent to Tnemec Series 4 Versare Primer or Sherwin-Williams Kem Kromik Universal Metal Primer. Field coat in accordance with Section 09 97 01 Industrial Coatings, Service Conditions F1, unless scheduled otherwise.
 - d. Inside Coating, Process Liquid Service: Cement mortar lining with bituminous seal coat, ANSI/AWWA C104/A21.4, unless scheduled otherwise.
 - e. Polyethylene Encasement:
 - 1) Conformance: ANSI/AWWA C105/A21.5.

- 2) Material: ASTM D4976, Group 2.
- 3) Configuration: Seamless tube or sheet.
- 4) Film Requirements:
 - a) Linear Low-density Polyethylene:
 - i. Thickness: 8 mil.
 - ii. Density: $0.910 \text{ to } 0.935 \text{ g/cm}^3$.
 - iii. Tensile Strength: 3,600 psi for 8 mil, ASTM D 882.
 - b) High-density, Cross-laminated Polyethylene:
 - i. Thickness: 4 mil.
 - ii. Density: $0.940 \text{ to } 0.960 \text{ g/cm}^3$.
 - iii. Tensile Strength: 6,300 psi for 4 mil, ASTM D 882.
- 5) Color: Weather-resistant black containing not less than 2% carbon black.
- 6) Pipe Wrap Tape:
 - a) Material: 10 mil all weather polyvinyl film.
 - b) Durability: Resistant to moisture and corrosive soil.
 - c) Adhesion: Adheres to metal and plastic, and conforms to irregularities in substrate surfaces.
 - d) Elongation: 245%.
 - e) Tensile Strength: 30 psi.
 - f) Width: 2 inches.
 - g) Printed Identification Marking: UPC code and mil thickness.
 - h) Acceptable Manufacturer: Northtown Company, or Engineer reviewed equivalent.
- 7) Strapping: Non-metallic, water resistant FS PPP-S-760.
- 8) Install on buried ductile iron piping, fittings, and restraint assemblies in accordance with AWWA C105, unless scheduled otherwise.

B. Steel:

- 1. Pipe:
 - a. Refer to Section 44 42 56.33 Package Booster Pumping System, for Pump Station Piping.
 - b. 6 inches and larger: AWWA C200; Minimum wall thickness: 0.25 inch unless otherwise scheduled.
 - c. 5 inches and smaller:
 - 1) ASTM A53 for gas service (unless specified otherwise in Division 15) and all other uses.
 - 2) Or as scheduled.
- 2. Flanges and Flange Hardware: AWWA C207.
 - a. Bolts to be hexagonal head.
 - b. Bolts and nuts to be zinc coated per ASTM A153.
 - c. Gaskets as specified in AWWA C207 except gaskets on air service lines to be red silicone rubber.
- 3. Fittings: ANSI/AWWA C208.

4. Corrosion Protection:

- a. Outside Coating, 6 inches and Larger, Buried Service: SSPC-SP10 with 16 mils coal tar enamel per ANSI/AWWA C203.
- b. Outside Coating, 5 inches and Smaller, Buried Service: Cold-Applied Tape Wrap:
 - 1) Surface Preparation: SSPC SP-2 Hand Tool Cleaning.
 - 2) Conformance Standard: NACE SP0109 (Cold-Applied Laminate Polymeric Tapes), and ANSI/AWWA C209 (Type II).
 - 3) Thickness: 50 mils
 - 4) Primer: Integrated with Adhesive. Follow manufacturer's recommendations for using optional primer at low application temperatures.
 - 5) Installation: Spiral wrap with minimum 1 inch overlap or 20% of the tape width, whichever is greater. Follow manufacturer's recommendations.
- c. Outside Coating, Exposed Service: Section 09 97 01 Industrial Coatings, Service Condition F3 unless otherwise scheduled at the end of this Section.
- d. Inside Coating:
 - Potable water service: Contractor's choice of cement mortar lining or SSPC-SP10 blast with NSF 61-certified epoxy coating unless otherwise scheduled at the end of this Section.
 - 2) Wastewater, storm water, and similar fluids: Section 09 97 01 Industrial Coatings, Service Condition F1.

C. Galvanized Steel:

- 1. Pipe: ASTM A53, Grade B.
- 2. Fittings: Joints as shown on Drawings.
 - a. Malleable Iron, threaded: ANSI B16.3.
 - b. Steel Fittings, welded and flanged: ASTM A234.
 - c. Flanges: AWWA C207, red rubber (SBR) gaskets, except high temperature air service gaskets shall be Viton rated to 350°F.
 - d. Malleable Iron, grooved and shouldered: ASTM A47.
- 3. Air Piping: Schedule 40 for 6 inch and smaller.
 - a. Schedule 20 for 8 inch to 12 inch.
 - b. Schedule 10 for 14 inch and larger.
- 4. Corrosion Protection:
 - a. Hot-Dip Process: ASTM B6 zinc inside and outside:
 - 1) Pipe: ASTM A123.
 - 2) Threaded fittings and flange bolts: ASTM A153.
 - b. Weight of Coating: ASTM A90.
 - c. Field Touch-up: After assembly, coat exposed threads and all other damage to factory zinc coatings with liquid-applied cold galvanizing compound in conformance with ASTM A780.

- D. Polyvinyl Chloride (PVC):
 - 1. Pipe and fittings:
 - a. Pipe sizes 4 inch through 60 inch:
 - 1) ANSI/AWWA C900.
 - 2) Pressure class as scheduled; Class 235 psi (DR 18) minimum if not scheduled otherwise.
 - 3) Fittings: Cast from ductile iron; ANSI/AWWA C110/A21.10, full body or ANSI/AWWA C153/A21.53, short body; mechanical joint ANSI/AWWA C111/A21.11, external mechanical restraint devices as specified herein. Encase fittings and all external restraint assemblies with polyethylene encasement per ANSI/AWWA C105/A21.5, unless scheduled otherwise.
 - b. Pipe sizes 3.5 inch and smaller:
 - 1) Unless otherwise scheduled or shown on the Drawings.
 - a) ASTM D2241.
 - b) 1.5 inch and smaller: SDR 21.
 - c) 2 inch through 3.5 inch: SDR 26.
 - d) Pressure rating as scheduled; 160 psi minimum if not scheduled.
 - 2) If scheduled or shown on the Drawings:
 - a) Schedule 40 and 80 Pipe Dimensions and Workmanship: ASTM D1785.
 - b) Schedule 40 minimum unless otherwise scheduled or shown on Drawings.
 - c) Material: ASTM D1784, Class 12454-B.
 - d) Fittings:
 - i. ASTM D2466, Schedule 40.
 - ii. ASTM D2464, Schedule 80, threaded.
 - iii. ASTM D2467, Schedule 80, socket type.
 - 2. Joints:
 - a. Gasket Bell Ends: ASTM D3139, lubricant assembled.
 - b. Gaskets: ASTM F477, elastomeric.
 - c. Solvent Cement: ASTM D2564 only where specifically allowed by Engineer, schedules or Drawings.
 - d. Solvent Cement Bell End: ASTM D2672.
 - 3. Joint Restraint: Furnish external mechanical restraint devices, including restrained flange adaptors, as specified herein, or integral joint restraints for buried joints if specified herein. Furnish restraint devices where scheduled, noted on Drawings, and where specified in this specification.
- E. High Density Polyethylene (HDPE) 3 inch to 54 inch:
 - 1. Conformance: AWWA C906, AWWA Manual M55, PPI Handbook of Polyethylene Pipe.
 - 2. Resin: High density polyethylene (HDPE) PE4710 having minimum cell classification 445474C/E as rated by the Plastic Pipe Institute (PPI) and in conformance with ASTM D3350.

- 3. Wall Thickness Design: ASTM F714, DR pipe dimension ratio based on controlled outside diameter, DIPS sizing system.
 - a. Unless scheduled otherwise, DR 11.
- 4. Joints: Thermal fusion ASTM F2620.
- 5. Connections to Other Piping and Valves: Fusion bonded HDPE Flange adapters with ductile iron back-up rings, ANSI B16.5 150 lb. flange pattern, or fusion bonded restrained MJ adapters.

F. External Mechanical Restraint Devices:

- 1. Works on principle of multiple wedging action against pipe, which increases its resistance as line pressure increases while maintaining joint flexibility. Set screw devices are not acceptable. Split non-serrated back-up rings behind bells are acceptable. Split serrated restraint rings are not acceptable, except on spigot end of bell restraint harness of C900 PVC pipe up to 12 inches. EBAA Iron Sales, Inc. or Engineer reviewed equivalent.
- 2. Gland: Ductile iron with dimensions which match standard mechanical joint bells per ANSI/AWWA C153/A21.53, ASTM A536, Grade 65-45-12.
- 3. Wedges: Heat-treated ductile iron with minimum Brinnel hardness of 370 BHN.
- 4. Wedges tightened during installation via twist-off nuts.
- 5. Devices shall be designed for the following working pressure:
 - a. 250 psi for 18 inch to 48 inch DIP, 2:1 safety factor.
 - b. 350 psi for 3 inch to 16 inch DIP, 2:1 safety factor.
 - c. Meets or exceeds standardized pressure rating of host PVC piping.
- 6. Devices shall be designed for the type of pipe material and pipe joint being harnessed.
- 7. An identification number shall be cast into each gland body with the following information: Date and shift of manufacture, and plant location.
- 8. All physical and chemical test results shall be made available to Engineer for review upon request by referencing the identification number.
- 9. Coating for wedges, wedge actuators, bolts, tie bolts, nuts, and related fastener and gripping components:
 - a. Surface Preparation: Cleaner wash, phosphatizing, rinse, and drying.
 - b. Coating: Liquid applied fluoropolymer-matrix consisting of lubricating compounds, UV stabilizers, and coloring agents or pigments. Heat cured. Two coats, 0.7 to 1.0 mil total DFT.
 - c. Low VOC, resin bonded and thermally cured, single film, dry lubricant, primarily formulated for use on fasteners.
 - d. Designed to prevent corrosion and facilitate make-up torque.
 - e. Provide lubricity of coating for proper dispersion of PTFE.
- 10. Coating for Cast Bodies:
 - a. Surface Preparation: Cleaner wash, phosphatizing, rinse, and drying.
 - b. Coating: Electrostatically applied TGIC polyester-based powder. Heat cured. 1.5 to 4.0 mils total DFT.
 - c. Designed to prevent corrosion, impact and UV resistance.

d. Appearance: Class 5 (orange peel) PCI smoothness standard; 75% to 85% gloss at 60 degrees per ASTM D523; pinhole free.

G. Grooved and Shouldered Joints:

- 1. Conformance: ANSI/AWWA C606.
- 2. Rated Working Pressure: Not less than that specified for the pipe.
- 3. Application:
 - a. Exposed and buried ductile iron pipe, 3 inch to 36 inch, Class 53 or heavier, in lieu of flanged or mechanical joints and fittings.
 - b. Exposed black or galvanized steel pipe, in lieu of flanged joints and fittings.
 - c. Or where indicated on Drawings.
- 4. Mechanical Couplings:
 - a. Design: Housing and gaskets shall be designed to fully seat and seal by visual verification without need to measure bolt torque.
 - b. Groove: Cutting, rolling and dimensions in conformance with ANSI/AWWA C606.
 - c. Rigid/Flex Style Joints: Locations as indicated on Drawings or as indicated on accepted shop drawings.
 - d. Housing: Two or more segments of ductile iron, ASTM A536, grade 65-45-12.
 - e. Housing Factory Coating:
 - 1) Exposed Service: 1.5 mil alkyd phenolic primer, enamel top coat.
 - 2) Buried or Immersion Service: Coal tar epoxy.
 - f. Gaskets: Pressure-responsive synthetic rubber, grade as recommended by manufacturer as suitable to meet fluid and temperature requirements. All materials in contact with potable water shall be NSF 61 certified.
 - g. Coupling Bolts and Nuts:
 - Exposed Service: Heat treated carbon black steel per ASTM A183, 110,000 psi tensile strength, with zinc plating per ASTM B633.
 - 2) Buried or Immersion Service: Type 304 stainless steel.
- 5. Ductile Iron Fittings:
 - a. Material: Ductile iron, ASTM A536, grade 65-45-12.
 - b. Center-to-End Dimensions and Wall Thickness: Conform to ANSI/AWWA C110/A21.10.
 - c. Rated Working Pressure:
 - 1) 3 inch to 12 inch: 350 psi.
 - 2) 14 inch to 36 inch: 250 psi.
 - d. Grooved Ends: ANSI/AWWA C606.
 - e. Factory Coating:
 - 1) Exposed Service: 1.5 mil alkyd phenolic primer, enamel top coat.
 - 2) Buried or Immersion Service: Coal tar epoxy.
 - 3) Lining: Cement mortar lining ANSI/AWWA C104/A21.4.

- 6. Connection to Adjacent Valves and Flanged Piping:
 - a. Furnish valves with factory grooved ends conforming to ANSI/AWWA C606.
 - b. Or furnish flange adapter with grooves conforming to ANSI/AWWA C606.
- 7. Acceptable Manufacturers: Victaulic Company, Shurjoint, or Engineer reviewed equivalent.
- 8. Installation: Follow manufacturer's recommended grooving and assembly instructions.
- 9. Manufacturer's Field Service Representative:
 - a. Provide a minimum of one visit to job site to train Contractor's field personnel in the proper use of grooving tools, application of groove, and product installation.
 - b. Provide a minimum of one visit to job site to review installation.

 Contractor shall remove and replace any improperly installed products.

H. Couplings:

- 1. Use only where indicated on Drawings or reviewed by Engineer. Do not use where restrained fittings are specified.
- 2. For buried or exposed service, furnish factory applied fusion-bonded epoxy coating in accordance with ANSI/AWWA C213, and corrosion-resistant alloy bolts equivalent to Dresserloy or Type 316 stainless steel.
- 3. For air service, furnish high temperature EPDM or Viton gaskets rated for 250°F or higher.
- 4. Shall meet ANSI/AWWA C219: Described by reference to couplings manufactured by Dresser Industries, Inc., Bradford, PA; equivalent couplings by Ford Meter Box, JCM Industries, Romac Industries, or by other manufacturers may be used:
 - a. Dresser Style 38 for exposed steel, cast iron, and ductile iron pipe unless indicated otherwise on Drawings or scheduled.
 - b. Dresser Style 253 cast iron couplings for buried steel, cast iron, ductile iron, and asbestos cement pipe, unless indicated otherwise on Drawings.
 - c. Dresser Style 40 long couplings where long couplings are indicated.
 - d. Dresser Style 62 Type reducing couplings where reducing couplings are indicated.
 - e. Dresser Style 162 couplings for transition between different pipe materials.
 - f. Dresser Style 63 expansion coupling where expansion coupling is indicated; type as indicated on Drawings or scheduled.
 - g. Dresser Style 227 and 128 coupling with flanged adaptor where indicated on Drawings.
 - h. Dresser Style 131 dismantling joint.

- I. Pipe Sleeves for Carrier Pipes 22 inch Diameter or Smaller:
 - 1. Manufactured from non-metallic, non-corrosive, thermoplastic material.
 - 2. Formed to have a water stop and anchor plate at least 4 inches larger than the main outside diameter and position, unless otherwise specified, in the middle of the sleeve body.
 - 3. Seal shall provide electrical insulation barriers between the pipe and wall.
 - 4. Link-Seal Century Model CS, Thunderline Corporation, or Innerlynx Model PWS.

J. Pipe Sleeves for Carrier Pipes 24 inch Diameter and Larger:

- 1. Steel sleeves with full circle waterstop collar continuously welded on both sides hot dipped galvanized or thermally bonded plastic coating.
- 2. Link-Seal Model WS or Innerlynx Model Gal-vo-plast®.

K. Mechanical Seals:

- 1. Watertight, synthetic rubber seal composed of interlocking links joined by bolts, modular sealing element when sleeve is placed in slabs with one side against soil or as shown on Drawings.
- 2. Rubber links shall completely fill the annular space between pipe and sleeve to provide water tight seal capable of resisting a hydrostatic pressure of 20 psi.
- 3. Pipe Sleeve Installations: Link-Seal LS for sleeve model CS or Innerlynx Model IL-C.
- 4. Core Drilled Installations: Link-Seal LS or Innerlynx IL-C.

L. Wall Pipe:

- 1. Material: DIP or cast iron pipe.
- 2. Seep Ring: Continuously welded or integrally cast intermediate flange.
- 3. Size, Thickness and Ends: To match connecting piping.

M. Tapping Saddles:

- 1. AWWA C900 PVC Host Pipe:
 - a. Body Material: Bronze or brass.
 - b. Strap Material: Type 304L stainless steel.
 - c. Style: Two strap.
 - d. Rated Working Pressure: At least 200 psig.
 - e. Outlet Seal: EPDM O-ring.
 - f. Tap Size: As indicated on Drawings.
 - g. Conformance: Applicable portions of AWWA C800.
 - h. Acceptable Manufacturers: Mueller BR2S, Romac 202BS, Ford 202BSD, or Engineer reviewed equivalent.

2. Ductile Iron Host Pipe:

- a. Body Material: Ductile iron, ASTM A536 with 10 to 12 mil nylon or epoxy coating.
- b. Strap Material: Type 304L stainless steel.
- c. Style: Two strap.
- d. Rated Working Pressure: At least 200 psig.

- e. Outlet Seal: EPDM O-ring.
- f. Tap Size: As indicated on Drawings.
- g. Conformance: Applicable portions of AWWA C800.

N. Tapping Sleeves:

- 1. Minimum working pressure: 250 psi.
- 2. Welded, fabricated type 304 stainless steel body with the following features:
 - a. Buna-N rubber gasket, gridded, 360 degree pipe coverage.
 - b. Type 304 stainless steel bolts and nuts.
 - c. Flat face steel flange per AWWA C228, Class D 150 lb. pattern per AWWA C207.
 - d. Test Plug: 3/4-inch NPT, no-lead brass.
- 3. Ford FTSS, Smith-Blair 663 or JCM 432.
- 4. Sizes as shown on Drawings.

2.02 ACCESSORIES

A. Supports and Anchors:

- 1. Clevis Hangers: FS WW-H-171E, as appropriate or as shown on Drawings.
- 2. Hanger Rods: ASTM A307, Grade R.
- 3. Fabricated Supports: Galvanized steel with stainless steel hardware.
- 4. Beam Clamps: FS WW-H-171E, as appropriate or as shown on Drawings.
- 5. Concrete Inserts:
 - a. Individual: FS WW-H-171E, as appropriate or as shown on Drawings.
 - b. Continuous:
 - 1) Channel 12 gauge, galvanized 1-5/8 inch x 1-5/8 inch.
 - 2) Anchor lugs on 4 inch centers, 2 minimum.
- 6. Wall Supports and Frames: FS WW-H-171E, as appropriate or as shown on Drawings.
- 7. Floor Supports:
 - a. 6 inch and smaller: FS WW-H-171E, Type 38.
 - b. Larger than 6 inch: FS WW-H-171E, Type 36 or 39.
- 8. Other: As indicated on Drawings.
- B. Pressure Gauges: As specified in Section 40 73 13 Pressure Gauges, and as shown on Drawings.
- C. Pipe Marking Systems for Buried Utilities: Refer to Section 31 23 33 Trenching and Backfilling.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:

- 1. Install as indicated on Drawings.
- 2. Trenching, Backfilling and Compacting: Section 31 23 33 Trenching and Backfilling.

- 3. Pipe cutting measurement taken at site.
- 4. Clean all pipe, accessories, and appurtenances before use.

B. Flanged Joints:

- 1. Flange faces to bear uniformly on the gasket and bolts tightened in progressive crisscross order.
- 2. Tighten flange bolts with a properly calibrated torque wrench set at the following ranges unless otherwise agreed by the Engineer:

Flange Size Torque Range (ft-lbs)
4" through 24" 75 – 90
30" through 36" 100 – 120
>36" 120 - 150

3. All flange bolts at each connection to be uniformly tightened to the specified range.

C. Other Joints:

- 1. Manufacturer's recommendations.
- 2. Lubricants: Vegetable soap solution.
- 3. Solvent cementing of PVC pipe only where scheduled.
- D. Clean all lines by repeated flushings after installation.

E. Pipe Sleeves:

- 1. For pipes passing through concrete or masonry.
- 2. Install before concrete is placed where practical.
- 3. Use on all penetrations for line sizes 20 inch or smaller unless otherwise shown on Drawings or indicated on Schedule.

F. Mechanical Seals:

- 1. To be used with pipe sleeves and core drilled penetrations.
- 2. Use only where indicated on Drawings or Schedule for wall penetrations.

G. Wall Pipe:

- 1. Only where indicated on Drawings or scheduled, provide wall pipe for pipes passing through concrete walls.
- 2. Install when concrete is placed.
- 3. Provide tapped holes where wall pipes with flanges are flush with concrete.

H. Floor Penetrations:

- 1. Install pipe sleeve through floor sized to provide 0.25 inch to 1.0 inch annular space around pipe and maximum of 1" projection above top of floor.
- 2. Pipe sleeve shall be heavy wall PVC or galvanized steel.
- 3. Pipe sleeve shall contain a 1 inch wide collar located in center of floor slab.
- 4. Fill annular space with watertight resilient seal: Type A urethane sealant with joint backer, as specified in the Elastomeric Sealants section.
- 5. Use on all penetrations unless otherwise shown on Drawings or indicated on Schedule.

- I. Anchoring and Supports:
 - 1. Where needed or indicated on Drawings.
 - 2. Section 05 50 10 Anchor Bolts and Chemical Anchors.
 - 3. Maximum Support Spacing:

Nominal Pipe	Maximum Span, Water Service, feet		
Size, inches	Schedule 40 and 80 Rigid PVC	Schedule 40 Steel	
0.5 and smaller	3	7	
0.75	3	7	
1	3.5	7	
1.5	4.5	9	
2	5	10	
3	6	12	
4	6.5	14	
6	7.5	17	
8	8	19	
10	8.5	22	
12	9.5	23	
14	10	25	
16	10.5	27	
18	11	28	
20	11.5	30	
24	12.5	32	

J. Buried Pipe Anchorage:

- 1. Furnish and install anchors, joint restraint devices, or other acceptable means of preventing pipe movement at all of the following locations, whether shown on the Drawings or not:
 - a. Unlugged bell and spigot or all unflanged tees.
 - b. Y branches.
 - c. Bends deflecting 22-1/2 degrees or more.
 - d. Plugs.
 - e. Fittings in fills or unstable ground.
 - f. Above grade or exposed structure.

3.02 FIELD QUALITY CONTROL

- A. Ductile Iron Pipe: AWWA C600, except as specified or shown otherwise.
- B. Steel Pipe: AWWA C604, except as specified or shown otherwise.
- C. PVC Pipe, and Fusible PVC Pipe: AWWA C605 for pressure rated, and AWWA Manual M23, except as specified or shown otherwise.
- D. HDPE Pipe: AWWA C906, AWWA Manual M55, and PPI Handbook of Polyethylene Pipe, except as specified or shown otherwise.

- E. All pipes and fittings tested in presence and to the satisfaction of the Engineer.
- F. Test Conditions:
 - 1. Low Pressure Air Piping: 10 psi air, check with soap solution, bubble tight.
 - 2. High Pressure Air Piping: 100 psi air, check with soap solution, bubble tight.
 - 3. Exposed Pressurized Water and Wastewater Lines: 150 psi hydrostatic test, no visible leakage for 1 hour.
 - 4. **Do not test PVC, FPVC or CPVC with air** because pipe failure from pressurized air may result in explosive shards.
 - 5. Buried Force Mains Except HDPE: Hydrostatic test at 150% of shut-off head for lift station pumps or 75 psi, whichever is greater, for two-hour minimum; allowable leakage shall be less than that determined by the following formula:
 - a. $L = (N) (D) (P^0.5) / 133,200$
 - b. Where:
 - 1) L = allowable leakage in gallons per hour.
 - 2) N = length of pipeline tested in feet.
 - 3) D = nominal diameter of pipe in inches.
 - 4) P = average test pressure during test, psig.
 - 6. Buried pressure-rated and restrained piping subject to gravity flow and submergence up to 30 feet: 50 psi hydrostatic test for two hours minimum; allowable leakage shall be less than that determined by the formula specified for buried force mains except HDPE.
 - 7. Buried HDPE Force Mains: Hydrostatic test at 150% of shutoff head for lift station pumps or 75 psi, whichever is greater.
 - a. Fill Phase: Fill the restrained test section completely with water. Evacuate air from all high points.
 - b. Initial Expansion Phase: After the piping and water have equalized to a common temperature, gradually pressurize test section to test pressure, and maintain test pressure for 3 hours. During the initial expansion phase, HDPE pipe will expand slightly. Add additional water to maintain pressure. It is not necessary to monitor the amount of water added during the initial expansion phase.
 - c. Test Phase: Immediately following the initial expansion phase, reduce test pressure by 10 psi, and stop adding test water. If test pressure remains steady (within 5% of the target value) for 1 hour, no leakage is indicated.
 - d. Depressurization Phase: Gradually release the test pressure by controlling the release of water.
 - e. Total Test Duration: Limit the time the pipe is pressurized at test pressure to 8 hours. If pipe must be pressurized again to test pressure, depressurize pipe first and allow it to relax for at least 8 hours before repressurizing.
 - f. Supervision: Do not leave the test section unsupervised at any time during leak testing.
 - 8. Other Piping: No detectable leakage under normal or simulated operating conditions.

G. Procedure:

- 1. Disconnect fixture, equipment, and accessories which may be damaged by test pressure.
- 2. Plug ends as required.
- 3. If leakage is indicated, locate and repair leaks.
- 4. Retest repaired joints, piping, and fittings until system complies with above criteria for allowable leakage.

3.03 PIPE SCHEDULE

- A. From outside of skid to 5 feet horizontally outside pump station building.
- B. Inlet line to air valves.
- C. Vent line from air valves.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	<u>Pay Item</u>	Pay Unit
1.25, 3.23, 4.03, 5.01, 5.03, 5.04	Exposed Process Piping Systems to 5 feet Horizontally Outside of	Lump Sum
	Structures	

END OF SECTION

SECTION 40 27 02.09

MISCELLANEOUS VALVES

PART 1 GENERAL

1.01 WORK INCLUDED

A. Furnish and install all miscellaneous valves specified herein.

1.02 SUBMITTALS

- A. Section 01 33 23 Shop Drawings, Product Data, and Samples: Product data for all items listed in PART 2 PRODUCTS, except for hose bibbs and plug cocks.
- B. Section 01 78 23 Operation and Maintenance Data: Operation and Maintenance (O&M) Manuals for all items listed in Part 2 PRODUCTS, except for hose bibbs, plug cocks, stop gates, gate valves under 4 inches, and elastomeric check valves.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Same manufacturer for each type of valve throughout where practical.
- B. Manufacturer's name or initials and working pressure ratings cast on valve body.

2.02 DESIGN REQUIREMENTS

- A. General: Unless otherwise indicated, use valves suitable for 125 minimum psi WOG and 150°F.
- B. Lead Free: All materials in contact with potable water shall be lead-free, as certified by the Water Quality Association to comply with NSF/ANSI 372, and shall be NSF 61 compliant.

C. Gate Valves:

- 1. 3 inch or smaller:
 - a. Bronze body and wedge with threaded ends, non-rising stem; Grinnel or Engineer reviewed equivalent.
 - b. Pressure rating: 200 psi non-shock cold water, oil, or gas, unless otherwise scheduled or shown on Drawings.
 - c. Furnish gate valves for buried lines with valve key operator.
 - d. 4 inch or larger: See Section 33 12 01 Water Systems.

- D. Air/Vacuum and Air Release Valves:
 - 1. Water Service Air Valves:
 - a. Functions furnish type and size of water service air valves as scheduled or as noted on Drawings:
 - 1) Air Release Valves: Releases air pockets during system operation.
 - 2) Air/Vacuum Valves: Exhausts large quantities of air at system start-up, and introduces air to protect system from vacuum.
 - 3) Combination Air Valves (CAV): Releases air pockets during system operation, exhausts large quantities of air at system start-up, and introduces air to protect system from vacuum.
 - b. Conformance: AWWA C512, NSF/ANSI 61 certified for drinking water, and NSF/ANSI 372 certified lead-free by WQA.
 - c. Pressure Rating: 150 psi, unless otherwise scheduled or shown on Drawings.
 - d. Body, Cover, and Baffle: Cast iron or ductile iron.
 - e. Interior and Exterior Coating: Fusion bonded epoxy in accordance with AWWA C550.
 - f. Float and Trim: Type 316 stainless steel.
 - g. Seat: Buna-N or Viton.
 - h. 2-inch Inlet and Smaller: NPT threaded inlet and outlet.
 - i. 3-inch and 4-Inch Inlet: NPT or 125 lb. pattern flange inlet, NPT outlet, as indicated on Drawings.
 - j. 6-inch and 8-Inch Inlet: 125 lb. pattern flange inlet, NPT outlet.
 - k. Piping Appurtenances: Inlet stainless steel ball or gate valve and vent return leg piping with ¼-inch mesh stainless steel bug screen fastened to outlet, unless shown otherwise on Drawings.
 - 1. Drain Valve Inspection Piping: Install stainless steel ball valve and stainless steel fittings on air valve body lower drain tap in accordance with manufacturer's Operation and Maintenance Manual to facilitate performance testing.
 - 2. Training of Owner's Personnel: Manufacturer's Field Service Representative shall provide 4 hours of training to Owner's personnel on operation and maintenance in accordance with the requirements of Section 01 79 01 Manufacturer's Instruction of Owner's Personnel.
 - 3. Insulation Blanket for Valves and Piping Inside Air Valve Stations:
 - a. Service: Flexible, removable insulation blanket around valves and piping located inside buried air valve manholes.
 - b. Outer and Inner Jackets: 17.0 oz./sq. yd. silicone impregnated fiberglass cloth.
 - c. Insulation:
 - 1) Material: Fiberglass, 9 pcf density.
 - 2) Thermal Conductivity: k = 0.4 BTU/inch/hr/SF/F degree at 300°F
 - 3) Thickness: 1-1/2 inches.
 - d. Fabrication Requirements:
 - 1) Blanket construction shall be double-sewn lock stitch with a minimum of seven stitches per inch. Raw jacket edges shall have a

- tri-fold Silicone cloth binding. No raw-cut jacket edges shall be exposed. Stitching shall be done with Teflon-coated fiberglass thread.
- 2) Blanket design shall encase the unit to be insulated.
- 3) To maintain uniform thickness, stainless steel quilting pins shall be placed at random locations no greater than 18 inches apart. This will prevent shifting of the insulation fiber.
- 4) Blanket insulation shall use a belt system fastening method: 1-inch wide webbed nylon belting with a 1-inch wide "D" ring fastener sewn onto the belt. The belts shall be left long enough to facilitate easy tightening. Heat the ends of the belts to prevent fraying.
- 5) Fabricate blanket to enclose valves and valve handles.

E. Hose Bibbs:

- 1. Body: Brass or bronze.
- 2. Hose Connection Spout: 3/4 inch.
- 3. Packing: Nitrile or EPDM.
- 4. Seat Washer: Nitrile.
- 5. Wheel Handle: Aluminum or painted steel.
- 6. Maximum Pressure: 125 psi.
- 7. Maximum Temperature: 120°F.
- F. Bronze Ball Valves for Exposed Metal Pipe Installations, 1/4 inch to 4 inch:
 - 1. Body and Adapter: Lead free copper silicon alloy.
 - 2. Style: Two-piece, standard port.
 - 3. Pressure Rating:
 - a. 600 psi WOG non-shock at 300°F for 1/4 inch to 3 inch.
 - b. 400 psi WOG non-shock at 250°F for 4 inch.
 - 4. Ball: Type 316 stainless steel.
 - 5. Seat: Carbon/glass filled or enhanced PTFE.
 - 6. Body Seal: PTFE.
 - 7. Stem: Type 316 stainless steel, blowout-proof.
 - 8. Stem Packing: Glass reinforced, PTFE.
 - 9. Stem Packing Nut: Brass, ASTM B16, C36000, adjustable packing gland.
 - 10. Lever Handle and Nut: Zinc plated carbon steel.
 - 11. Handle Sleeve: Vinyl.
- G. Stainless Steel Ball Valves for Exposed Metal Pipe Installations, Including Air Valve Isolation, 1/4 inch to 3 inch:
 - 1. Body, End Cap and Ball: Type 316 wrought stainless steel, or ASTM A351 grade CF8M cast stainless steel.
 - 2. Style: Two-piece, standard port.
 - 3. Pressure Rating: 1,000 psi WOG at 100°F.
 - 4. Seat and Body Seal: RPTFE.
 - 5. Stem: Type 316 stainless steel, blow-out proof.
 - 6. Stem Packing: RPTFE.
 - 7. Stem Packing Gland: Type 304 stainless steel.

- 8. Lever Handle and Nut: Type 304 stainless steel with safety latch locking device.
- 9. Handle Sleeve: Vinyl.

H. Vent Pipe Two-Way Damper:

- 1. Type: Wafer-style, two-way hingeless damper to prevent cold air from entering the vault but allow the vent to admit and expel air under normal operating conditions.
- 2. Design: Two-part bolted body with a field-replaceable hingeless flexible disc that opens fully in either direction to provide 100% flow area.
- 3. Connection to Piping: Wafer style designed to fit between two ANSI B16.1 125-pound pattern flanges.
- 4. Operating Temperature Range: -40° to 150°F.
- 5. Materials:
 - a. Body: High density polyethylene.
 - b. Flexible Disc: Nylon reinforced high grade Neoprene.
 - c. Damper Seal: PETG.
 - d. Body Bolts: Type 316 stainless steel.
- 6. Acceptable Manufacturer:
 - a. Val-Matic Series 1500 FrostSafe®, Elmhurst, IL.
 - b. Or Engineer reviewed equivalent.

2.03 PROTECTIVE COATING

A. Fusion-bonded epoxy coatings.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Manufacturer's recommendations.
- B. Per code or best trade or industry practice.
- C. As indicated on Drawings.

3.02 SCHEDULE

A. As indicated on Drawings.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
1.02, 1.13, 2.08, 3.15	Miscellaneous Valves Installed in Air Valve Stations	Each
3.23, 5.04	Exposed Gate Valves, and Damper Installed in PRV and	Lump Sum
	Meter Vaults	

END OF SECTION

SECTION 40 27 02.10

VALVE BOXES

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Boxes for all buried, manually operated valves, and appurtenances.
- B. Box covers with cast markings.

1.02 SUBMITTALS

- A. Section 01 33 23: Shop Drawings, Product Data, and Samples for all items specified in PART 2 PRODUCTS.
- B. Section 01 78 23: Operation and Maintenance Manual for valve position indicators.

PART 2 PRODUCTS

2.01 MATERIALS AND CONSTRUCTION

- A. ASTM A48 Class 35 cast iron, adjustable screw extension type, traffic type.
- B. Minimum thickness of metal at any point: 3/16".
- C. Coating: Asphaltic bituminous coating, inside and out, 1.5 mil minimum thickness.
- D. Removable cast iron cover, 5-1/4" diameter standard drop lid, cast marking with words, "WATER", "SEWER", "REUSE", or "GAS" to match appropriate utility.
- E. Cast iron base properly sized to fit over valve bonnet and bear on bricks, as shown on Drawings.
 - 1. Base shall be large enough to extend 6 inches below bottom of valve operating nut.
 - 2. Base shall be large enough so no part of the base or its bearing bricks shall bear on any part of the valve.
- F. For valves on washwater and irrigation system only: Class 200 PVC pipe.
- G. Furnish valve stem extension to position standard AWWA 2-inch operating nut as shown on Valve Stem Extension Detail on Sheet W-502.

PART 3 EXECUTION

3.01 INSTALLATION

A. Per AWWA Manual M44: Distribution Valves: Selection, Installation, Field Testing, and Maintenance, Latest Edition.

- B. With concrete collar, as shown on Drawings.
- C. Shall not bear on pipe or valve.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
1.01, 1.02, 1.03, 1.11, 1.12,	Valve Boxes Installed in Linear	Each
1.14, 2.01, 2.07, 3.12, 3.13, 3.14	Easements and R.O.W.s	
1.25, 4.01, 5.03	Valve Boxes Installed within Yard Piping	Lump Sum

END OF SECTION

SECTION 40 27 02.13

SELF-CONTAINED CONTROL VALVES

PART 1 GENERAL

1.01 WORK INCLUDED

A. Automatic control valves such as, but not limited to pump control valves, altitude valves, differential control valves, pressure reducing and/or pressure sustaining valves, surge control valves, and combination valves.

1.02 REFERENCES

- A. American Water Works Association (AWWA):
 - 1. AWWA C116/A21-16 Protective Fusion-Bonded Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service.
 - 2. AWWA/ANSI C530 Pilot-Operated Control Valves.

1.03 SUBMITTALS

- A. Section 01 33 23 Shop Drawings, Product Data, and Samples:
 - 1. Product data and conformance to referenced standards for valves and accessories.
 - 2. Manufacturer's installation instructions.
 - 3. Manufacturer's certification of control schematic.
 - 4. Shop drawing for each valve.
 - 5. Computerized cavitation chart showing flow rate, differential pressure and percentage of valve opening, Cv factor, system velocity, and if there will be cavitation damage. All analysis to be fully supported by independent third-party testing laboratory.
- B. Section 01 78 23 Operation and Maintenance Data:
 - 1. Operation and maintenance manual for all valves.
 - 2. Field operation and maintenance instruction for each valve.
 - 3. Video record field operation and maintenance instruction, if scheduled.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Cla-Val Co., Newport Beach, CA.
- B. Singer Valve, Surrey, BC.
- C. Or Engineer reviewed equivalent.

2.02 DESIGN AND CONSTRUCTION

- A. Conformance to referenced minimum standards, unless specified otherwise herein: AWWA C530.
- B. Valve design to be globe single diaphragm type in horizontal or angle pattern as required; edges of diaphragm shall be exposed.
- C. Main valve to have a single, removable seat with a 5 degree taper, and shall be combined with the lower guide into a single part for smaller valves or a multiple-part assembly for larger valves, and include a precision machined O-ring gland; the seat shall be a screw-in design or mechanically retained with Spiralock bolts (to not cause damage to the O-ring). Seat shall be oriented to mate with a completely vertical shaft; slanted seats are not allowed.
- D. Coating: Fusion-bonded epoxy inside and out, NSF/ANSI 61 certified, AWWA C116.
- E. Lead-free materials in contact with water, as certified by the Water Quality Association to comply with NSF/ANSI 372.
- F. Non-Toxic: NSF 61 compliant, all materials in contact with potable water.
- G. Main valve resilient disc to be retained on 3-1/2 sides; O-ring type discs are not allowed.
- H. Main valve stem to be guided by bearings at the top in the valve cover and at the bottom in the valve seat.
- I. Stem to be drilled and may be tapped at cover end to accept accessories.
- J. Control system components shall be manufactured by the same company as the main valve.
- K. Main Valve Diaphragm:
 - 1. Vulcanized at stemhole and not used as the seating surface.
 - 2. Capable of withstanding Mullins Burst test of 600 psi per nylon layer.
 - 3. No lip seals or packing may be used to seal the actuator.
 - 4. Flat diaphragm models shall be fully supported in full open and full closed positions by precision machined surfaces.
 - 5. Flat diaphragm models shall be protected from over-extension in full open position by contact of precision machined surfaces of diaphragm washer and cover stops.
 - 6. Single rolling diaphragm models shall have smooth frictionless movement without binding throughout the full valve stroke to provide accurate control, especially in low flow situations.
- L. All necessary repairs and/or modifications shall be possible without removing the main valve from the line.

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- M. Valve to be hydraulically operated, pilot-controlled diaphragm type.
- N. Valve cover and body mating surfaces: Precision machined with register fits or locating pins and serrated surfaces to grip and seal the diaphragm and center the cover.
- O. Single Chamber Type Valves:
 - 1. Single operating chamber separated from line pressure by the diaphragm.
 - 2. Removable guide bearings for main stem.
 - 3. Disc guide: One-piece design with straight edges and radius on top edge or hourglass shaped design.
- P. Dual Chamber Type Valves:
 - 1. Two operating chambers sealed from each other by the diaphragm.
 - 2. Lower operating chamber: Separated from line pressure by an O-ring seal.
 - 3. Check flow feature when scheduled: Lift type, non-hydraulic check feature using a two-piece stem.
 - 4. Main valve stem to be fully guided with bearings in the valve cover and seat for port sizes 8" and smaller.
- Q. Reduced Port Type: Valve seat diameter to be one nominal size smaller than valve flange diameter.

2.03 MATERIALS

- A. Main valve body and cover......Ductile Iron ASTM A536.
- B. Main valve stem......Stainless-steel Type 303 or 316.
- C. Main valve stem nut......Stainless Steel or Brass.
 - 1. Note: Main valve stem and stem nut must have sufficient material and hardness difference to prevent galling during assembly and disassembly.
- D. Main valve springStainless Steel Type 303.
- E. Main valve seatBronze, ASTM B62 or Stainless Steel Type 316.
- F. Main valve bearings......Brass or Bronze, ASTM B62.
- G. Diaphragm and discBuna N Rubber.
- I. Pilot valve body and cover.....Bronze, ASTM B62.

- J. Pilot valve seatStainless Steel Type 303.
- K. Disc retainer and diaphragm washer.....Cast Iron.

2.04 ACCESSORIES

A. In-Line Strainer:

- 1. Type: In-line H-Style Design. Strainer removable by removing top cover. Strainer does not extend below pipe flange.
- 2. Service: Potable water up to 175°F.
- 3. Conformance: NSF/ANSI 61 compliant.
- 4. Rated Pressure: 250 psi.
- 5. Main Case: Cast ductile iron.
- 6. Flanged Ends: Ductile iron, ANSI B16.42, 150-pound pattern.
- 7. Coating: Fusion-bonded epoxy inside and out, NSF/ANSI 61 certified, AWWA C116.
- 8. Cover Bolts: Type 316 stainless-steel.
- 9. Cover Seal: Buna-N rubber.
- 10. Screen: Flat, type 316 stainless-steel, 10 mesh with 0.078-inch openings, 55% open area.
- 11. Accessories: Threaded stainless-steel drain/blow-off and air bleed plugs.
- 12. Acceptable Manufacturer:
 - a. Cla-Val Co., Newport Beach, CA.
 - b. Or Engineer reviewed equivalent.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Manufacturer's recommendations.
- B. As indicated on Drawings.
- C. Contractor shall furnish 3/8-inch stainless-steel drain tubing from all drip sources in the pilot assembly to the nearest floor drain or through wall to daylight, unless shown otherwise on Drawings.
- D. Provide pilot tubing sizes and appurtenances as recommended by the valve manufacturer.
- E. Install pilot tubing on the side of the valve that is most accessible for maintenance.
- F. Costs for furnishing and installing pilot tubing, appurtenances, and connections shall be incidental work associated with each valve.

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3.02 FIELD SERVICE REPRESENTATIVE

- A. See Section 01 75 01 Field Service Representative, for qualifications of Field Service Representative.
- B. Manufacturer's representative shall have an office that is capable of providing repair service and maintains minimum of \$10,000 in valve parts inventory and employs service personnel that are factory trained. Representative shall have been designated at least five (5) years prior to Bid Date.
- C. Start-up, check, and adjust systems and components: Eight (8) hours on-site minimum.
- D. Certification in writing that each valve system is properly installed and ready for use.
- E. Training of Owner's designated personnel: Eight (8) hours minimum devoted to training and scheduled in writing to the Engineer.

3.03 SCHEDULE

- A. Altitude Valve at Hondo 2 Fire Storage Tank:
 - 1. Size: 6".
 - 2. Function: Altitude valve for one-way flow into tank.
 - 3. Design Basis: Cla-Val Model No.: 210-01-KCBDHYPBVRPESS.
 - 4. Adjustable Range: 5 to 25 psi.
 - 5. End Connections and Pressure Class: 6-inch flanges, ANSI Class 150 lb. pattern.
 - 6. Mounting Position: Horizontal.
 - 7. Coating, Inside and Outside: NSF/ANSI 61 certified fusion bonded epoxy coating.
 - 8. Chamber Design: Single Diaphragm.

Options Included:

- a. Globe Pattern.
- b. Isolation Cocks in Pilot Tubing.
- c. Inlet Strainer with Blowdown Valve.
- d. X142 Dry Position Indicator.
- e. X129 Closed Indication Limit Switch.
- f. Tap for pilot sensing tube from tank.
- g. Inlet and outlet pressure gauges.
- 9. Electrical Requirements: None.
- 10. Quantity: 1.

- B. Pressure Reducing Valve in PRV Vault on Line 3:
 - 1. Size: 6".
 - 2. Function: Reduce pressure in Line 3 as flow passes from the Lamy Junction pressure zone to the Cañoncito service area pressure zone. Also maintain minimum sustained pressure in the Lamy Junction zone.
 - 3. Design Basis: Cla-Val Model No.: 92-01-KOKCBCSVY2PBVPESS.
 - 4. Adjustable Range: 10 to 60 psi.
 - 5. End Connections and Pressure Class: 6-inch flanges, ANSI Class 150 lb. pattern.
 - 6. Mounting Position: Horizontal.
 - 7. Coating, Inside and Outside: NSF/ANSI 61 certified fusion bonded epoxy coating.
 - 8. Chamber Design: Single Diaphragm.

Options Included:

- a. Globe Pattern.
- b. Isolation Cocks in Pilot Tubing.
- c. Inlet Strainer with Blowdown Valve.
- d. X142 Dry Position Indicator.
- e. X129 Closed Indication Limit Switch.
- f. Inlet and outlet pressure gauges.
- 9. Accessories: 6-inch in-line strainer as shown on Drawings.
- 10. Electrical Requirements: None.
- 11. Quantity: 1.
- C. Low Flow Pressure Reducing Valve in PRV Vault on Line 3:
 - 1. Size: 2".
 - 2. Function: Installed in parallel with the main 6" PRV in the PRV Vault to handle low flows. Reduce pressure in Line 3 as flow passes from the Lamy Junction pressure zone to the Cañoncito service area pressure zone. Also maintain minimum sustained pressure in the Lamy Junction zone.
 - 3. Design Basis: Cla-Val Model No.: 92-01-KOKCBCSVY2PBVPESS.
 - 4. Adjustable Range: 10 to 60 psi.
 - 5. End Connections and Pressure Class: 2-inch flanges, ANSI Class 150 lb. pattern.
 - 6. Mounting Position: Horizontal.
 - 7. Coating, Inside and Outside: NSF/ANSI 61 certified fusion bonded epoxy coating.
 - 8. Chamber Design: Single Diaphragm.

Options Included:

- a. Globe Pattern.
- b. Isolation Cocks in Pilot Tubing.
- c. Inlet Strainer with Blowdown Valve.
- d. X142 Dry Position Indicator.
- e. X129 Closed Indication Limit Switch.
- 9. Electrical Requirements: None.
- 10. Quantity: 1.

- D. Pressure Relief Valve in PRV Vault on Line 3:
 - 1. Size: 6".
 - 2. Function: Relieve excessive pressure from the downstream side of the PRV vault to prevent over pressurizing the Cañoncito service area in case the PRVs fail.
 - 3. Design Basis: Cla-Val Model No.: 50-01KO.
 - 4. Adjustable Range: 10 to 60 psi.
 - 5. End Connections and Pressure Class: 6-inch flanges, ANSI Class 150 lb. pattern.
 - 6. Mounting Position: Horizontal.
 - 7. Coating, Inside and Outside: NSF/ANSI 61 certified fusion bonded epoxy coating.
 - 8. Chamber Design: Single Diaphragm.

Options Included:

- a. Globe Pattern.
- b. Isolation Cocks in Pilot Tubing.
- c. Inlet Strainer with Blowdown Valve.
- d. X142 Dry Position Indicator.
- e. X129 Closed Indication Limit Switch.
- 9. Electrical Requirements: None.
- 10. Quantity: 1.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
3.23, 4.03, 5.01	Self-Contained Control Valves	Lump Sum
3.23	Strainer	Lump Sum

END OF SECTION

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SECTION 40 61 21.13

INSTALLATION, TESTING, AND CALIBRATION OF INSTRUMENTATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Installation and testing of instrument circuits.
- B. Installation, calibration, and testing of instruments.
- C. Test equipment for testing and calibration of instrumentation.

1.02 SYSTEM REQUIREMENTS

- A. For purposes of this section, "instrument" means:
 - 1. A transmitter which measures a process variable and produces an analog signal, such as 4 to 20mA, 1 to 5V, or similar.
 - 2. Other analog devices which produce or utilize mA or similar signals, such as indicators and isolators.
 - 3. A switch which measures a pressure, temperature, or similar, in an analog fashion but produces a discrete output. This does not include float switches.
- B. Instrumentation refers to the entire system of instruments and associated indicators, circuits, and accessories.
- C. Provide minor pipe, fittings, adapters, valves, tubing, supports, and accessories to make a complete, operating installation for each instrument, whether shown on Drawings or not.
- D. Provide labor to accomplish a complete, tested, calibrated, and correctly operating installation.

1.03 SUBMITTALS

A. Assemble calibration reports into ring binders, filed in order of Tag Number. Place project information on each binder. Submit three copies. The information in the reports having been field verified, this submittal will be reviewed only for completeness.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 INSTALLATION OF CIRCUITS

A. Use type and size of wire or cable specified in Section 26 05 19 – Low Voltage Wire and Cables, or as shown on Drawings, whichever is larger.

- B. Color code and label every wire end as specified in Section 26 05 19 Low Voltage Wire and Cables.
- C. Run instrumentation circuits unbroken, such as from instrument to TVSS to indicator to PLC, with no intermediate connection except:
 - 1. Where terminal boards are shown on Drawings.
 - 2. Where terminal boards with appropriate enclosures are proposed by the Contractor and allowed in writing by the Engineer.
- D. Connect to remote terminal unit (RTU), remote control panel (RCP), programmable logic controller (PLC), or similar controller I/O terminals only after testing specified below is complete.
- E. Maintain physical separation between DC instrumentation circuits and all AC circuits.
- F. The quantity, type, and AWG of wire and cable called for on Drawings is for facility equipment as designed. If equipment is furnished which requires a greater quantity of, different type or larger AWG wire or cable than called for, then furnish the correct quantity, type, and AWG plus appropriate conduit at no additional cost to the Owner. Submit proposed changes to Engineer for review.

3.02 TESTING OF CIRCUITS

- A. Conduct testing to verify that analog circuits and associated DC power circuits are properly installed and connected, that there are no shorts, and that there are no unintentional grounds on the signal conductors. Lift intentional grounds from shields and verify that there are no unintentional grounds on the shields.
- B. Connect circuits to the terminals of the controller and connect shield grounds.
- C. Provide all test equipment.

3.03 INSTALLATION OF INSTRUMENTS

- A. Coordinate installation of instruments such that instruments are installed by appropriately skilled workers and such that all necessary labor and materials are included in the Bid. For example, determine the appropriate trade for the installation of a 24" electromagnetic flow element versus the transmitter and the installation of a conductivity analyzer probe versus the transmitter and assign the work accordingly. Also determine which trade will provide and install such adapters and hardware as needed for a complete, working installation. For another example, determine in advance which trades will install thermal wells versus temperature transmitter elements.
- B. Follow recommendation and instructions of equipment manufacturer in addition to requirements of Drawings and Specifications in handling and installation of instrumentation equipment.

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- C. Cleaning: Before assembly or installation, thoroughly clean equipment of temporary protective coatings and foreign materials. After installation of equipment, clean external surfaces of oil, grease, dirt, or other foreign material.
- D. Mount instrumentation equipment approximately where shown on Drawings. Propose exact locations to the Engineer in advance of mounting. Mount with pipe stands, brackets, or strut as specified and as shown on Drawings. If not detailed on Drawings, propose bracket details in the field. Provide floor stands where instruments are located away from walls or other building structure. Provide manufacturers' mounting adapters as needed.
- E. Painting: Paint ferrous, custom or field-fabricated brackets, stands, and miscellaneous mounting members as specified in Division 9. Painting is not required for aluminum, galvanized steel, or stainless steel.
- F. Transmitters Which are Separate from their Sensing Element:
 - 1. Transmitters not in a building:
 - a. Mount the transmitter so the display faces north.
 - b. If not practical to face north, so demonstrate to the Engineer, then face east.
 - c. Only with written approval from the Engineer, face the display south or west.
 - 2. Mount the transmitter at a convenient height (approximately 64" centerline) above the finished walking surface (grade).
 - 3. Mount the transmitter so it is easily accessible for reading, testing, and calibration.
 - 4. Provide manufacturer-furnished or recommended cable for connection of sensing element to transmitter.
- G. Transmitters Which are Integral with their Sensing Element:
 - 1. If piping run or structure permits, mount the transmitter between 18" and 72" above grade and so the transmitter is easily accessible for reading, testing, and calibration.
 - 2. Where the Drawings show transmitters more than 72" above grade or where the piping run or structures require mounting the transmitter more than 72" above grade, locate the transmitter where access by means of a ladder is convenient.
 - 3. Transmitters in a building:
 - a. If the transmitter is mounted high and is adjustable, face the display downward, angled for operator convenience.
 - b. If the transmitter is at an intermediate height and is adjustable, adjust angle for operator convenience.
 - c. If the transmitter is mounted low and is adjustable, face the display upward, angled for operator convenience.
 - 4. Transmitters not in a building:
 - a. If the transmitter is mounted high and is adjustable, face the display downward, angled for operator convenience.

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- b. If the transmitter is mounted at an intermediate height, if practical, mount the transmitter so the display faces north. If not practical to face north, so demonstrate to the Engineer, then face east. Only with written approval from the Engineer, face the display south or west.
- c. If the transmitter is mounted low, face upward unless shown otherwise on the Drawings. Provide sun shade similar to the requirements below but with a hinged portion on top to protect the display from the sun. Mount sun shade to a bracket which is independent of the process pipe or vessel.

H. Local Indicators:

- 1. Mount the indicator at a convenient height (approximately 64" centerline) above the finished walking surface (grade).
- 2. Mount the indicator so it is easily accessible for reading, testing, and calibration.
- 3. Face the display the same as required for separately mounted transmitters.

I. Sun Shades:

- 1. Provide sun shades for all LED and LCD displays of separately mounted transmitters and local indicators which are not within a building and which are not facing north, whether sun shades are shown on the Drawings or not. Also provide sun shades for other transmitters where noted on the Drawings.
- 2. The purpose of sun shades is to protect the readout from direct sun and to allow easier reading of the display by an operator. Fabricate and install accordingly. An acceptable design is 14 gage aluminum plate with two bends formed in it and mounted so it extends 3-4" beyond the front of the transmitter or indicator on the left, top, and right, complete with a top-hinged flap which completely shades the display except when lifted by hand. Make all corners smooth, especially the upper two corners. Mount so the sun shade stands off from the enclosure of the transmitter or indicator to allow for air circulation. Mount with SS hardware. Other designs may be proposed for review by the Engineer.

J. Nameplates:

- 1. Install an engraved nameplate to identify each instrument.
- 2. If text is not shown on Drawings, show function and tag number of instrument.

3.04 CALIBRATION OF INSTRUMENTS

- A. Provide all test and calibration equipment. Unless equipment is new for this project, provide current National Institute of Standards and Technology traceable calibration information for it.
- B. Calibrate the following instruments in place and demonstrate correct calibration as installed, under simulated operating conditions. For calibration range, see Instrument Tag List. If not shown, see Drawings. If not shown, obtain information from Engineer during construction.
 - 1. Temperature transmitters.
 - 2. Pressure transmitters.
 - 3. Level transmitters.
 - 4. Open channel flow meters.

- 5. Other flow meters offering field calibration capability.
- 6. Analyzers, such as dissolved oxygen, pH, ORP, TDS, and similar process analyzers.
- 7. Valve position analog indicators.
- 8. Transmitters for electrical values, such as voltage, current, and watt transducers.
- 9. Temperature switches, pressure switches, and the like.
- C. Provide certificates of factory calibration for instruments for which the manufacturer provides no means of field calibration, such as the flow element of an electromagnetic flow meter.
- D. Some instruments contain small meters or gages, which cannot be calibrated in the field, to indicate output signals. Record the performance of these indicators as if an external indicator.
- E. Verify that the instrument is working while isolated.
- F. Perform other testing of instrumentation as required by Section 40 80 00 Plant Process Control Commissioning.
- G. Notify Owner and Engineer minimum 6 working days in advance of calibrating an instrument. The Owner or Engineer will witness the calibration and sign the calibration report, but only to denote presence as a witness.

H. Calibration Procedure:

- 1. Remove shipping stops/plugs from instruments before starting.
- 2. Have instruction manuals available, and install miscellaneous components which have been supplied separately but are integral parts of equipment.
- 3. Nameplate Check: Verify data on nameplate with respect to conditions of range, operating temperature, specific gravity, and other ratings required by the Specifications and as submitted. Correct discrepancies before proceeding.
- 4. For analyzers, use standard solutions or mix solutions strictly in accordance with manufacturer's instruction.
- 5. Calibrate each instrument in accordance with manufacturer's calibration procedures over full operational range. Prove instruments to be within published specification and accuracy. Then calibrate the entire loop, including wiring, remote indicators, loop isolators, and SPD. Prove each item in loop to be within published accuracy.
- 6. Where an instrument loop controls a plant variable, such as return activated sludge flow rate, calibrate the loop as a system (i.e., transmitter, controller, and VFD). Components which have adjustable features shall be carefully set for specific conditions and applications of this project.
- 7. Place a calibration sticker on each active component of the loop, showing:
 - a. Calibration report number and date.
 - b. Equipment identification tag number.
 - c. Printed name of person who performed calibration.
- 8. Prepare and submit a calibration report for each loop, showing the below information. Provide serial number where shown on the equipment name plate, although it is recognized that not all items will bear a serial number.

- a. Calibration report number and date.
- b. Owner's name and project name.
- c. Service of instrument, such as "RAS flow."
- d. Equipment identification tag number.
- e. Engineering name of variable of interest, such as "Level," even though it is being measured by a pressure transmitter.
- f. List of equipment used to independently measure process variable.
- g. For Analyzers:
 - 1) Manufacturer's name and catalog number for standard solutions.
 - 2) Method of use of solutions.
- h. For Transmitters:
 - 1) Manufacturer's name, model number(s), and serial number(s) for transmitter and element.
 - 2) Range of capability of transmitter.
 - 3) Calibrated range for this project.
 - 4) Table showing actual value of measured variable versus mA output of transmitter. Show minimum of two such points. Some Sections may require more than two calibration points.
- i. For signal isolators in the loop:
 - 1) Manufacturer's name, model number, and serial number.
 - 2) Table showing mA in versus mA out at 0%, 50%, and 100%.
- j. For signal converters in the loop:
 - 1) Manufacturer's name, model number, and serial number.
 - 2) Table showing signal in versus signal out at 0%, 50%, and 100%.
- k. For indicators in the loop:
 - 1) Manufacturer's name, model number, and serial number.
 - 2) Table showing signal in versus reading at 0%, 50%, and 100%.
- 1. For Switches:
 - 1) Manufacturer's name, model number, and serial number.
 - 2) Table showing value of process variable versus contact action.
- m. Date of calibration.
- n. Printed name of person who performed calibration. Signature.
- o. Printed name of person who witness calibration. Signature.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
5.05	Instrumentation Installation,	Lump Sum
	Testing, and Calibration	

END OF SECTION

SECTION 40 61 21.19

INSTALLATION AND TESTING OF CONTROL CIRCUITS AND DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Installation and testing of control circuits.
- B. Installation and testing of control devices.

1.02 SYSTEM REQUIREMENTS

A. Definition of a Control Device:

- 1. A device which measures a process variable, such as a level switch, and produces a discrete signal. Certain switches which respond to analog process variables, such as pressure switches and temperature switches, are treated as if they are instruments under Section 40 61 21.13 Installation, Testing, and Calibration of Instrumentation.
- 2. Hand switches that are field mounted. Hand switches in control panels are covered under Section 40 67 10 Control Panels, and Sections referenced therein.
- 3. Relays that are field mounted. Relays in control panels are covered under Section 40 67 10 Control Panels, and Sections referenced therein.
- 4. Indicator lights, horns, alarm strobes, and similar discrete operator interface devices that are field mounted.
- 5. Other devices which produce a discrete signal.
- 6. Other similar devices that are neither instrumentation nor power devices.
- B. Controls refers to the entire system of control devices and to all circuits associated with the plant control system in the larger sense, except for those circuits covered under Section 40 61 21.13 Installation, Testing, and Calibration of Instrumentation.
- C. Provide labor to accomplish a complete, tested, and correctly operating installation.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 INSTALLATION OF CIRCUITS

- A. Use type and size of wire or cable specified in Section 26 05 19 Low Voltage Wire and Cables, or as shown on the scs, whichever is greater.
- B. Color code and label every wire end as specified in Section 26 05 19 Low Voltage Wire and Cables.

- C. Run control circuits from control device to control device to control panel with no intermediate connection except:
 - 1. Where terminal boards are shown on the Drawings.
 - 2. Where terminal boards with appropriate enclosures are proposed by the Contractor and allowed in writing by the Engineer.
- D. Connect to remote terminal unit (RTU), remote control panel (RCP), programmable logic controller (PLC), or similar controller I/O terminals only after testing specified below is complete.
- E. Maintain physical separation between DC instrumentation circuits and all AC circuits.
- F. The quantity, type, and AWG of wire and cable called for on Drawings is for facility equipment as designed. If equipment is furnished which requires a greater quantity of, different type or larger AWG wire or cable than called for, then furnish the correct quantity, type and AWG plus appropriate conduit at no additional cost to the Owner. Submit proposed changes to the Engineer for review.

3.02 TESTING OF CIRCUITS

- A. Conduct testing to verify that control circuits and associated power circuits are properly installed and connected, that there are no shorts, and that there are no unintentional grounds on the conductors. Lift intentional grounds for and verify that there are no unintentional grounds on the neutral conductors.
- B. Connect circuits to the terminals of the controller and connect intentional grounds.
- C. Provide all test equipment.

3.03 INSTALLATION OF CONTROL DEVICES

- A. Coordinate installation of control devices such that devices are installed by appropriately skilled workers and such that all necessary labor and materials are included in the Bid. Also determine which trade will provide and install such adapters and hardware as needed for a complete, working installation. For another example, determine in advance which trades will install concrete that might be needed for support of stands for control devices.
- B. Follow recommendation and instructions of equipment manufacturer in addition to requirements of Drawings and Specifications in installation of control devices.
- C. Cleaning: Before assembly or installation, thoroughly clean equipment of temporary protective coatings and foreign materials. After installation of equipment, clean external surfaces of oil, grease, dirt, or other foreign material.

- D. Mount control devices approximately where shown on Drawings. Propose exact locations to the Engineer in advance of mounting. Mount with pipe stands, brackets, or strut as specified and as shown on Drawings. If not detailed on Drawings, propose bracket details in the field. Provide floor stands where control devices are located way from walls or other building structure.
- E. Painting: Paint ferrous, custom or field-fabricated brackets, stands, and miscellaneous mounting members as specified in Division 9. Painting is not required for aluminum, galvanized steel, or stainless steel.
- F. Mount control devices at a convenient height (approximately 54" centerline) above the finished walking surface (grade), where it is easily accessible to the plant operator and for maintenance.

3.04 TESTING OF CONTROL DEVICES

- A. First, test control devices individually.
- B. Then, test control devices as part of a system, such as operating a motor in HAND. Verify that every motor operates correctly in HAND and that control devices such as float and limit switches operate correctly as part of the system.
- C. Perform other testing of control devices as required by Section 40 80 00 Plant Process Control Commissioning.
- D. Notify Engineer minimum 6 working days in advance of testing control devices as part of a system. The Engineer will either witness the testing or notify the Contractor that witness testing is waived for all or part of the devices.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
5.05	Control Circuit Installation and Testing	Lump Sum

END OF SECTION

SECTION 40 67 10

CONTROL PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Control panels.

1.02 NATIONALLY RECOGNIZED TESTING LABORATORY (NRTL)

- A. Underwriters Laboratories, Inc. (UL), Electrical Reliability Services, Inc., Division of Emerson Electric, (ERS), or other organization that is recognized by the State of New Mexico and is acceptable to the Engineer.
- B. NRTL is used below to refer to UL and/or ERS. Other organizations may request inclusion. Submit information minimum 10 working days before the Bid date for review by the Engineer. Include minimum 25 year company history, company qualifications similar to UL or ERS, a detailed description of the NRTL requirements which apply to a panel shop, including follow-up inspections, plus documentation showing recognition by the State of New Mexico. NRTL found to be acceptable will be added by addendum.

1.03 STANDARDS

- A. For panels which will be installed in ordinary locations with an ambient temperature of up to 40°C, comply with the requirements of UL508A, Standard for Industrial Control Panels, latest edition.
- B. For panels which will be installed in hazardous locations, comply with the requirements of UL 698, Standard for Industrial Control Equipment for Use in Hazardous (Classified) Locations, latest edition.
- C. For panels which incorporate intrinsic safety barriers and are intended for connection to circuits residing in hazardous locations, comply with the requirements of UL 698A, Standard for Industrial Control Panels Relating to Hazardous (Classified) Locations, latest edition.
- D. UL 508A is used in Paragraph 1.04 to refer to UL508A, UL698, or UL698A depending on the type of panel. It is recognized that there may be standards similar to UL508A, UL698, and UL698A which are published by a NRTL not listed above. The Engineer will review such standards for acceptability only if a complete, original, current copy of both the UL standard, and the proposed alternate standard are submitted a minimum of 10 working days before the Bid date. Also submit information about the NRTL itself, as required above. Standards found acceptable will be added by addendum.

1.04 MANUFACTURING AND LABELING

- A. Provide control panels that are manufactured and labeled by a company which:
 - 1. Specializes in the manufacture of panels which are:
 - a. Designed and manufactured to comply with the requirements of UL508A,
 - b. Labeled to certify compliance with UL508A;
 - 2. Is currently and directly authorized by a NRTL to regularly apply labels of the NRTL which certify compliance with UL508A;
 - 3. Has successfully passed a factory inspection conducted by the NRTL Follow-Up Services, including inspection of NRTL-certified product then being manufactured, during the calendar quarter previous to or during the calendar quarter of the Bid date and successfully passes all such inspections which may occur during the period of manufacturing of the panels for this project.
 - 4. Also specializes in the supply and startup of instrumentation and control systems.
 - 5. Has on staff a field service representative who is currently certified as a Certified Control Systems Technician, Level 3, by the National Institute for Certification in Engineering Technologies.
- B. A control panel which is manufactured by a company which is not currently and directly authorized by a NRTL to regularly apply labels of the NRTL will not be acceptable, except as provided in Paragraph 1.04 D.
- C. A control panel which is manufactured by a company which did not successfully pass a factory inspection conducted by the NRTL Follow-Up Services, including inspection of NRTL-certified product then being manufactured, during the calendar quarter previous to or during the calendar quarter of the Bid date or which does not successfully pass all such inspections which may occur during the period of manufacturing of the panel(s) for this project will not be acceptable except as provided in Paragraph 1.04 D.
- D. A control panel manufacturer which would propose to provide panels which are labeled on a one-by-one basis by a NRTL may be acceptable. Submit information to the Engineer to show compliance with the following requirements a minimum of 10 working days before the Bid date. Provide complete information in well-organized, indexed, tabbed ring binders. Lack of compliance with the previous sentence will be a basis for rejection. Insufficient or confusing information will be a basis for rejection. No subsequent information for purposes of this Paragraph will be requested or accepted. Nothing will be returned. A manufacturer found to be acceptable will be added by addendum.
 - 1. Requirements for an acceptable control panel manufacturer:
 - a. Company specializes in the manufacture of panels which are designed and manufactured to comply with the requirements of UL508A, and labeled by the proposed NRTL to certify compliance with UL508A. Provide a list of at least 20 such panels, giving project name, panel name, and description of function of panel.

- b. Company specializes in the supply and startup of instrumentation and control systems. Provide a list of at least six projects for which the company supplied and started up the complete instrumentation and control system. Include name of owner, name of project, name of installing contractor, name of prime contractor, and name and telephone number of a contact of each above organization.
- c. Company has on staff a field service representative who is currently certified as a Certified Control Systems Technician, Level 3, by the National Institute for Certification in Engineering Technologies. Provide a copy of the certificate.
- d. Company understand requirements of the Specifications for this project related to submittals and O&M Manuals. Provide a sample submittal package and a sample O&M Manual, addressing each particular element of the Specification requirements.
- 2. Also provide standard, published information about the inspection and labeling process used by the NRTL and a copy of three different, specific reports prepared by the NRTL as a result of having labeled panels for the proposed panel manufacturer. Delete or change information as needed in order to conceal the identity of the owner of the subject panel.

1.05 SUBMITTALS

A. For a company which complies with the requirements of Paragraphs 1.04 A. 2. and 3., provide a certificate from the NRTL showing such compliance. For a company added under the provisions of Paragraph 1.04 D., provide two additional sets of the information provided in response to the requirements of Paragraphs 1.04 D. 1. a., b., and c. and 1.04 D. 2.

1.06 OPERATION AND MAINTENANCE DATA

A. Provide a complete set of wiring diagrams and panel layout drawings including panel dimensions and applied nameplates.

1.07 EXTRA MATERIALS

A. Relays: Minimum two of each type but more if required in other Sections.

PART 2 PRODUCTS

2.01 ENCLOSURE

- A. Section 26 27 16 Cabinets and Enclosures.
- B. If so scheduled, shown on Drawings, or required in other Sections, provide a LexanTM window in the door of a control panel:
 - 1. Construct as to preserve NEMA rating of enclosure.

- 2. For a PLC or other type of controller/RTU, locate so diagnostic and indicator lights on face of PLC are easily visible.
- 3. For a recorder, locate so full face of recorder is easily visible.

2.02 CABINET COOLERS

- A. Provide one or more coolers in a given Control Panel if:
 - 1. The schedule calls for coolers, or
 - 2. A component having an ambient temperature rating that is 2°C lower than other components is furnished, or
 - 3. The panel manufacturer recommends coolers.

B. Cooler Requirements:

- 1. Two fans, each minimum 215 CFM and rated for 10 years of life.
- 2. Sealed heat pipes, rated for 30 years of life.
- 3. Air exchange between enclosure and external environment not allowed.
- 4. Designed and installed to preserve the NEMA Rating of the panel and to have the same NEMA Rating as or better NEMA Rating than the panel.
- 5. Models available rated from 16.5W per °C ▲ T up to 110W per °C.
- 6. Rated for operation in ambient temperatures from -40° C to $+70^{\circ}$ C.
- 7. Size the cooler to extract heat from the panel at a rate sufficient to prevent the panel interior from being more than 6°C higher than the local ambient.
- 8. Minimum manufacturer's standard warranty: 4 years
- 9. Minimum cooler: Noren (650-322-9500) CC Series, or the equal Thermal Edge series (888-580-0202); no others.

2.03 GROUND BARS

A. Enclosure Ground Bar:

- 1. Tin-plated copper.
- 2. Solidly bond to enclosure.
- 3. Use for connection of:
 - a. Grounding electrode conductors.
 - b. Equipment grounding conductors.
 - c. Other grounds not connected to the Shield Ground Bar.
- 4. Provide separate screw, bolt, or terminal point for connection of each conductor.

B. Shield Ground Bar:

- 1. Tin-plated copper.
- 2. Mount on standoff insulators, close to and parallel to Enclosure Ground Bar.
- 3. Use for connection of shields of TWSH cable carrying analog signals to ground. Connect shield to terminal board point adjacent to the signal conductors. Connect from there to Shield Ground Bar with green, stranded #14.
- 4. Provide separate screw, bolt, or terminal point for connection of each conductor.

5. Connect Shield Ground Bar to Enclosure Ground Bar with two #10 stranded at each end four total. Arrange these connections for easy removal and replacement for purposes of testing.

2.04 PANEL ALARM HORN

- A. Where and if designated, provide steady-tone piezoelectric alarm horn in control panels as scheduled or shown on Drawings.
- B. Sonalert or ENGINEER approved equivalent.

2.05 SWITCHES, PUSHBUTTONS, PILOT LIGHTS

- A. Comply with Section 40 78 10 Control Hardware.
- B. Provide engraved legend plates for switches, pushbuttons, and pilot lights. Text as shown on Drawings. If not shown, show on submittals.

2.06 RECORDERS, INDICATORS

A. Comply with Sections 40 78 26 – Paperless Programmable Chart Recorders, and 40 78 13 –Indicators and Meters.

2.07 CONTROL COMPONENTS

- A. Section 40 78 10 Control Hardware.
- B. As shown on Drawings.

2.08 NAMEPLATES

- A. Section 26 05 53 Electrical Identification.
- B. Furnish the following nameplates (NP):
 - 1. Main NP:
 - a. Black with 1/2" white letters.
 - b. Text as on Drawings.
 - 2. Component and device NP (internal):
 - a. Adjacent to each terminal board, switch, pushbutton, pilot light, control component, and the like.
 - b. Black with 1/8" white letters.
 - c. Text: Same as on schematic.

- 3. Warning NP:
 - a. On panel front.
 - b. Red with 1/4" white letters.
 - c. Text: "WARNING. THERE MAY BE VOLTAGE IN THIS PANEL FROM MULTIPLE SOURCES".
- 4. Panel front indicating and display devices:
 - a. Provide for each panel front mounted meter, recorder, and the like.
 - b. Black with 1/4" white letters.
 - c. Text: Same as on Drawings.
- 5. As called for on Drawings.

2.09 TERMINAL BLOCKS

A. Section 26 27 27 – Wire Connectors and Accessories.

2.10 INCOMING POWER

- A. Where hard-wired, connect to terminal blocks.
- B. Where AC power comes from a UPS which is external to the panel and which has receptacles for load connections, provide an SO cord with attachment cap. Provide strain relief connector with rubber bushing at penetration of the control panel enclosure wall.

2.11 FACTORY WIRING

- A. Wire Type:
 - 1. Internal AC Wire: MTW, THHN, THWN.
 - 2. Analog Signal Wire: TWSH.
 - 3. Other DC wire: TWSH, MTW, THHN, THWN.
- B. Color Coding:
 - 1. Neutral: White; ground: green.
 - 2. 480V phases: Brown, orange, yellow (A, B, C, respectively).
 - 3. 120/240V that is controlled by the panel: Black, blue.
 - 4. 120/208V that is controlled by the panel: Black, blue, violet (A, B, C, respectively).
 - 5. 120V that is used in control circuits:
 - a. Where derived from a control power transformer in the panel whose primary is disconnected by an overcurrent device handle on the panel that is interlocked with the door: Red.
 - o. Foreign source: Yellow.
 - 6. 24 VDC: TWSH as required in Section 26 05 19 Low Voltage Wire and Cables.
- C. Except where fuses are shown on Drawings, provide DIN-rail mounted circuit breakers (not shown on Drawings) for AC power to all devices requiring AC power.

- D. Provide multiple TB points and route wire such that removing the power wiring to any given device does not interrupt HOT or NEUTRAL to any other device.
- E. Do not make connections by means of wire nuts or other similar means of splicing. If a component is factory equipped with integral leads, provide terminal boards nearby rather than splicing onto the leads.
- F. Make field connections to panels onto terminal boards, not to devices. Provide 25% spare terminals.
- G. Label each terminal board.
- H. Mark each terminal board (TB) point. Use numbering as shown on Drawings. Where not shown on Drawings, assign a logical number. Submit to Engineer for review. Show all numbering on submittals.
- I. Mark each wire end as follows:
 - 1. Control conductors associated with MCC: Mark each conductor with tag number appended with MCC terminal point (i.e., M7101-X2).
 - 2. Control conductors not associated with MCC: Mark each conductor with tag number and terminal board number. If conductor is routed between two devices without going to a terminal board, mark wire with tag number and an arbitrary number not used on terminal block.
 - 3. Instrumentation (all ends of complete run of all digital and analog inputs and outputs to/from PLC whether in PLC, integrated control panels, termination panels, MCC, local control panels, or field device): Tag number. Also use black wire for + (plus) polarity and white for (minus).
 - 4. Show all wire numbering on submittals.
 - 5. Marking method: Section 26 05 19 Low Voltage Wire and Cables.
- J. Install wiring in plastic wiring duct.
- K. Route DC wiring minimum 3" separated from AC wiring.
- L. Route analog wiring separately from all other wiring except DC Digital Inputs (DI).
- M. Where wiring crosses a hinge or other flex point, bundle wires with plastic spiral wrap so bundles twist in a direction roughly parallel to hinge pin rather than folding or flexing perpendicular to hinged panel or door.
- 2.12 TRANSIENT VOLTAGE SURGE SUPPRESSORS: SINE WAVE TRACKING, 120 VAC SINGLE PHASE, DIN RAIL MOUNT
 - A. UL labeled, showing compliance with UL 1449, Third Edition.
 - B. Features:
 - 1. Protection modes: line to neutral, line to ground, and neutral to ground.
 - 2. Green LED Status indicator and form C alarm contact.

- 3. Sine wave tracking.
- 4. Thermal fusing to prevent MOV overheating.

C. Ratings:

- 1. Nominal Voltage: 120V, 1 phase, 3 wire.
- 2. Continuous Current Rating: 20A.
- 3. UL 1449, Third Edition, Suppressor Classification, 120 VAC normal/common mode: 400 VAC.
- 4. Minimum peak surge current capability (8 X 20 ms):
 - a. Line to Neutral: 10 kA.
 - b. Line to Ground: 20 kA.
 - c. Neutral to Ground: 10 kA.
- 5. Noise Attenuation per UL 1283:
 - a. Normal Mode: 50 dB, minimum.
 - b. Common Mode: 40 dB, minimum.
 - c. Let-through voltage of not more than 50V above the Sine Wave for Category A1 Ring Wave and not more than 500V L-N/900V L(N)-GND for a B3/C1 Impulse Wave.
- 6. Maximum Continuous Operating Voltage (MCOV): 150V RMS. Control power transformers do not closely regulate the secondary voltage. Therefore, suppressors with lower MCOV may not function properly to protect these circuits.

D. Environmental:

- 1. Temperature: minus 40°C to plus 60°C.
- 2. Humidity: 0% to 95%, non-condensing.

E. Physical:

- 1. Steel case which mounts on 35mm DIN rail conforming to DIN EN 50022.
- 2. Easily accessible, front-mounted screw terminals.
 - a. Line Side: Hot, Neutral, Ground.
 - b. Load Side: Hot, Neutral, Ground.
 - c. Three for form C alarm contact.
- F. Warranty: 10 years.
- G. Phoenix Contact (www.phoenixcon.com) SFP SPD, Sola/Hevi-Duty (www.solaheviduty.com) STV25K-10S, or Engineer reviewed equivalent.
- H. May or may not be shown on Drawings. Show in Submittal Drawings.
- I. Install on each incoming AC circuit that is used for input to DC power supplies and/or other AC powered components, such as recorders.
- J. Not required for:
 - 1. Circuits which are not used for power in the panel, such as those switched to control a motor and those used as digital inputs.
 - 2. Lighting, convenience receptacle, fans, heat exchangers.

2.13 DC CURRENT LOOP SPD (DCCL SPD)

A. SPD Proper:

- 1. Listed under UL 497B.
- 2. Two Part Design:
 - a. Base terminal block which mounts to DIN rail.
 - b. Plug-in surge protection module. Replacing a module shall not require the removal of any wires nor shall it interrupt the signal.
 - c. Provide keying between base and plug to make sure that only the correct protection module will fit in the base.
- 3. Wiring Points and Plug Connections: "Touch safe" with no live voltages that can make contact with a misplaced finger in accordance with IEC 529.
- 4. Maximum Continuous Operating Voltage (MCOV): 28 VDC.
- 5. Surge protection module: Multistage hybrid circuit with staging inductors or resistors to properly coordinate the components; nominal resistance 10Ω .
- 6. Rated Continuous Operating Current: 450 mA.
- 7. Withstand a 10 kA test current of an 8/20 μs waveform according to IEC 1024 Application Guide A and ANSI/IEEE C62.41 Category C Area.
- 8. Measured Response Time:
 - a. L-L: Maximum 1 ns.
 - b. L-GND: Maximum 100 ns.
- 9. Phoenix Contact PT Series, Edco PC-642 Series, or Engineer reviewed substitute.

B. Accessories:

- 1. 35mm DIN rail conforming to DIN EN 50022.
- 2. Terminal blocks for grounding of DCCL SPD.
- 3. Terminal block for carrying shield through ungrounded.
- 4. End stops; markers; nameplates.
- C. Provide positive grounding of SPD assembly as follows:
 - 1. Scrape the pan at the mounting points beneath the rail for good contact and bond the pan to the enclosure ground bar as specified above for the shield ground bar, using green #10 THWN at two places.
 - 2. Attach a green/yellow ground terminal block to the rail and bond the rail to the enclosure ground bar with two #12.
 - 3. Make no sharp bends in grounding conductors.
- D. Be careful to install field conductors on the field side of the DCCL SPD and equipment conductors on the equipment side. Orient the DCCL SPD so field and equipment pairs do not touch each other.
- E. Mark the SPD assembly and the terminal points on the DCCL SPD as required for terminal boards and terminal board points under Section 26 27 27 Wire Connectors and Accessories.

- F. The Drawings and/or the Tag List show field DCCL SPD. Provide all such SPD under this Section for field installation, in enclosures, and complying with the installation requirements above.
- G. For each loop which has a field DCCL SPD, provide one in the control panel for that loop, whether shown on Drawings or not. Show field and panel-mounted devices in submittal Drawings.
- H. DCCL SPD which are not part of a larger control panel and/or not detailed elsewhere:
 - 1. NEMA 4X SS enclosure with bare SS mounting pan.
 - 2. Connect the SPD grounding screws to the ground bar (if present in the enclosure), a conduit bonding clamp (if lacking a ground bar), or other solidly grounded point (if lacking the previous grounds) with green #10 THWN. Make no sharp bends in grounding conductors.
 - 3. Also comply with the requirements of Paragraphs B. through E., above.

2.14 OVERCURRENT AND SHORT CIRCUIT PROTECTION

A. Fuses:

- 1. Section 26 28 13 Low Voltage Fuses.
- 2. Use Only:
 - a. Where called for on Drawings.
 - b. Where recommended by the manufacturer of a specific piece of load equipment.
 - c. If required in order to facilitate UL listing of panel.

B. AC Circuit Breakers:

- 1. Listed/labeled under UL 489 with 10 kA interrupt rating at 120 VAC.
- 2. 120/240 VAC, 60 Hz. Do not use for DC circuits.
- 3. DIN rail mount; toggle for On/Off/Reset; available in 1, 2, and 3 pole.
- 4. Trip-free thermal-magnetic trip unit with time/current characteristics:
 - a. 50 to 100 seconds at 2 times rated current.
 - b. 3 to 10 seconds at 5 times rated current.
 - c. Instantaneous at 8 to 10 times rated current.
- 5. ABB S200U series, or equivalent.

C. DC Circuit Breakers:

- 1. UL Recognized component with UL 1077 2 kA interrupt rating at 65 VDC.
- 2. Use for 24 VDC applications only.
- 3. DIN rail mount; toggle for On/Off/Reset; use only single pole breakers.
- 4. Trip-free thermal-magnetic trip unit with time/current characteristics:
 - a. 20 to 150 seconds at 1.5 times current.
 - b. Instantaneous at 2 to 4 times rated current.
- 5. Phoenix Contact TMC-1 series, or equivalent.

- D. Provide circuit breakers where shown on Drawings. Also provide other breakers, as follows, which are typically not shown in Drawings. Show in submittals Drawings.
 - 1. DC circuit breaker, 0.2A, in the source for each 4-20 mA analog loop which is powered from a control panel. Mount CB on the DIN rail adjacent to the respective DCCL SPD assembly.
 - 2. AC circuit breaker of appropriate size for each AC device in a control panel, such as on the input of a DC power supply.

2.15 FACTORY TEST

- A. Perform a factory test on each contractor furnished control panel.
- B. Perform tests required for compliance with UL standards.
- C. Verify correct calibration of all analog instruments and indicators.
- D. Test complete hardware system including relays, timers, hand controls, indicators, instruments, and other active components.
- E. For PLC Type Control Panels:
 - 1. Verify that opening and closing system inputs activates the correct PLC points.
 - 2. Verify that simulated operation of PLC outputs produces the correct hardware actions.
 - 3. Test all software to verify that it functions as specified.
- F. Verify correct communications with the operator interface system. Verify correct operation of software in conjunction with PLC software.
- G. Verify that telemetry hardware and radios function properly.
- H. Record test results and submit prior to installation of panel in field.

PART 3 EXECUTION

3.01 FIELD WIRING

- A. Mark each field wire end except on twisted, shielded pairs, mark jacket, not individual wires.
 - 1. Text: As shown on submittals.
 - 2. Method: Section 26 05 19 Low Voltage Wire and Cables.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.Pay ItemPay Unit5.05Control PanelsLump Sum

END OF SECTION

SECTION 40 71 13.13

INLINE ELECTROMAGNETIC FLOW METERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electromagnetic flow meters and accessories.
- B. Documentation.
- C. Startup, training, and other services.

1.02 SUBMITTALS

- A. Standard manufacturer's literature showing compliance with the Specifications.
- B. Dimension Drawings of each size of flow element.
- C. Dimension Drawing of flow transmitter.
- D. Installation manuals.

1.03 OPERATION AND MAINTENANCE (O&M) MANUALS

- A. Manufacturer's standard O&M manual.
- B. Warranty letter which lists the serial number of each flow element and each flow transmitter and states the day of expiration of the warranty for each item of equipment.

PART 2 PRODUCTS

2.01 ELECTROMAGNETIC FLOW METERS – GENERAL

- A. Acceptable Manufacturers:
 - 1. Endress + Hauser Proline W400 to match Owner's standard.
 - 2. No substitutes.
- B. Furnish all electromagnetic flow meters for this project from a single manufacturer in order to achieve standardization for operation, maintenance, spare parts, and manufacturer's service. Meters to be designed, manufactured, and calibrated in an ISO9001, NAMAS, NIST, NATA certified facility.

- C. All electromagnetic flow transmitters furnished shall be fully interchangeable with all electromagnetic flow elements furnished.
- D. Measuring Method: Low frequency pulsed DC coil excitation, potential electrodes, and high impedance amplifier.
- E. Furnish a complete system for each electromagnetic flowmeter, including as a minimum a flow element, a flow transmitter, and the appropriate length of signal and power interconnecting cable.
- F. Flow Stream to be Measured: See Schedule.
- G. Analog Output:
 - 1. Guaranteed overall mA output accuracy when configured with six diameters of straight pipe upstream of the electrode axis and two diameters of straight pipe downstream of the electrode axis, at ideal temperature, input voltage, and load:
 - a. Range: 1000 to 1 on 6" and smaller, 1500 to 1 on 8" and larger.
 - b. Accuracy: 1/2" to 6" 0.2% of rate; 8" and larger 0.15% of rate.
 - c. Repeatability: $\pm 0.05\%$ or ± 0.0008 ft/s, whichever is greater; $\pm 0.5\%$ at 0.67 feet per second (FPS), changing to $\pm 0.2\%$ at 1.64 FPS.
 - 2. Inaccuracy due to ambient temperature changes shall not exceed $\pm 0.025\%$ of flow rate per degree difference from 21°C ambient.
 - 3. Inaccuracy due to changes in load shall not exceed $\pm 0.02\%$ of flow rate from minimum to maximum load.
 - 4. Inaccuracy due to changes in input voltage shall not exceed 0.2% of flow rate at $\pm 10\%$ input voltage and shall not exceed 0.3% of flow rate at 100 input volts.
- H. Provide circuitry to eliminate noise errors that would otherwise be caused by hard particles striking the electrodes.
- I. Furnish systems with the capability of measuring, indicating, and totalizing flow in both directions.
- J. Control Power for Flow Transmitter: 120 VAC, $\pm 10\%$, 60 Hz power, at rated accuracy. Power the flow element from the flow transmitter.
- K. Ambient Temperature Range Within Which Specified Accuracy is Maintained: -25°to+60°C.
- L. Meter Process Pressure Rating:
 - 1. For Flanged Meters: Match the pressure rating of the specified meter flanges.
 - 2. For Wafer Meters: Match the pressure rating of the flanges shown on Drawings.
- M. System: Immune to RFI interferences by design or supplied with RFI filters by the meter manufacturer.

2.02 FLOW ELEMENT

- A. Comply with the requirements of IP68 for continuous submergence in water and direct burial, as scheduled.
- B. Metering Tube: 304 stainless steel.
- C. Flanges: Carbon steel ANSI or AWWA, raised-faced, as required to meet the process and piping requirements. Standard connection type to be as follows unless scheduled otherwise:
 - 1. 1/10" to 4" Wafer design.
 - 2. 6" to 24" ANSI 150 flanges.
 - 3. 30" and larger AWWA Class D flanges.
- D. Provide one grounding ring or a grounding electrode, with two ground straps with each flow element. Make rings of 304 stainless steel, 316 stainless steel, or of other material as scheduled.
- E. Flow Element Liner: As scheduled.
- F. Electrodes:
 - 1. Conical and self-cleaning.
 - 2. As scheduled.
- G. Coat external surfaces with an epoxy or polyurethane corrosion-resistant coating.

2.03 FLOW TRANSMITTER

A. Features:

- 1. Microprocessor based.
- 2. Field configurable.
- 3. Mounted remotely from the flow element.
- 4. Multi-function integral LCD display.
- 5. A totalizing register for each direction of flow and a total net flow totalizing register, each of which shall be displayed on a time-shared basis on the LCD display, along with the instantaneous flow.
- 6. Flow indication and totalizers: Field programmable in engineering units.
- 7. Memory retention of totals and programmed configurations during power outages of up to 10 years.
- 8. Minimum amplifier input impedance: $10E12\Omega$.
- 9. Enclosure: Coated with an epoxy or polyurethane corrosion-resistant coating, or NEMA 4X.

B. Analog Output:

- 1. Isolated, 4 to 20 mA DC signal in linear proportion to flow rate.
- 2. Capable of driving loads in the range of 0 to 500Ω without adjustments.
- 3. Span and Zero: Field configurable by manual adjustment.

C. Directional Flow Measurement:

- 1. Required as standard.
- 2. Indicate flow direction on the LCD display.
- 3. Provide pulse outputs individually scalable for each direction of flow for totalization at the site and for use by the control system.
- 4. Provide an output signal to indicate the flow direction. If the output is not a dry contact, then provide a relay in a NEMA 12 enclosure which is controlled by the output signal and connect the relay contact to the process controller. The relay may or may not be shown on Drawings. Field mount adjacent to transmitter and connect.
- 5. Provide separate 4-20mA signal for direct and reverse flow. Two 4-20mA output signals required.

D. Low Flow Cutoff:

- 1. Field configurable from 0 to 10% of flow range.
- 2. Below the low flow cutoff and during empty pipe conditions, show zero flow on the local display, transmit a 4-mA signal to indicate zero flow, and do not accumulate totalizer counts.
- E. Full Scale Range: Adjustable between 1 and 49 FPS.
- F. Dampening adjustment to control the rate of change of the transmitter output.
- G. Electronics: Self-checking; display error messages.
- H. Configuration of Transmitter: Accomplished by means of pushbuttons.
- I. Profibus connection and protocol for transmission of data to PLC.

2.04 SIGNAL AND POWER INTERCONNECTING CABLE

- A. Furnished by the manufacturer of the flowmeter.
- B. Both power and signal cables shall be run in one conduit between the flow element and the flow meter unit. Units that require two conduits are not acceptable.
- C. Suitable for transmitting all required power and signals from the flow element to the transmitter, up to a maximum distance of 330'.
- D. Supply as a single piece for each meter.
- E. Terminals, terminal installation tools, cable seals, and seal fittings, as needed to obtain the specified submersible rating: furnished by the factory as part of the system.

2.05 FIELD CALIBRATOR

- A. Capable of providing a minimum five-point calibration of the flow transmitters in the field.
- B. Furnish a calibrator only if scheduled.

2.06 FACTORY TESTING

- A. Hydraulically calibrate each meter at the factory at a minimum of three calibration points to be determined by the manufacturer for best possible accuracies based on the meter size.
- B. Supply each meter with a curve and certificate defining the calibration points used in verifying that the meter meets the required accuracy criteria.
- C. Flow facility must be certified by volume or weight certified provers. Facility must have the capability to hold the flow rate at the calibration points for a minimum of 5 minutes to allow stabilization for flow and repeatability point checks. Maximum uncertainty of 0.07% of flow rate.
- D. Conduct testing by means of a gravimetric method similar to that used by the NIST. Testing based on a volumetric method will be accepted only from laboratories having a minimum 5-year history of compliance with NIST accuracy standards.
- E. Factory/Field Verification (Calmaster):
 - 1. Test Mode: Provide the ability to verify the accuracy of the unit and the integrity of the current loop without any external equipment.
 - 2. Self-Diagnostics: Internal checks of all outputs and displays.
 - 3. *In situ* Calibration Verification: This system shall be able to verify in a quantifiable manner the current condition of the meter versus the condition of the meter when originally manufactured, then factory tested. This calibration verification of the meter shall be performed without need for physical access to the meter flow tube. The calibration verification shall meet or exceed the following requirements:
 - a. The original FINGERPRINT values shall be stored on a computer disk given to the Owner.
 - b. The verification process shall consist of at least 52-meter conditions pertaining to the primary coils, electrodes, interconnecting cable, and signal converter.
 - c. The coil verification shall include faults of continuity, impedance, resistance to ground, inductance, and magnetic field strength.
 - d. The electrode verification shall include faults of continuity, impedance, and insulation.
 - e. The cable verification shall include faults of coil, electrode, driven shield, and ground connections, cable cuts, cable damage, and water in the cable.

- f. Signal converter verification shall include faults of current supply to coils, zero offset, span forward and reverse, electrode offset, current output, frequency output forward and reverse, driven shield to ground, overall shield to ground, and signal ground connection to ground.
- g. The calibration verification shall include the following: Water ingress into the primary elements, faulty electrodes, dirty electrodes, electrode leakage, corroded electrodes, high process noise, liner failure, conductive coatings on the liner, insulating coatings on the liner, and primary element damage.
- h. All tests shall be performed by means of comparison between the absolute values and change in values from the new conditions.
- i. Verification standard shall be $\pm 1\%$ of wet calibration for meters produced using the calibration verification service, or $\pm 2\%$ for standard meters.
- j. The software shall be Windows®-based. This software shall be capable of generating a report based upon the result of the forgoing described tests. The software shall be capable of creating and storing an audit trail of the meter's conditions and the meters history.
- k. The calibration verification and metering system shall meet or exceed the standards established by the NIST.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Mount and install in accordance with the manufacturer's instructions.
- B. Install all conduit; install power, ground, and load conductors; and install factory furnished interconnecting cable in the conduit.
- C. Energize the system only upon request of the manufacturer's field service representative.

3.02 STARTUP SERVICES

- A. Furnish the services of a manufacturer's field service representative to accomplish the following:
 - 1. Install cable seals, dress and terminate the cables, and make all final connections at each flow element and transmitter.
 - 2. Certify by letter or copy of the service report that all conductors are properly terminated and connected, and that the installation meets the manufacturer's requirements to achieve the specified submersibility and is in accordance with the manufacturer's installation instructions.
- B. Include the cost of these services in the cost of each flowmeter.

3.03 **SCHEDULE**

- A.
- Meter Types Required for This Project:
 1. Endress + Hauser Proline W400 to matching existing.
 - No other types. 2.

Tag	Description	Size	Range	Calibration
01FIT 0100	County-to-District Master Meter Vault	4"	65-800 gpm	Factory
02FIT 0100	Hondo 2 Pump Station Discharge Meter Vault	10"	0-1,200 gpm	Factory

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
1.25, 5.04	Electromagnetic Flow Meter	Lump Sum

END OF SECTION

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SECTION 40 72 23

RADAR LEVEL TRANSMITTER

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Radar level transmitter.

1.02 SUBMITTALS

A. Catalogs cuts, technical data, and ratings.

1.03 OPERATION AND MAINTENANCE (O&M) DATA

- A. Catalogs cuts, technical data, and ratings.
- B. Manufacturer's standard O&M Manual.
- C. Programming Software on CD/DVD.

1.04 EXTRA MATERIALS

A. One complete transmitter.

PART 2 PRODUCTS

2.01 RADAR LEVEL TRANSMITTER/ANTENNA

- A. Transmitter/Antenna Characteristics:
 - 1. Measurement Principle: Pulse burst radar @ 26 GHz.
 - 2. Antenna: Encapsulated 100mm Horn, Polypropylene.
 - 3. 24 VDC, 2-wire loop powered transmitter for level, volume, and open channel flow measurement.
 - 4. Loop Resistance: 400Ω @ 24 VDC/20 mA, 350Ω @ 24 VDC/22 mA.
 - 5. Span (from threads): 15 to 40.
 - 6. Output Type: Analog 4 to 20 mADC with optional HART digital signal.
 - 7. Output Range: Analog 3.8 to 20.5 mA useable; Digital 0 to 999".
 - 8. Output Resolution: Analog 0.01 mA; Digital 0.1".
 - 9. Repeatability: < 0.1" (2.5 mm) or 0.025% of tank height.
 - 10. Response Time: Less than 1 second.
 - 11. Warm-up Time: 30 seconds.
 - 12. Ambient Temperature: -40° to +80°C.
 - 13. Ambient Temperature Effect: 0.05% per 10°C.
 - 14. Housing Material: Cast aluminum A356T6.

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- 15. Cable: Provide manufacturer's 8 conductor shielded cable used for connecting transmitter/antenna to remote display. See Drawings for required cable length.
- 16. Cable Entry: Provide and install 1/2" NPT adaptor for connecting conduit to transmitter/antenna and gland fitting for connecting cable to remote display.
- 17. Enclosure: NEMA 4X/6P (IP67/68).
- 18. Antenna Mounting:
 - a. Flanged mounting.
 - b. Maximum Total Beam Spread Angle: 8 degrees.
 - c. Provide flange adapter or companion flange if required and as shown on the Drawings.
- 19. Minimum Blocking distance: 15 inches.
- 20. Configuration Interface:
 - a. Menu-driven data entry and system security keypad.
 - b. 4-line digital display with pushbuttons and data backup function.
- 21. Endress and Hauser Micropilot FMR50 with 100mm horn antenna and FHX50 Remote Display or Engineer reviewed equivalent.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install remote display in NEMA 4, 10Hx8Wx4D, 316 SS continuous hinged enclosure with back panel, no clamps, and mount on strut as shown on mounting detail Drawing.
- B. See equipment installation instructions and mounting detail Drawings for proper wire, conduit and remote display installation.
- C. Install in accordance with manufacturer's recommendations.

3.02 CALIBRATION

- A. Field calibration:
 - 1. Calibrate as indicated on Water Resource Drawings with tank dimensions.
 - 2. Demonstrate proper operation.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	<u>Pay Item</u>	<u>Pay Unit</u>
5.05	Radar Level Transmitter	Lump Sum

END OF SECTION

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SECTION 40 73 13

PRESSURE GAUGES

PART 1 GENERAL

1.01 WORK INCLUDED

A. Furnish and install pressure gauges and gauge accessories as specified and as shown on the Drawings.

1.02 SUBMITTALS

- A. Section 01 33 23 Shop Drawings, Product Data, and Samples:
 - 1. Product Data for Gauges and Accessories.

1.03 OPERATION AND MAINTENANCE DATA

- A. Section 01 78 23 Operation and Maintenance Data.
- B. Manufacturer's complete operations and maintenance manuals, including the following items as a minimum:
 - 1. Operating Instructions.
 - 2. Maintenance Instructions.
 - 3. Calibrating Instructions.

PART 2 PRODUCTS

2.01 PRESSURE GAUGES FOR WATER AND AIR SERVICE

- A. Accuracy Requirements: $\pm 1.0\%$ of span, ASME B40.100 Grade 1A.
- B. Materials of Construction and Design Features:
 - 1. Bourdon Tube: Type 316 stainless steel.
 - 2. Case liquid filled at factory, glycerine.
 - 3. Case: Type 304 stainless steel.
 - 4. Dial Size: 4".
 - 5. Process Connection: Type 316L stainless steel, 1/4" NPT lower connection of gauge.
- C. Scale: As shown on Drawings.
- D. Manufacturer: WIKA Type 233.54; 1/4" male NPT process connection; factory filled, and tack welded to overpressure protector-diaphragm seal assembly to form a single unit. See Drawings for gauge connection mounting and required installation.

- E. Overpressure Protector: WIKA Type 910.13.
 - 1. Function: Spring-actuated piston closes valve at given high pressure setting to protect gauge.
 - 2. Connections: 1/2" NPT male inlet, 1/4" NPT female outlet.
 - 3. Body and Piston Valve: Type 316 Ti SS (titanium stabilized).
 - 4. O-Ring: FPM (Viton).
 - 5. High Pressure Setting: Factory preset to match high pressure scale value on gauge.
- F. Gauge Diaphragm Seal: WIKA Model L990.10 diaphragm type chemical seal with 1/2" NPT female process connection.
 - 1. Overpressure protector (instrument) connection size: 1/2" NPT female.
 - 2. Body and Diaphragm: 316L stainless steel.
 - 3. Gasket: Viton.

PART 3 EXECUTION

3.01 INSTALLATION

A. Per manufacturer's instructions.

3.02 SCHEDULE

A. As indicated in the following table:

Location	Description	Range	Calibration
Hondo 2 Altitude Vault	Inlet to Altitude Valve	0-60 psig	Factory
Hondo 2 Altitude Vault	Outlet from Altitude Valve	0-30 psig	Factory
Hondo 2 Pump Skid	Suction Header	0-30 psig	Factory
Hondo 2 Pump Skid	Discharge Header	0-300 psig	Factory
Pressure Reducing Valve (PRV) Vault	Inlet to PRV	0-300 psig	Factory
Pressure Reducing Valve (PRV) Vault	Outlet from PRV	0-60 psig	Factory

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	<u>Pay Unit</u>
5.01	Pressure Gauge Assemblies	Lump Sum

END OF SECTION

SECTION 40 73 25

ABSOLUTE AND GAGE PRESSURE TRANSMITTER

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pressure Transmitters.

1.02 SUBMITTALS

- A. Manufacturer's catalog cuts.
- B. Exact model number and manufacturer's ordering information sheet which shows what each character of the model number means and shows available choices for each character.

1.03 OPERATIONS AND MAINTENANCE (O&M) MANUAL

- A. Manufacturer's catalog cuts.
- B. Exact model number and manufacturer's ordering information sheet which shows what each character of the model number means and shows available choices for each character
- C. Manufacturer's standard O&M Manual.
- D. Provide all information on paper and in AdobeTM .pdf format on CD.

PART 2 PRODUCTS

2.01 PRESSURE TRANSMITTERS

A. General:

- 1. Two-wire, microprocessor-based absolute or gage pressure transmitter with analog and digital output capability.
- 2. Nominal 2 lbs. total weight for mounting directly to pipe or to optional mounting bracket.
- 3. Dual-compartment housing with a moisture barrier totally isolating the electronic circuitry from the field wiring and calibration terminals.
- 4. Modular electronics incorporating replaceable circuitry.

B. Compliance Requirements:

- 1. Transmitter:
 - a. National Electrical Code (NFPA 70) 501-5.
 - b. NEMA 4X.
- 2. Manufacturer: Third-party certified as meeting the requirements of ISO 9001.

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C. Construction:

- 1. Wetted Materials: 316L SST.
- 2. Fill Fluid: Silicone oil.
- 3. Process Connection: 1/2-14 FNPT.

D. Ranges:

- 1. 30 psi: 1.5 minimum span, 30 maximum span.
- 2. 150 psi: 7.5 minimum span 150 maximum span.
- 3. 800 psi: 40 minimum span, 800 maximum span.
- 4. 4000 psi: 200 minimum span, 4000 maximum span.

E. Accuracy:

1. 0.20% accuracy, including linearity, hysteresis, and repeatability.

F. Time Response:

- 1. Time Constant: 200 milliseconds,
- 2. Dead Time: < 0.1 s,
- 3. Update Rate: 20 times per second minimum.

G. Environmental Conditions:

- 1. Humidity: 0 to 100% relative humidity.
- 2. Ambient Temperature Limits: -40° to 185°F (-40° to 85°C).

H. Process Conditions:

- 1. Suitable for liquid, gas, and vapor service.
- 2. Process Temperature Limits: -40° to 250°F (-40° to 121°C).
- 3. Pressure Limits: Minimum of twice the maximum span of the transmitter except, 120 lbs. for 30 lb. range.

I. Electrical:

- 1. Conduit connections: 1/2–14 NPT.
- 2. Factory sealed so external conduit seal is not required to meet FM explosion-proof requirements.
- 3. Power: 10.5 to 36 VDC with no load (6–14 VDC for low power).
- 4. Standard Outputs:
 - a. 4-20 mADC digital HART protocol signal into 250 to 500Ω .
 - b. 4–20 mA analog signal into maximum loop resistance of 43.5 times (Power Supply Voltage 10.5V) Ω .
 - c. Low Power Option: 1–5 VDC output.
 - d. Self-diagnostics capability.

J. Adjustments:

- 1. Zero suppression and elevation.
- 2. Zero and span non-interactive with each other.
- 3. Non-active during transmitter operation.

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- K. Tagging:
 - 1. Factory tag transmitter with contract tag number.
- L. Options, provide as scheduled:
 - 1. Absolute or gage type.
 - 2. Manifold.
 - 3. SST mounting bracket with SST hardware.
 - 4. Factory Mutual Hazardous Location Certification
 - 5. LCD digital display.
 - 6. Calibration certificate.
 - 7. Accuracy of 0.1%.
 - 8. Fail up-scale or fail down-scale.
 - 9. Low power option (maximum 3 mA) with 1-5 VDC output.
 - 10. Transient protection.
- M. Endress + Hauser Cerabar PMC71 or Engineer reviewed equivalent.
- PART 3 EXECUTION (NOT USED)
- PART 4 PAYMENT
- 4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
5.05	Pressure Transmitters	Lump Sum

END OF SECTION

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SECTION 40 77 26

LIMIT SWITCHES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Limit switches.

1.02 SUBMITTALS

A. Complete manufacturer's catalog cuts.

PART 2 PRODUCTS

2.01 HAZARDOUS LOCATION SEALED CONTACT LIMIT SWITCH

- A. Suitable for NEC Class 1, Division 2, Groups A through D locations.
- B. Contacts:
 - 1. Hermetically sealed in a glass envelope.
 - 2. NEMA B600 and NEMA P300 rated.
 - 3. Compatible with Programmable Logic Controller digital inputs at 24V and above.
- C. Enclosure: NEMA 13.
- D. Operators Available:
 - 1. Eight roller type.
 - 2. Six rod lever type.
 - 3. Five push type.
 - 4. Wobble stick and cat whisker.
- E. Ambient Temperature: 0° to 130°F.
- F. Allen-Bradley Bulletin 802R, or Engineer approved equivalent.

2.02 HAZARDOUS LOCATIONS SEALED CONTACT LIMIT SWITCH

- A. Suitable for NEC Class 1, Division 1, Groups B through D locations.
- B. Contacts:
 - 1. Hermetically sealed in a glass envelope.
 - 2. NEMA B600 and NEMA P300 rated.
 - 3. Compatible with Programmable Logic Controller digital inputs at 24V and above.
- C. Enclosure: NEMA 7 and 9.

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D. Operators Available:

- 1. Eight roller type.
- 2. Six rod lever type.
- 3. Five push type.
- 4. Wobble stick and cat whisker.
- E. Ambient Temperature: 0° to 130°F.
- F. Allen-Bradley Bulletin 802XR, or Engineer approved equivalent.

2.03 CABLE SWITCH

A. Switch:

- 1. UL labeled. Enclosure rated IP 66.
- 2. Ambient Temperature: -25° to $+80^{\circ}$ C.
- 3. Contacts:
 - a. Actuated by extra force on pre-tensioned cable or by pressing on mushroom-head button.
 - b. Actuated by insufficient tension in cable.
 - c. Latch open immediately on actuation.
 - d. Reset only by intentionally turning a reset knob.
 - e. Two normally closed and one normally open.
 - f. Continuous 10A, break 2A at 250 VAC or at 24 VDC.
 - g. Rated Insulation Voltage: 500V; Rated Impulse Voltage: 2500V.
- 4. Cable Tension Indicator: Visible through window in cover.
- 5. Allen-Bradley Lifeline 4 or Engineer reviewed equivalent.
- 6. Also referred to as "rope safety switch."

B. Installation Kit:

- 1. Red vinyl covered wire rope.
- 2. Tensioner.
- 3. Eyebolts, connectors, hardware.
- 4. Same manufacturer as switch.

C. Tensioner Spring:

- 1. 19 mm y 210 mm by 50N force.
- 2. Same manufacturer as switch.

D. Sheave:

- 1. With swivel eye.
- 2. Designed for use with wire rope furnished.
- 3. Same manufacturer as switch.

2.04 MAGNETICALLY OPERATED LIMIT SWITCH

A. Switch:

- 1. UL 634 listed industrial duty SPDT hermetically sealed reed-type switch completely enclosed and encapsulated in aluminum housing.
- 2. Surface mounted, using integral, through-case mounting holes.

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- 3. Switch leads factory soldered to switch.
- 4. Leads connection by 3' stainless steel armored cable.
- 5. Closed loop.
- 6. Three inch gap $\pm 20\%$.
- 7. Switch ratings 100V AC/DC and 0.5A.

B. Magnet:

- 1. Surface mounted rare earth material magnet.
- 2. Surface mounted, using integral, through-case mounting holes.
- C. Sentrol GE Interlogics 2500A switch and 1920 magnet or Engineer approved equivalent.

2.05 MAGNETIC PROXIMITY SWITCH

A. Standards:

- 1. Switches installed in hazardous location: UL listed explosion proof for Class I, II, III; Division 1, Groups A through G; Class I, II, III; Div. 2, Groups A, B, C, D, F, G.
- 2. Other Switches: UL Listed General Purpose, CSA Certified General Purpose, and FM approved.
- B. Operating temperature range: -40° to $+105^{\circ}$ C.

C. Enclosure:

- 1. NEMA 4X.
- 2. 304 SS with polyurethane corrosion resistant coating.
- 3. One-half inch-14 NPT conduit outlet.

D. Contacts:

- 1. DPDT.
- 2. Materials: Silver cadmium oxide, gold flashed.
- 3. AC Ratings, Resistive Load: 10A at 120V; 5A at 240V, 2.5A at 480V.
- 4. DC Ratings, Resistive Load: 3A at 24V; 1A at 48V; 0.5V at 120V.

E. Connections:

- 1. For DPDT switches and for switches that are rated for hazardous locations furnish leads:
 - a. Six for contacts plus ground.
 - b. Potted to switch.
 - c. Long enough to run unspliced from switch to junction box containing terminal boards.
- 2. For other switches provide screw terminals.

F. Performance:

- 1. Repeatability: 0.002".
- 2. Response Time: 8 milliseconds.
- 3. Differential: Approximately 1/4" (6 mm).

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- 4. Sensing Range: Approximately 1/4" but provide target magnet for increased sensing range of up to 3 7/8" range.
- G. Topworx series 80 GO Switch or Engineer approved substitute.

PART 3 EXECUTION

3.01 INSTALLATION

- A. For switches with armored cable, install a conduit box nearby with miniature terminal board for connection of leads to field wiring.
- B. Box and TBs may or may not be shown on the Drawings. Use box suitable for the area installed. Connect cable to box with connector having compression bushing which grips the armored cable.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	<u>Pay Unit</u>	
5.05	Limit Switches	Lump Sum	

END OF SECTION

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SECTION 40 78 10

CONTROL HARDWARE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Control Hardware: switches, pushbuttons, indicator lights, relays, timers, photoelectric cells, and diodes.

1.02 SYSTEM DESCRIPTION

- A. If a component is shown on Drawings but is not fully identified, and it is reasonable to use one of the components below, then submit as such. If no description is applicable, submit a first class product of a reputable manufacturer.
- B. Components of certain equipment are specified under the specification for that equipment and shall be supplied as required.

1.03 SUBMITTALS

- A. Catalog cuts. Duplicate submittals of cuts for different applications are not required.
- B. Combine with Submittals for Section 40 61 13 Plant Control System, or Section 40 67 10 Control Panels.

PART 2 PRODUCTS

2.01 SEALED CONTACT SWITCHES AND PUSHBUTTONS

- A. Contacts: Hermetically sealed glass reed with NEMA B600 and P300 ratings.
- B. Enclosures, operators, contact blocks, legend plates, engraved nameplates, hardware, and accessories: Corrosion resistant.
- C. All stop pushbuttons shall be lockout type.
- D. Enclosures:
 - 1. Class I, Division 1, Class I, Division 2, and Process Areas: NEMA 4X.
 - 2. Non-Process Indoor Areas: NEMA 12.
 - 3. As shown on Drawings.
- E. Operators: NEMA 4X where mounted in NEMA 4X enclosures; NEMA 13 where mounted in NEMA 12 enclosures or control panels.
- F. Allen-Bradley Bulletin 800R for 4X application; Bulletin 800T for NEMA 13; or Engineer-approved equivalent.

2.02 LED PILOT LIGHTS

- A. High brightness light emitting diode with cartridge holder.
- B. Complete with current limiting resistor suitable for DC supply voltage and 400 PRV diode to block reverse voltage.
- C. Lighted Pushbuttons or Switches: Not acceptable.
- D. Push-to-test type unless specifically shown otherwise on Drawings. Push-to-test wiring may not be shown on schematics.

E. Enclosures:

- 1. Class I, Division 1 and Class I, Division 2 areas: Copper-free, cast aluminum, NEMA 7.
- 2. Process areas: NEMA 4X.
- 3. Non-Process Indoor areas: NEMA 12.
- 4. As shown on Drawings.

F. Devices:

- 1. NEMA 7 where mounted in NEMA 7 enclosures.
- 2. NEMA 4X where mounted in NEMA 4X enclosures.
- 3. NEMA 12 where mounted in NEMA 12 enclosures.
- G. Allen-Bradley Bulletin 800H for 7 or 4X application; Bulletin 800T for NEMA 12 application; or Engineer approved equivalent.

2.03 MINIATURE PLUG-IN RELAY

A. Contacts:

- 1. SPDT or DPDT as shown on Drawings.
- 2. Pilot Duty Rating: NEMA B300.
- 3. Rated Thermal Current: Single Pole = 10A; Double Pole = 5A.
- 4. Rated Insulation Voltage: 250V IEC; 300V UL/CSA.
- 5. Single pole 120 VAC single phase inductive rating: Make 30A; Break 3A; 1/3 HP.
- 6. Double pole 240 VAC single phase inductive rating: Make 15A; Break 1.5A; 1/2 HP.
- 7. Make, break, and continuous at 30 VDC: Single Pole = 10A; Double Pole = 5A.

B. Coil:

- 1. Nominal 60 Hz AC coil voltages available: 6, 12, 24, 120, 240 VAC.
- 2. Nominal DC coil voltages available: 6, 12, 24, 48, 110 VDC.
- 3. Permissible coil voltage variation:
 - a. 85 to 110% of nominal voltage at 60 Hz.
 - b. 80 to 110% of nominal voltage at DC.
- 4. Maximum AC power consumption: 1.2 VA.
- 5. Maximum DC power consumption: 0.53W.

- C. Dielectric Withstand Voltage: Pole to pole or pole to coil => 1500 VAC RMS.
- D. Mechanical Life Operations: Minimum 5 million.
- E. Switching Frequency Operations: 1800 per hour.
- F. Operating time at nominal voltage at 20° C: Pickup = 15 ms; Dropout = 15 ms.
- G. Environmental:
 - 1. Operating Temperature: -30° to $+55^{\circ}$ C.
 - 2. Altitude: 2,000 meters.
- H. Construction:
 - 1. Insulating Material: Molded high dielectric material.
 - 2. Enclosure: Transparent dust cover.
 - 3. Contact Material: Silver-cadmium oxide.
- I. Socket:
 - 1. Screw terminal, DIN-mount.
- J. Allen Bradley Bulletin 700 HK with HN socket or Engineer reviewed equal.
- K. Use for programmable logic controller output interposing relays except where higher contact current ratings are required.
- L. If input interposing relays are used, then use either the above relay or Allen-Bradley Bulletin 700-HL Terminal Board Relays.

2.04 HEAVY DUTY RELAY

- A. 600V, industrial type.
- B. Contacts: Field convertible by inverting plug-in contact module with captive terminal clamp screws.
- C. Contact Rating:
 - 1. Minimum: 7200VA make, 720VA break, 10A continuous.
 - 2. Provide 20A contacts where required on Drawings.
- D. Contact Arrangements: As shown on Drawings.
- E. GE Type CR120B or Engineer approved equivalent.

2.05 PHOTOCELLS

- A. Base: Molded phenolic, 3" skirt.
- B. Dome: Aluminum color (unpainted) translucent tenite butyrate.
- C. Contacts: NC, 1500W.

- D. Cadmium Sulfide Cell: 1" diameter hermetically sealed glass to steel, dissipation power greater than twice demand.
- E. Surge Protection: 60°C. Sparkover: 1500V rms. Critical Impulse Sparkover Voltage Discharge: 10000A, 1-1/2 to 40 ms wave 2000V.
- F. Time Delay: 15 seconds or more.
- G. Temperature Range: -50° to $+60^{\circ}$ C.
- H. Operational Level: Factory preset for 3 footcandles. ON/OFF ratio: 1:2.
- I. Low profile.
- J. 120 V: Tork 2003 or Engineer approved equivalent. 208/277 V: Tork 2004 or Engineer approved equivalent.

2.06 DIODES

- A. Continuous Current: 1A.
- B. Ifsm: 30A.
- C. PRV: 400V.
- D. 1N4004.
- E. Factory install on the coil terminals of each DC relay, whether shown on Drawings or not.

PART 3 EXECUTION

3.01 MOUNTING OF SWITCHES AND PILOT LIGHTS

- A. On control panel where so shown on detail or implied by schematic.
- B. On wall if sufficiently close to controlled equipment or control point.
- C. On unistrut bolted to floor or bolted to side of pump base.
- D. Location subject to approval of Engineer.
- E. Support enclosure independent of conduit.

3.02 MARKING

A. Switches, pilot lights, and other components mounted in/on a control panel: Mark as required in Section 40 67 10 – Control Panels.

- B. Switches and pilot light not mounted in/on a control panel: engraved nameplate (NP) on or adjacent to enclosure.
- C. Other components, such as relays, timers, time clocks:
 - 1. Engraved NP on the face of the enclosure.
 - 2. If more than one such component in an enclosure: engraved NP inside the enclosure adjacent to each component.
- D. Text:
 - 1. As shown on Drawings.
 - 2. If not shown on Drawings, use name and tag number of associated process equipment.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
5.05	Control Hardware	Lump Sum

END OF SECTION

SECTION 40 78 59.13

DC POWER SUPPLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. DC power supplies.
- B. DC uninterruptible power supplies/Buffer Modules.

1.02 SUBMITTALS

- A. Make combined submittal as part of a larger assembly, such as a control panel with a programmable logic controller.
- B. Manufacturer's literature.
- C. Battery literature (if applicable).
- D. Complete model number.

PART 2 PRODUCTS

2.01 DC POWER SUPPLIES

- A. Safety and Performance Requirements:
 - 1. Listed under UL Standard 508.
 - 2. EMC & Noise Emission Directives EN61000-6-2 and EN5008-1-2.
 - 3. CE EMC Directive 89/336/EEC.
 - 4. CE LVD Directives 73/23/EEC.
 - 5. MTBF greater than 500,000 hours in accordance with IEC 61709 (SN 29500).
- B. Housing: IP20, fully enclosed metal housing.
- C. Terminations: Plug connection with no exposed live voltage in accordance with IEC 529.
- D. Mounting: 35mm DIN-rail conforming to DIN EN 50022.
- E. Input Voltage: 85 to 264 VAC, 47 to 63 Hz.
- F. Operating Temperature Range: -25° to +60°C.
- G. Output current rating for this project:
 - 1. Calculate worst-case load.
 - 2. Furnish model with 60°C current rating of 1.33 times worst-case load.

- H. Typical Efficiency: Power Supplies shall have an efficiency of at least 80% with high efficiency models (~90%) available. Voltage adjustment capability:
 - 1. Nominal 12 VDC Supply: 12 to 14 VDC.
 - 2. Nominal 24 VDC Supply: 18 VDC to 29.5 VDC (> 24 V constant capacity. Output Voltage Fluctuation: <+/- 2% overall (combination line, load, time, and temperature-related changes).
- I. Residual ripple shall not exceed 100 mV peak-to-peak at nominal current values. Input over-voltage protection: 105%.
- J. Inrush Current: 40A maximum.
- K. Termination:
 - 1. Finger-safe in accordance with IEC 529 (EN 60529: 1991).
 - 2. Wires shall be attached to the power supplies by means of a cable-clamping terminal block activated by a screw or a bi-stable spring clamp. Connections shall be gas-tight, and the terminal block shall be fabricated of non-ferrous, non-corrosive materials.
- L. Dielectric Withstand Strength (Insulation Voltage):
 - 1. Between input and output terminals: Minimum 3,000 VAC, 1 minute.
 - 2. Between input terminals and housing: Minimum 2,000 VAC, 1 minute.
 - 3. Between output terminal and housing: Minimum 500 VDC, 1 minute.
- M. Status Indication:
 - 1. Contact for remote indication of failure if input supply power is lost.
 - 2. "DC Power OK" LED.
- N. Ability to limit DC current in case of short circuit or overload event.
- O. Thermal Magnetic Circuit Breakers: When used, breakers shall be of selective fuse-breaking technology.
- P. Parallel mode operation without external circuitry.
- Q. Warranty: 5 years.
- R. Phoenix Contact QUINT Series, (Third Generation with SFB), PULS Dimension QS Series, or Engineer reviewed equivalent.
- 2.02 DC UNINTERRUPTIBLE POWER SUPPLIES/BUFFER MODULES
 - A. General:
 - 1. DC UPS and buffer modules shall be fully enclosed, and provide screw terminations. All wiring points and plug connections shall be "touch safe" with no live voltages that can make contact with a misplaced finger, in accordance with IEC 529.
 - 2. Housing: IP20 (minimum).

- 3. Battery backup time period: Selectable using a switch on the front UPS.
- 4. MTBF: >500,000 hours according to IEC 1709.
- 5. Vibration Shock: 30 g in all space directions in accordance with IEC 68-2-27 and vibration up to 2.3 g 90 min. (<15 Hz, amplitude = +/-2.5 mm/15-150 Hz) according to IEC 68-2-6.
- 6. Efficiency: > 95%
- 7. Electronic short circuit protection on DC output.

B. Mounting:

- 1. 35mm DIN-rail conforming to DIN EN50022.
- 2. Battery modules: Metal foot attached to 35mm DIN-rail or tabs that allow for a panel mount configuration.

C. Wire Connections:

- 1. Cable-clamping terminal block activated by a screw.
- 2. Fabricated with non-ferrous, non-corrosive materials.

D. Status Indication:

- 1. "DC Power In OK" LED.
- 2. Dry contact for "Alarm" status indicating backup period expired, battery presence, and battery quality (UPS only).
- 3. "Battery Mode" LED indicating where operating on batteries (UPS only).
- 4. "Battery Charge" display to indicate whether the battery is charging or not (UPS only).

E. UPS Equipment:

- 1. Be of an intelligent design that facilitates communication between the DC UPS and Battery.
- 2. Automatic battery presence check once every 60 seconds.
- 3. Automatic battery quality check once every 180 hours.
- 4. Batteries:
 - a. Maintenance-free, valve-regulated lead-acid.
 - b. Hot swappable.
 - c. Accepts up to five 1.3AH to 38AH batteries wired in parallel and will not require external circuitry.
 - d. Individually fused.
- 5. Temperature-compensated battery charging.
- 6. Must be able to indicate current charge level of the connected battery module(s).
- 7. Must be able to indicate the remaining amount of runtime while in battery backup operation.
- 8. Must be able to indicate the remaining working lifespan of the battery module(s) before replacement.
- 9. Configurable parameters through PC Software.
- 10. Capable of providing up to 150% of its rated output current.

F. Warranty: Five 5 years.

- G. DC UPS:
 - 1. Phoenix Contact QUINT-UPS-IQ series, PULS U-Series DC-UPS, or other Engineer reviewed equivalent.
- H. Buffer Modules (40A):
 - 1. Phoenix Contact QUINT Power, model series QUINT-UPS/24DC/24/DC40 amp, P/N 23 20 24 1, or Engineer reviewed equivalent.

PART 3 EXECUTION

- 3.01 SCHEDULE
 - A. DC UPS required.
 - B. Program output of DC UPS to alarm when batteries require replacement.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	<u>Pay Unit</u>	
5.05	DC Power Supplies	Lump Sum	

END OF SECTION

SECTION 40 80 00

PLANT PROCESS CONTROL COMMISSIONING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Control system commissioning.

1.02 SUBMITTALS

- A. Commissioning scheme; individual test procedures.
- B. Assemble completed test procedures, which have become test reports in the field, into ring binders. File in order of tag number. Place project information on binders. Submit three copies. The information in the reports having been field verified, this submittal will be reviewed only for completeness.

PART 2 PRODUCTS – (NOT USED)

PART 3 EXECUTION

3.01 PROCEDURE

- A. Meet with the Engineer to define the broad outline for commissioning, such as the extent of the breakdown of the testing into sub-systems and systems, each system having a separate test procedure. Also discuss the order of testing for organizational purposes.
- B. Submit preliminary test procedures, which list step-by-step testing for subsystems and for systems at each facility. Provide space on the procedures for checking off the completion of logical portions of the testing and for showing results thereof.
- C. Submit an overall commissioning scheme for use in efficiently executing the test procedures.
- D. The Engineer will review the procedures and overall scheme and prepare comments.
- E. Meet with the Engineer to review comments and agree on disposition of comments during the meeting.
- F. Revise procedures and overall scheme in accordance with comments and prepare final test procedures and overall scheme for use during testing.

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3.02 PREREQUISITES

A. Conditions:

- 1. Commence system commissioning for each facility only after
 - a. Complete installation of process equipment, associated piping, and associated electrical power, control, and instrumentation systems.
 - b. Certifications from process equipment manufacturers' field service representatives are submitted as specified under the respective Sections.
 - c. Test procedures and overall commissioning scheme are ready.
 - d. Contractor has arranged the schedule with the Owner and the Engineer.

B. Tests:

- 1. Commence commissioning only after performing these tests and submitting specified reports:
 - a. Mechanical/process equipment testing.
 - b. Tests required under Sections 40 61 21.13 Installation, Testing, and Calibration of Instrumentation and 40 61 21.19 Installation and Testing of Control Circuits and Devices.
 - c. Megger testing as required under Section 26 08 10 Electrical Testing.
 - d. Testing of all equipment to show that is operates properly in HAND.

 Include the completion of this testing as line items on the test procedures.
 - e. Testing of miscellaneous individual control devices not already tested. Include the completion of this testing as line items on the test procedures.

3.03 EQUIPMENT

- A. Provide all necessary test equipment to perform system startup.
- B. Provide all equipment as may be necessary to simulate process conditions during startup.

3.04 SYSTEM TEST

- A. Use the test procedures and commissioning scheme as a guide to testing. Enter progress and results. Add printed names and signatures of test personnel and witnesses then submit six copies as test reports.
- B. Furnish Contractor personnel who are familiar with the project for the duration of the Commissioning to operate valve, pumps, and other equipment, as well as to adjust, repair, or replace defective equipment. Do not pull testing personnel away from testing for these activities unless their expertise is needed for troubleshooting or re-calibration.
- C. Furnish Contractor personnel, including field service representative(s) of the manufacturer(s) of control panels:
 - 1. Test all systems in conjunction with the programmable logic controller (PLC) and Operator Interface Unit (OIU) hardware and software.

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- 2. After the above is finished, then schedule with the Owner and Engineer, then demonstrate correct operation of systems to the Owner and the Engineer.
- D. Test each system not directly associated with a PLC, plant control panel, or OIU then demonstrate correct operation to the Owner and the Engineer.
- E. Test and demonstrate all remaining controls.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit	
5.05	Plant Process Control	Lump Sum	
	Commissioning	-	

END OF SECTION

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SECTION 41 22 00

HOISTS AND CRANES

PART 1 GENERAL

1.01 WORK INCLUDED

A. Furnish and install jib cranes and pedestal bases at locations shown on Drawings and scheduled herein.

1.02 RELATED SECTIONS

A. Section 05 50 01 – Anchor Bolts and Chemical Anchors.

1.03 QUALITY ASSURANCE

- A. Acceptable Manufacturers:
 - 1. Thern, Inc.
 - 2. Or Engineer reviewed equivalent.
- B. Requirements of Regulatory Agencies:
 - 1. OSHA Standards, Subpart N Materials Handling and Storage, 29 CFR 1910.179 Overhead and Gantry Cranes.
 - 2. Perform all necessary lead testing.
 - 3. Obtain all necessary inspections and certifications.

C. Warranty:

- 1. 2-Year written warranty for materials and workmanship from date of Substantial Completion.
- D. Standardization: All hoists, trolley, jib cranes, and bridge cranes supplied by a single supplier unless otherwise specifically approved in writing by Engineer.

1.04 SUBMITTALS

- A. Product Data: Section 01 33 23 Shop Drawings, Product Data, and Samples.
 - 1. Sufficient data to verify compliance with specifications.
 - 2. Outline and installation drawings.
 - 3. Data describing materials used, parts, devices, rails, stops, and other accessories.
 - 4. Warranty.
- B. Copies of all required inspection reports, certificates, and load test reports.
- C. Operation and Maintenance Manuals: Section 01 78 23 Operation and Maintenance Data.

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1.05 TRAINING FOR OWNER'S PERSONNEL: Section 01 79 01 – Manufacturer's Instruction of Owner's Personnel.

PART 2 PRODUCTS

2.01 PERFORMANCE AND DESIGN REQUIREMENTS

A. See Schedule.

2.02 MATERIALS

- A. Winch Gearing:
 - 1. General: Steel or cast iron, machine cut.
 - 2. Pinions: Heat treated alloy steel.
- B. Bearings: Antifriction, oil lubricated or permanently grease-packed.
- C. Cable: Type 304 stainless steel rope.
- D. Lifting Hook: Forged steel with safety latch.

2.03 FABRICATION AND MANUFACTURE

- A. Manual Winch Operated Davit Crane:
 - 1. Lifting height: See schedule.
 - 2. Capacity: See schedule.
 - 3. Factory labeled per OSHA requirements.

PART 3 EXECUTION

3.01 ERECTION

- A. Erect in accordance with manufacturer's instructions.
- B. Complete ready to use installation.

3.02 SCHEDULE

- A. Portable Davit Crane Located on Top of Tank No. 1 and Tank No. 2 over Mixer.
 - 1. Capacity: 500 to 1,000 pounds, depending on boom extension position.
 - 2. Base: Pedestal, with roller ball bearing allows 360 degrees rotation of boom under load, with stainless steel lock and rotation handle.
 - 3. Boom Length: Adjustable, four position telescoping lengths.
 - 4. Boom Height: Adjustable under load with ratchet style screw-jack.
 - 5. Hook Reach / Hook Height Above Floor Level: Adjustable reach/height capabilities:
 - a. Condition 1: Hook Reach: 54" / Hook Height: 60".
 - b. Condition 2: Hook Reach: 36" / Hook Height: 84".

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- 6. Lift Below Floor Level: 20 feet.
- 7. Winch: Worm gear hand winch capable of being drill driven, epoxy coated.
- 8. Wire Rope: 1/4" type 304 stainless steel with stainless steel eye hook with swaged ball.
- 9. Finish: Type 304 Stainless Steel.
- 10. Portable Design: Provide quick disconnect pins and other connections that do not require tools, to enable disassembly of the crane into manageable pieces, each not to exceed 42 pounds.
- 11. Acceptable Manufacturer: Thern Commander 1000 Series, model 5PT10 S-M2X, or Engineer reviewed equivalent.
- 12. Quantity: One (1).

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.Pay ItemPay Unit4.02Davit CraneLump Sum

END OF SECTION

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SECTION 41 22 10

PORTABLE GANTRY CRANE AND HOIST

PART 1 GENERAL

1.01 WORK INCLUDED

A. Deliver to Owner one portable gantry crane with Army-type trolley hoist for use in the Hondo 2 Pump Station A-Frame Building to lift the pumps.

1.02 QUALITY ASSURANCE

- A. Acceptable Manufacturers:
 - 1. Gorbel, Inc.
 - 2. Spanco, Inc.
 - 3. B.E. Wallace Products Corp.
 - 4. Budgit.
 - 5. Or Engineer reviewed equivalent.
- B. Requirements of Regulatory Agencies:
 - 1. ANSI B30.17: Overhead and Gantry Cranes (Top Running Bridge, Single Girder, Underhung Hoist).
 - 2. ANSI B30.2.0: Safety Code for Overhead and Gantry Cranes.
 - 3. OSHA Standards, Vol. III, Subpart N: Cranes, Derricks, Hoists, Elevators, and Conveyors.
 - 4. Obtain all necessary inspections and certifications.

1.03 SUBMITTALS

- A. Product Data: Section 01 33 23 Shop Drawings, Product Data, and Samples.
 - 1. Sufficient data to verify compliance with specifications.
 - 2. Outline and installation drawings.
 - 3. Data describing materials used, parts, devices, rails, stops, and other accessories.
 - 4. Written warranty.
- B. Copies of all required inspection reports and certificates.

1.04 WARRANTY

A. Five years (except casters) material and workmanship from date of substantial completion.

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PART 2 PRODUCTS

2.01 PERFORMANCE AND DESIGN REQUIREMENTS

A. See Schedule.

2.02 MATERIALS

- A. Gantry Crane: Structural steel or aluminum square tubing uprights and I-beam; factory enamel coating on steel option.
- B. Casters: Polyurethane.
- C. Hardware: Zinc-plated.
- D. Gearing:
 - 1. General: Steel or cast iron.
 - 2. Pinions: Heat treated alloy steel.
- E. Bearings: Antifriction, oil-lubricated, or permanently grease-packed.
- F. Lifting Hook: Forged steel with safety latch.
- G. Chain:
 - 1. Load Chain: Zinc plated carbon steel.
 - 2. Hand Chain: Aluminum.

2.03 FABRICATION AND MANUFACTURE

- A. General: Comply with MMA standards and HMI No. 100, except as specified herein.
- B. Gantry Crane:
 - 1. Casters: 6" minimum diameter, four-position swivel locking, and wheel brakes.
- C. Trolley:
 - 1. Push type.
 - 2. Capacity: See Schedule.
 - 3. Factory labeled per OSHA requirements.
- D. Hoists:
 - 1. Hand Operated Chain Hoists:
 - a. 85 lb. maximum pull.
 - 2. Lifting height: See schedule.
 - 3. Capacity: See Schedule.
 - 4. Low head type unless otherwise scheduled.
 - 5. Factory labeled per OSHA requirements.
 - 6. All chain hoists furnished with bucket for storing chain.

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PART 3 EXECUTION

3.01 ERECTION

- A. Erect in accordance with manufacturer's instructions.
- B. Complete ready-to-use installation.

3.02 TESTING

- A. Perform initial operational testing in accordance with OSHA standards.
 - 1. Perform load test at 125% of rated load of equipment in conformance with OSHA 1910.179.
 - 2. Submit load certification.

3.03 SCHEDULE

- A. Portable Gantry Crane and Hoist located at Hondo 2 Pump Station:
 - 1. Capacity: 0.5 or 1 ton gantry and hoist.
 - 2. Lifting Height: 7'-0" above floor.
 - 3. Gantry Height: Adjustable 6'-7" to 9'-0" to bottom of I-beam, with winching system.
 - 4. Overall Width: 8'-0"
 - 5. Hoist/Trolley: Manual Army-type hoist-trolley combined unit; maximum headroom 13"; push-type trolley.
 - 6. Quantity: One (1).
 - 7. Delivery: Assemble crane inside of Pump Building.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No. Pay Item		Pay Unit	
5.01	Portable Gantry Crane	Lump Sum	

END OF SECTION

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SECTION 43 23 31.28

VERTICAL MULTI-STAGE IN-LINE CENTRIFUGAL PUMPS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Vertical multi-stage in-line centrifugal pumps with factory installed motors.

1.02 RELATED SECTIONS

- A. Section 26 04 23 Vertical Solid Shaft Motors.
- B. Section 43 23 32 Package Booster Pumping System.

1.03 SUBMITTALS

- A. Product Data: Section 01 33 23 Shop Drawings, Product Data, and Samples:
 - 1. Performance curves, pump and motor.
 - 2. Materials of construction.
 - 3. Dimensioned pump outline drawings.
 - 4. Pump station drawings for accessories.
 - 5. Detailed electrical data.
 - 6. Control drawing and data.
 - 7. Warranty.
 - 8. Installation instructions.
- B. Operation and Maintenance Manuals: Section 01 78 23 Operation and Maintenance Data.
- C. Training for Owner's Personnel Suitable for Video Recording: Section 01 79 01 Manufacturer's Instruction of Owner's Personnel.
- D. Certification that Installation is Ready to Use: Part 3 herein.

PART 2 PRODUCTS

2.01 MATERIALS AND DESIGN REQUIREMENTS

- A. Design:
 - 1. Vertical multi-stage pump.
 - 2. Flanged in-line suction and discharge.
 - 3. Self-adjusting mechanical seal.
 - 4. Suitable for continuous operation.
 - 5. Motor:
 - a. Vertical 3450 rpm TEFC NEMA C Face.
 - b. Positive alignment of rotating element.
 - c. 460V, 60 Hz, 3 phase unless otherwise scheduled.

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- d. Supplied by pump manufacturer.
- e. Non-overloading through entire operating range.

B. Materials:

- 1. Impeller: Stainless steel.
- 2. Shaft: Stainless steel.
- 3. Outer Sleeve: Stainless steel.
- 4. Diffuser: Stainless steel.
- 5. Mechanical Seal:
 - a. For pressures less than 150 psi: Carbon-ceramic seal faces.
 - b. For pressures of 150 psi or more: Carbon-tungsten seal face.
 - c. Stainless steel metal parts.
- 6. Motor Supports: Cast iron.
- 7. Pump Base Housing: Cast iron.
- 8. Pump Head: Cast iron.
- 9. Coupling: Cast iron.

2.02 ACCEPTABLE MANUFACTURERS AND PRODUCTS

- A. Grundfos Series CR.
- B. Aurora Pump Series PVM (X).
- C. Engineer's reviewed equivalent.

2.03 MAINTENANCE MATERIALS

A. Spare Parts: One set of mechanical seals and any O-rings for each pump, unless otherwise scheduled.

PART 3 EXECUTION

3.01 INSTALLATION

- A. In accordance with manufacturer's recommendations.
- B. Accurately aligned with suction and discharge piping so no stress is transmitted to pump flanges.

3.02 SCHEDULE

A. Pump schedule is included in Section 43 23 32 – Package Booster Pumping System.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
5.01	Vertical Multi-Stage Centrifugal	Lump Sum
	Pumps	

END OF SECTION

SECTION 43 23 32

PACKAGE BOOSTER PUMPING SYSTEM

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Furnish, install, connect, and test a factory tested, skid mounted Package Booster Pumping System as specified and as shown on the Drawings.
- B. System consists of skid-mounted in-line vertical multi-stage centrifugal pumps with motors, piping, isolation valves, check valves, pressure gages and transmitters, PLC-based control system, motor controls, panel-mounted VFDs, and appurtenances.

1.02 RELATED SECTIONS

- A. Division 26 Electrical
- B. Section 26 04 23 Vertical Solid Shaft Motors
- C. Section 26 29 23 Variable Frequency Drives
- D. Section 33 12 17 Hydropneumatic Tanks
- E. Division 40 Instrumentation
- F. Section 40 27 02.13 Self-Contained Control Valves
- G. Section 40 73 25 Absolute and Gage Pressure Transmitter
- H. Section 40 73 13 Pressure Gauges
- I. Section 43 23 31.28 Vertical Multi-Stage In-Line Centrifugal Pumps

1.03 SUBMITTALS

- A. Section 01 33 23 Shop Drawings, Product Data, and Samples:
 - 1. Manufacturer's product data for all components, including rating information for all electrical components.
 - 2. Bill of material, materials of construction, weights of major components.
 - 3. Characteristic curves for each model of pump, showing total dynamic head, efficiency and brake horsepower plotted against capacity in gpm for conditions of head and capacity with required impeller.
 - 4. Provide motor derating calculations for project site conditions.
 - 5. Dimensioned Shop Drawings of skid assembly with pumps and piping, including elevation, plan, and isometric views.
 - 6. Structural loads on slab and anchor details.

- 7. Connection diagram showing location of each component (identified by function and by tag number such as PIT101, etc.), terminal boards, wiring on the skid, and notation beside terminal board identifying the function of each terminal intended for a field connection.
- 8. Control panel layout drawings showing all connections to and from each component including terminal blocks and relays.
- 9. PLC interconnection drawings showing all digital and analog device connections to input and output cards or modules.
- 10. Control descriptions detailing the complete operation of the connected system including alarms, interlocks, setpoints, pump control functionality, etc.
- 11. Nameplate schedule.
- 12. Written warranty.
- 13. Qualifications of skid manufacturer.
- 14. Qualifications of manufacturer's authorized warranty repair station.
- 15. Spare parts list.
- B. Section 01 78 23 Operation and Maintenance Data:
 - 1. Recommended spare parts.
 - 2. PLC set points established as the result of startup and shakedown operations.
- C. Field Certification Report: See Part 3 herein.

1.04 QUALITY ASSURANCE

- A. Manufacturer of the packaged pump system shall have a minimum of 10 years' experience in the design and construction of packaged pumping systems.
- B. Factory Testing: Test pumps and controls under design conditions as an integrated package before shipping. Hydrostatic test piping to 1.5 times the nameplate maximum pressure for 15 minutes with no leakage.

1.05 WARRANTY

- A. Five-year warranty of pump and motor burn-out for any cause.
- B. Two-year warranty of motor bearings.
- C. One-year warranty for the complete system when operated and maintained in strict accordance with manufacturer's recommendations.
- D. Manufacturer's authorized warranty repair station: Located within a 250-mile radius of installation; repair station to have been appointed at least two years prior to start of this project.

1.06 PROJECT SITE CONDITIONS

A. Altitude: 7,145 feet MSL.

B. Maximum dry bulb temperature: 90°F.

1.07 DIMENSIONAL LAYOUT

- A. Fabricate package booster pumping system to dimensions shown on Drawings to maintain layout and clearances.
- B. Contractor shall pay for all costs associated with <u>any changes or modifications</u> required to install equipment which has not been fabricated to the dimensions shown or is not in accordance with these specifications.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS OF MAJOR COMPONENTS

- A. Package Booster Pumping System:
 - 1. Grundfos Engineered Systems.
 - 2. Or Engineer reviewed equivalent. Follow the substitution procedures specified in Section 01 25 00 Substitution Procedures.

2.02 PACKAGE BOOSTER PUMPING SYSTEM

- A. General: All materials in contact with potable water shall be NSF/ANSI 61 and NSF/ANSI 372 certified.
- B. Pumps: As specified in Section 43 23 31.28 Vertical Multi-Stage In-Line Centrifugal Pumps and as Scheduled herein.
- C. Motors:
 - 1. Comply with Section 26 04 23 Vertical Solid Shaft Motors.
 - 2. Vibration amplitude: 0.001 inch maximum.
 - 3. Non-overloading (without use of service factor and when derated for site conditions) over complete range of system head and flow.
 - 4. Motors shall be inverter duty rated.
- D. Variable Frequency Drives:
 - 1. VFDs shall comply with Specification 26 29 23 Variable Frequency Drives.
 - 2. VFDs shall be installed inside pump control panel.
- E. Check Valves: Wafer style silent check valves, epoxy coated ductile iron body, EPDM rubber seat, double guided spring loaded poppet, 300 psi rating, Flomatic Series 888R, or Engineered reviewed equivalent.
- F. Pressure Relief Valve: Hydraulically actuated, globe style, ductile iron body, 250 psi pressure rating, ANSI Class 150 lb. pattern flanges, fusion bonded epoxy coating inside and outside, EPDM diaphragm and seals, AISI 303/316 stainless steel pilot system trim, Singer Model 106-RPS, normally closed with pressure relief/sustaining pilot, or Engineer reviewed equivalent.

- G. Butterfly Isolation Valves: Lug style compatible with ANSI Class 150 lb. pattern flanges, one-piece ductile iron body, fusion bonded epoxy coating, Type 316 stainless steel disc, EPDM seat in body, 10-position locking lever handle, 200 psi pressure rating, bi-directional bubble tight close off, Pro Valve Series 500-LF, or Engineer reviewed equivalent.
- H. Piping Headers: Schedule 40 Type 304 stainless steel, welded fabrication, ANSI Class 150 flanges on connections to skid system. Provide blind flange on terminus of suction header.

I. Skid System Configuration:

- 1. Isolation Valves: Provide isolation butterfly valves on suction and discharge of each pump.
- 2. Check Valves: Provide silent check valves on discharge of each pump.
- 3. Pressure Gauges: Provide 4.5 inch diameter, liquid filled, pressure gauges with stainless steel isolation ball valves on suction and discharge piping of each pump. Suction gauges shall be 0 to 30 psi. Discharge gauges shall be 0 to 300 psi. Gauges shall be installed between pump and check valve and/or isolation valve.
- 4. Instrumentation: Provide pressure transmitters with isolation ball valves on suction and discharge headers.
- 5. Provide standard sampling hose bibb without threads on suction headers.
- 6. Provide other piping and appurtenances shown on Drawings.

J. Skid:

- 1. Fabricated structural carbon steel frame of sufficient section specifically designed to limit deflection to L/360 inches at span shown on Drawings with all pump components, cans, and motors installed.
- 2. The base shall be large enough to support the packaged pumping system's pumps, tanks, piping, controls, and electrical. Steel supports shall be welded to the base to support the piping, controls, and electrical. Both the base and supports shall consist of structural steel components, all welded per the AISC Manual of Steel Construction, Part 4, "Welded Joints".
- 3. Skid shall be manufactured from 3/8 inch thick carbon steel, break-formed around the perimeter and welded at the joints to provide a continuous structure from one piece of steel place. Additional mid-span stiffeners shall be placed as required to meet deflection requirements and adequately support pump station components without direct bearing from concrete floor below. Bottom flanges of all structural skid components shall be set to same elevation. Refer to Division 3 for concrete.
- 4. All structural steel welds shall be performed by certified welders employed by the pump manufacturer (Structural welders certified per AWS D1.1). Copies of welder certificates supplied on request.
- 5. Factory-mount and assemble pumps, tanks, piping, and components on base.
- 6. Provide skid mounting tabs with 3/4 inch diameter hole at each corner for field use in positioning skid on slab.

- 7. Properly support pumps, motors, manifold, piping, valves, tanks, Process Panel Termination Enclosures, and accessories.
- 8. Wiring:
 - a. All wiring in conduit.
 - b. AC wiring: Stranded #14 red for hot, white for neutral, black for switched power.
- 9. Tread plate working surface shall be 3/16 inch minimum thickness and cover the entire base.
- 10. Furnish two drilled and tapped grounding lugs on opposite corners of skid.
- 11. Furnish lifting lugs on skid.
- K. Coatings: Furnish all ferrous metals on skid system with factory coating of primer and aliphatic acrylic polyurethane topcoat. Repair all damage to coating in field to match original coating.

L. Power and Control Panel:

- 1. Furnish and install one Underwriters' Approved Power and Control Panel, NEMA 12 design, for mounting to the pump skid which shall be of modular construction with lockable, 3-point latch, gasketed doors.
- 2. Motor controllers to be Allen-Bradley VFDs, no substitutions allowed. Each motor controller shall be equipped with appropriate circuit protection and operator interface pad to allow display and programming of VFD functions. Control circuits shall be isolated from each motor control and power circuits.
- 3. Panel shall be complete with Transient Suppressors on analog input signals and Transient Suppressor on secondary side of control power.
- 4. Provide a standalone Allen-Bradley Programmable Logic Controller (PLC) containing Central Processing Unit (CPU), CMOS RAM memory with battery back-up, non-volatile memory module and input/output circuitry with terminals, no substitutions allowed.
 - a. Controller shall be configured with necessary input/output capabilities to perform all system control sequences plus accommodate control of a future pump by providing additional digital and analog inputs/outputs to handle the required monitoring and control functions.
 - b. Indicator lights shall display: Power On, CPU Run, Battery Low, Prog/CPU Error and input/output functions.
 - c. Controller shall provide normal operation at +10% to -15% of rated input voltage.
 - d. Program memory shall be as required to implement the specified sequence of operations plus an additional 2K beyond what is now required, with an average scan time of at least 15 ms.
 - e. Programming language shall be ladder diagram logic format or function block.
 - f. Output relay contacts rated 120-230 VAC, 2 amp shall be provided for digital outputs.
 - g. Input/output terminal strips shall be removable.
 - h. Controller shall bear U.L. listing for industrial controls.

- 5. Provide a Panel Mounted UL approved, 12 inch, color, NEMA 12 Operator Interface/Message Display Unit as manufactured by Allen-Bradley or Engineer approved equivalent. Features shall include direct communication to PLC programming port, 100 User Configurable Screens, Chaining of Screen Messages, Display Discrete I/O Status, Timer, Counter Modifications, Read and Change PLC Data Registers, 15-Position Numeric Keypad, 12 Function Keys, Ethernet port, and Rugged Cast Aluminum Housing.
- 6. An 8 port Ethernet switch shall be provided as part of the control panel components for connections to communication equipment. Panel shall include Ethernet VPN router and cellular modem. Modem shall be configured to operate over Owner approved cellular service.
- 7. Non-corrosive identification and serial plates to properly identify the system, pumps, control, and gauges shall be securely attached in appropriate visible locations.
- 8. Control panel shall include an uninterruptible power supply (UPS) to power PLC and other panel mounted electronic equipment, and external 2-wire connected instruments. During a power outage, UPS shall be sized to provide power for a minimum period of 30 minutes during full load conditions.
- 9. All modules shall be factory welded by the manufacturer to form a single, sturdy, "unit" type control center. Field assembly of control system is not allowed. The complete control center shall be factory tested for specification compliance.
- M. Gauge Pressure Transmitter: As specified in Section 40 73 25 Absolute and Gauge Pressure Transmitter.

2.03 COMMON FUNCTIONS

- A. Common functions that are generally applicable to all loops or to many similar loops are described under the heading "General Control Loop Functions" addressed below. These functions are not repeated in the descriptions for each individual control strategy.
- B. All system functions shall be provided by programmed control logic. The pumping system manufacturer shall employ experienced PLC programming personnel to provide 24 hour assistance for all controller and programming needs.
- C. General Control Loop Functions:
 - 1. The following terms are used in the descriptions of PLC functions:
 - a. Operator Settings: Operator set or entered values shall be constants that are adjustable or set from operator displays. Examples of operator set or entered values are controller set points, batch set points, etc. Specific values that are required to be operator set are noted in the Equipment Related Control Strategy Descriptions that follow.
 - b. Tunable Values: Tuning constants for PID controllers are only adjustable at the engineer level without requiring any software reconfiguration. These values shall not be adjustable from operator accessible displays.

- 2. The following general control system functions shall be provided:
 - a. All analog and discrete inputs to the PLC shall be displayed on the HMI. Both Pump RUN and Pump OFF input states shall be displayed.
 - b. All analog inputs shall have instrument failure alarms when the input is below 0 percent or above 100 percent of calibrated range for a tunable time initially set at 10 seconds.
 - c. All discrete FAIL inputs shall be alarmed. Other discrete inputs shall be alarmed as noted in the Equipment Related Control Strategy Descriptions.
 - d. All local alarms shall be monitored by the PLC software, but some of those alarms may be incorporated into common alarms as indicated.
 - e. PLC software alarms and interlocks are alarms or interlocks that are generated by the PLC program based on logic from one or more parameters that are monitored by the PLC.
 - f. Where alarms are specified in the Equipment Related Control Strategy Descriptions, alarms shall be initiated from the applicable inputs. If discrete inputs are not available, the specified alarms shall be initiated from the applicable analog input; alarm setpoints shall be operator adjustable.
 - g. All analog and discrete signals that generate alarm and shutdown functions shall incorporate a 0- to 300-second adjustable time delay before activating to assist in reducing or eliminating nuisance alarms.
 - h. All pulsed flow inputs and equipment run times shall be totalized in the PLC program and shall be properly recorded. All totalized values shall be displayed on the HMI.
 - i. Displays shall be grouped functionally for ease of operation. Both analog and discrete functions associated with an item of equipment or a group of equipment shall be provided on the same display.
 - j. Unless otherwise stated or shown, all discrete outputs shall be maintained outputs. For START/STOP PLC functions, the PLC shall issue a maintained START command until a FAIL state is detected or when a STOP command is issued. When a momentary command is required, the PLC shall issue the command for 2 seconds, then remove the signal.
 - k. For equipment that is controllable from the PLC, a control mode status signal shall be sent to the PLC to indicate when the PLC is allowed to control the equipment. The PLC shall monitor the control mode status (LOCAL/ REMOTE or HAND/OFF/AUTO) and attempt to control the equipment only when the system is in the REMOTE or AUTO mode.
 - 1. For ALL equipment that the PLC is allowed to control, the PLC shall provide a FAIL alarm if the equipment fails to comply with a PLC command signal (START, STOP, OPEN, CLOSE) that has been present for more than an adjustable time period. In this event, the command shall be removed until the system can be reset by the operator at the local site.
 - m. For equipment that is controllable from the PLC in either a MANUAL or AUTOMATIC mode, the operator shall be provided with a software AUTO/MANUAL selector switch at the operator interface panel. Transfer between the MANUAL and AUTOMATIC modes shall be bumpless.

- n. For all equipment for which RUN status is monitored by the PLC, provide run time totalizers in the PLC program which can be reset when desired by the operator.
- o. All PID control functions (P, PI, and PID) shall be provided with standard analog controller functions and operator interfaces including, but not limited to, the following:
 - AUTO/MANUAL mode selection: In AUTO, the output of the controller shall be based on the PID control algorithm. In MANUAL, the output of the controller shall be operator adjustable. Transfer between operational modes shall be bumpless.
 - 2) LOCAL/REMOTE setpoint selection: In LOCAL, the set point shall be operator adjustable from the equipment. In REMOTE, the setpoint shall be adjustable from a REMOTE set point input at the operator's control room or workstation.
 - 3) Setpoint, process variable, and controller output shall be displayed.
 - 4) Provisions shall be included to prevent reset windup.

2.04 ABBREVIATIONS

- A. The following abbreviations are used throughout this Section:
 - 1. AM AUTO/MANUAL
 - 2. HMI Human Machine Interface (Operator Interface Software)
 - 3. HOA HAND/OFF/AUTO
 - 4. HOR HAND/OFF/REMOTE
 - 5. LR LOCAL/REMOTE
 - 6. OIP Operator Interface Panel
 - 7. P&ID Process and Instrumentation Diagram
 - 8. PCP Pump Control Panel
 - 9. PID Proportional/Integral/Derivative (Control Loop)
 - 10. PLC Programmable Logic Controller
 - 11. VFD Variable Frequency Drive

2.05 EQUIPMENT RELATED CONTROL STRATEGY DESCRIPTIONS

- A. The Booster Pump is provided for normal operation and will be used for most of the pumping from the station as off-peak normal flows should be approximately 100 gpm.
- B. The operations description below is based on a single pump and control panel manufacturer. Coordinate with selected manufacturer during construction for programming adjustments as required by the manufacturer.
- C. When Local Mode is selected from the OIP, the pumps shall START and STOP as selected. Pumps shall run at the speed selected from HMI on the OIP when operating in HAND or LOCAL mode.

- D. When in AUTO Mode, the Booster Pump speed shall modulate using PID control programmed into the Pump Control Panel PLC to maintain a set discharge pressure setpoint. Each Pump VFD shall be called by the PLC to modulate its respective pump speed using the signal from the station discharge pressure transmitter as PID feedback. When conditions warrant, such as times of high water demand, additional pumps will be required to run. Should this occur, the High Service Pumps will be called to START and ramp up to maintain the pressure setpoint. The startup and shutdown sequence shall function as follows:
 - 1. When the Booster Pump reaches a speed of 96% of its designated range (58 Hz), one of the High Service Pumps shall be called to START. The selection of the particular High Service Pump shall alternate between both High Service Pumps to provide equal run times on each pump.
 - 2. When the first High Service Pump is brought online, the output of the PID algorithm shall control the speed of both the High Service Pump and the Booster Pump simultaneously using the same output value. This will slow down the Booster Pump and ramp up the High Service Pump so that they continue operating together to maintain the pressure setpoint.
 - 3. Should the pump system need to provide additional flow, a reduction in discharge pressure shall call for the second High Service Pump to START when both the Booster Pump and the first High Service Pump together reach a speed of 96% of their range (58 Hz). The second High Service Pump shall then ramp up using the output of the PID algorithm so that all three pumps operate together to maintain the discharge pressure setpoint.
 - 4. When a reduction in flow is required, the pumps shall slow down to maintain the pressure setpoint. When the pumps slow down to a speed of 64% of their range (38 Hz), the first High Service Pump to be started shall be called to STOP leaving the Booster Pump and the second High Service Pump to maintain the pressure setpoint.
 - 5. If the required flow continues to reduce and the Booster Pump and remaining High Service Pump reach a speed of 64% of their range (38 Hz), the High Service Pump shall STOP so that control of the discharge pressure setpoint is maintained by the Booster Pump.
 - 6. The flow signal from the discharge flowmeter shall be monitored and the PLC shall be programmed to display flowrate and record total flow. Exact range shall be established in the field after system variables are determined.
 - 7. Should the Booster Pump fail or be taken out of service for maintenance, the PLC shall control the High Service Pumps to maintain the discharge pressure setpoint as stated above. If the lead High Service Pump speed drops below 64% of its range (38 Hz), it shall be called to STOP. When the discharge pressure reaches a predetermined low psi value (which shall be adjusted in the field), the lag High Service Pump shall START allowing both pumps to attempt to maintain the pressure setpoint.
- E. Pumps shall be programmed to STOP after a field adjustable time delay should a Pump Discharge Pressure HIGH alarm or a Pump Suction Pressure LOW alarm be detected. The pumps shall also be required to STOP or not allowed to RUN if the Station Storage Tank level falls below 2 ft.

- F. The operational range and alarm setpoints for the flow and pressure values shall be adjusted in the field.
- G. All motor protection functions and alarms shall apply to the pump motors. Pump run times shall be recorded in the PLC.
- H. Should a power outage occur, the PLC shall be programmed to conform to the following start-up sequence:

Step	Delay (seconds)	Time (seconds)	Process
1	1	1	Electrical Failure – All Pumps Stop
2	10	11	Generator Set Started & Ready
3	2	13	Automatic Transfer Switch Cross Over
4	10	23	Booster Pump Startup Delay Until Call to Run
5	5	28	Booster Pump @ Full Flow 100 GPM
6	0	28	High Service Pump 1 Startup Delay Until Call to Run (If Needed)
7	10	38	High Service Pump 1 @ Full Flow 550 GPM
8	0	38	High Service Pump 2 Startup Delay Until Call to Run (If Needed)
9	10	48	High Service Pump 2 @ Full Flow 550 GPM

The same sequence shall be followed when normal utility power is restored.

- I. SCADA Alarms, Statuses and Interlocks: The SCADA system shall monitor appropriate signals and provide alarm and status indication on the Operator Interface Panel mounted on the PLC panel and made available for polling from the wastewater treatment plant control room for the following:
 - 1. Alarms:
 - a. UPS Battery LOW Alarm
 - b. Station LOSS OF POWER Alarm
 - c. Station Discharge Pressure HIGH Alarm
 - d. Station Discharge Pressure LOW Alarm
 - e. Station Suction Pressure LOW Alarm
 - f. Station Flowrate HIGH Alarm
 - g. Booster Pump FAIL Alarm
 - h. High Service Pump 1 FAIL Alarm
 - i. High Service Pump 2 FAIL Alarm
 - j. Storage Tank Mixer Alarm (based on 4-20mA signal from Mixer Panel)
 - k. Storage Tank Intrusion Alarm
 - 1. Storage Tank Level HIGH HIGH (from float)
 - m. Building Intrusion Alarm
 - n. Generator Common SHUTDOWN Alarm
 - o. Generator PRE-ALARM
 - p. Generator Battery Voltage LOW
 - q. Generator Battery Voltage HIGH

- r. Generator Battery Charger FAIL
- s. Generator Fuel Tank LEAK ALARM
- t. Generator Fuel Tank Level LOW
- u. Generator Fuel Tank Level HIGH
- v. Generator Coolant Temp LOW
- w. Generator Coolant Temp HIGH
- x. Surge Tank Level HIGH
- y. Pressure Relief Valve Activated
- 2. Status and Indications:
 - a. Station Flowrate
 - b. Station Total Flow
 - c. Station Storage Tank Level
 - d. Booster Pump RUNNING
 - e. High Service Pump 1 RUNNING
 - f. High Service Pump 2 RUNNING
 - g. Station Discharge Pressure
 - h. Station Suction Pressure
 - i. ATS in Utility Power Position
 - j. ATS in Generator Power Position
 - k. ATS Utility Power Available
 - 1. ATS Generator Power Available
 - m. Surge Tank Level
- 3. The HMI on the Operator Interface Panel shall include at a minimum the following screens:
 - a. Main Overview Screen
 - b. Alarm and Event Log
 - c. Motor Runtime for Each Pump
 - d. Control and Alarm Setpoint Entries
 - e. Trending for Analog Signals
 - f. Auto Switch Status for HOA Switches
 - g. I/O Mapping
 - h. Scaling for Analog Inputs
 - i. Pump Configuration
 - j. Other screens as called out in the Equipment Related Control Strategy Descriptions above

2.06 FACTORY TESTS

- A. Connect suction and discharge piping to source and sink of water.
- B. Run pumps for at least 2 hours, simulate all normal and alarm state inputs, and check for:
 - 1. Pump performance.
 - 2. Leaks.
 - 3. Proper operation of pump "No Flow" protection system, pump rotation and all other specified features for sequence of operations.

- C. Correct all defects before shipping.
- D. Furnish test reports.

PART 3 EXECUTION

3.01 O&M MANUAL

- A. Section 01 78 23 Operation and Maintenance Data.
- B. Additional copies of final, corrected submittals.
- C. Manufacturer's complete operations and maintenance manuals for pumps, motors, pump control valves, flow switches/capacity indicators, and pressure transmitter.
- D. Factory test report.

3.02 INSTALLATION

- A. As required by manufacturer's instructions/recommendations.
- B. As shown on Drawings.
- C. Lock skid in proper position on slab with four 1/2-inch anchor bolts. Tighten nuts to just snug, then back off one turn and lock in place with a jam nut.

3.03 REQUIRED SUPPORT BY FIELD SERVICE REPRESENTATIVE

- A. See Section 01 75 01 Field Service Representative, for qualifications of Field Service Representative.
- B. Present to check installation and operation.
- C. Provide 8 hours of training to Owner's personnel on operation and maintenance per requirements of Section 01 79 01 Manufacturer's Instruction of Owner's Personnel. Video record training sessions in accordance with Section 01 79 01 Manufacturer's Instruction of Owner's Personnel.
- D. Furnish written report to Engineer certifying that equipment is properly installed, fully functional, ready for use, and is operating correctly

3.04 FIELD TEST

- A. Perform alignment of pumps and motors in accordance with manufacturer's instruction.
- B. Furnish the services of the Package Booster Pumping System supplier's Field Service Representative to verify and certify that the installation and alignment is done in accordance with the manufacturer's instruction.

C. With the assistance of the Field Service Representative, demonstrate that all pumps, valves, gages, and the low flow protection system operate properly and all elements of the sequence of operations have been programmed as specified.

3.05 SCHEDULE

A. Site Elevation: 7,145 feet above MSL.

B. Booster Pump:

- 1. Design Basis Manufacturer: Grundfos.
- 2. Design Basis Model: CR 15-7 vertical multi-stage in-line centrifugal pump.
- 3. Connection Sizes: 2-inch suction, 2-inch discharge, ANSI B16.5 Class 300 flanges.
- 5. Design Duty Point 1: 100 gpm at 242 feet TDH at 3,000 rpm (90%).
- 6. Design Duty Point 2: 45 gpm at 350 feet TDH at 3,000 rpm (90%).
- 7. Shutoff Head: 463 feet at 100% speed.
- 8. Number of Stages: 7.
- 9. Pump Efficiency at Duty Point 1: 69.6%.
- 10. Motor: 15 HP, 3,600 rpm, 460 VAC, 3-Phase, 60 Hz, TEFC enclosure, 1.15 service factor, inverter duty.
- 11. Quantity: One duty.

C. High Service Pumps:

- 1. Design Basis Manufacturer: Grundfos.
- 2. Design Basis Model: CR 95-3-1 vertical multi-stage in-line centrifugal pump.
- 3. Connection Sizes: 4-inch suction, 4-inch discharge, ANSI B16.1 Class 125 flanges.
- 4. Design Duty Point 1: 560 gpm at 250.8 feet TDH at 3,545 rpm (100%).
- 5. Design Duty Point 2: 250 gpm at 380 feet TDH at 3,545 rpm (100%).
- 6. Shutoff Head: 404 feet.
- 7. Number of Stages: 3.
- 8. Pump Efficiency at Duty Point 1: 77.8%.
- 9. Motor: 50 HP, 3,600 rpm, 460 VAC, 3-Phase, 60 Hz, TEFC enclosure, 1.15 service factor, inverter duty.
- 10. Quantity: Two duty

D. Pressure Relief Valve:

- 1. Size: 2 inch.
- 2. Design Basis: Singer Model No.: 106-RPS with X129/X142 dry position indicator and closed indication limit switch.
- 3. Adjustable Range: Relief: 100 to 300 psig; factory set at 275 psi.
- 4. End Connections and Pressure Class: 2-inch flanges, ANSI Class 300.
- 5. Mounting Position: Horizontal.
- 6. Coating, Inside and Outside: NSF Fusion Bonded Epoxy Coating.
- 7. Chamber Design: Single Diaphragm.

- 8. Options Included:
 - 1) Isolation cocks in piloting.
 - 2) Valve stem for hard water service.
 - 3) Inlet strainer with blowdown valve.
- 9. Electrical Requirements: Limit switch only.
- 10. Quantity: One.

PART 4 PAYMENT

4.01 PAYMENT ITEMS

Bid Item No.	Pay Item	Pay Unit
5.01	Package Booster Pumping System	Lump Sum

END OF SECTION

Appendix A

GEOTECHNICAL ENGINEERING REPORT LINE #1 (TL 6S WATERLINE PROJECT) September 2, 2014

GEOTECHNICAL INFORMATION

A geotechnical report was prepared specifically for this project by Geo-Test, Inc., dated September 2, 2014, entitled: Geotechnical Engineering Services - Santa Fe County Water Transmission Line TL6S Project. Santa Fe County, New Mexico, Job No. 1-30603

Contractor may rely upon the general accuracy of the "technical data" contained in the following geotechnical investigation report. Contractor may not rely upon or make a claim against the Owner, Engineer, or any of the Engineer's Consultants with respect to:

- A. The completeness of such report for Contractor's purposes, including, but not limited to all of the construction criteria to be employed by Contractor during the construction process, or
- B. Other data, interpretations, opinions and information contained in the report, or
- C. Any Contractor interpretation of or conclusion drawn from any "technical data" or any such data interpretation, opinions or information.



GEOTECHNICAL
ENGINEERING SERVICES
JOB NO. 1-30603
SANTA FE COUNTY
WATER TRANSMISSION LINE
TL6S PROJECT
SANTA FE COUNTY, NEW MEXICO

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September 2, 2014 Job No.1-30603

Molzen Corbin & Associates 2701 Miles Road SE Albuquerque, New Mexico 87106

ATTN:

Steven Morrow, P.E.

RE:

Geotechnical Engineering Services

Santa Fe County Water Transmission Line

TL6S Project

PROFESSIONAL

Santa Fe County, New Mexico

Dear Mr. Morrow:

Submitted herein is the Geotechnical Engineering Services Report for the above referenced project. The report contains the results of our field investigation, laboratory testing, and recommendations for foundation design, waterline trench excavations, as well as criteria for the required earthwork.

It has been a pleasure to serve you on this project. If you should have any questions, please contact this office.

Respectfully submitted:

Reviewed by:

GEO-TEST, INC.

Robert D Booth, R

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Charles M. Miller, P.E.

cc: Addressee (3)



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INTRODUCTION

This report presents the results of the geotechnical engineering services investigation performed by this firm for the proposed TL6S Project to be located in Santa Fe County, New Mexico. The project involves the design and construction of approximately 7.7 miles of new 8 and 12 inch diameter water transmission lines, two enclosed skid-mounted booster pump stations along with a 50,000 gallon pump control tank, and a jack and bore crossing of the Santa Fe Southern Railroad.

The objectives of this investigation were to:

- Evaluate the nature and engineering properties of the subsurface soils underlying selected areas along the proposed waterline alignment, at the booster pump stations, and at the proposed crossing of the railroad.
- Provide recommendations for foundation design for the proposed booster pump stations, enclosures, and water tank as well as to provide criteria for the necessary earthwork and pipe line trenching.

The investigation includes subsurface exploration, selected soil sampling, laboratory testing of the samples, performing an engineering analysis and preparation of this report.

PROPOSED CONSTRUCTION

It is understood that the project begins just east of the community of Rancho Viejo where the new water line will connect to an existing 16 inch waterline extending to the west from the existing Rancho Viejo 1.5 million gallon water storage tank. The new waterline will then extend in a south-southeastern direction along an existing PNM power line easement approximately 3.2 miles to the northern limits of the Eldorado Area Water and Sanitation District. The alignment will then proceed in an easterly direction along the northern boundary of the Eldorado Area Water and Sanitation District to its connection with the future Lamy Junction water line just north of the intersection of Interstate 25 and U.S. Highway 285, a distance of about 4.5 miles. With the exception of the jack and bore crossing of the railroad and the existing PNM power line, the waterline alignment traverses undeveloped, vacant property with rolling hills and crosses several arroyos.

In addition to the above, one booster pump station with an enclosure building is planned about midpoint along the alignment of the waterline.

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Should project details vary significantly from those outlined above, this firm should be notified for review and possible revision of recommendations contained herein.

FIELD EXPLORATION

A total of 40 exploratory borings were drilled for the project, thirty-three (33) along the waterline alignment (borings 1 through 33), two (2) at the jack and bore crossing of the railroad (borings JB1 and JB2), and two (2) at the booster pump station site. The borings were drilled to depths ranging from approximately 10 to 25 feet below existing site grades. Locations of the borings are shown on the attached Boring Location Maps, Figures 1 and 2. The soils encountered in the borings were continuously examined, visually classified and logged during the drilling operation. The boring logs are presented in a following section of this report. Drilling was accomplished using a truck mounted drill rig equipped with 5-inch diameter continuous flight hollow stem auger. Subsurface materials were generally sampled at five foot intervals or less in the borings utilizing an open tube split barrel sampler driven by a standard penetration test hammer. Auger cuttings samples were also obtained at some of the borings.

Two additional borings were planned to be drilled near the eastern end of the waterline, boring 34 and 35. These borings locations were inaccessible at the time of our field investigation. Once access can be obtained, the borings will be drilled and the logs of which will be presented in an addendum to this report.

LABORATORY TESTING

Selected soil samples were tested in the laboratory to determine certain engineering properties of the soils. Moisture contents were determined to evaluate the various soil deposits with depth. The results of these tests are shown on the boring logs.

Sieve analysis and Atterberg limits tests were performed to aid in soil classification. Results of these tests are shown on the Summary of Laboratory Results presented in a following section of this report.

SUBSURFACE SOIL CONDITIONS

As indicated by exploratory boring 1 through 33, the soils underlying the proposed alignment of the water transmission line consist predominantly of alternating layers of sandy clays and clayey sands with lesser amounts of silty sands, sandy silts and relatively clean sands. The sandy clays and

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clayey sands generally range from low to medium plasticity while the silty sands, sandy silts and relatively clean sands were non-plastic to low in plasticity. As indicated by the standard penetration tests, the relative density or consistency of the soils range from loose to very dense or moderately firm to hard.

As indicated by exploratory boring nos. JB1 & JB2, the soils underlying the proposed jack and bore crossing of the Santa Fe Southern Railroad consist of clayey sands which extend to depths of about 8 feet below existing site grades. These soils are of low plasticity and range from loose to medium dense. Directly underlying the surface clayey sand soils, medium plasticity, firm, sandy clays were encountered at boring location JB 1, and non-plastic, medium dense silty sands were encountered at boring location JB 2. These soils extended to the full depths of the borings.

As indicated by boring nos. TPS 1 & 2, the soils underlying the booster pump station and enclosure building located near the midpoint of the proposed waterline alignment consist of alternating layers of clayey sands and silty sands which extend to the full depths of the borings. These soils range from low plasticity to non-plastic and are generally medium dense to dense.

Soil moisture contents were generally low throughout the extent of all of the borings and no groundwater encountered in any of the borings.

CONCLUSIONS AND RECOMMENDATIONS

Analyses of Results

The soils underlying the proposed booster pump station located near the midpoint of the proposed waterline alignment are generally medium dense to dense and are considered suitable in their present condition to provide reliable support of the proposed enclosure building housing the skid-mounted booster pump. Accordingly, the proposed enclosure building can be supported on shallow spread-type footings and slab on-grade bearing directly on the native soils or on properly compacted structural fill. Detailed recommendations for foundation design and the required earthwork are presented in the following sections of this report.

The results of this investigation indicate that the surficial soils encountered in the borings along the alignment of the waterline can be readily excavated using normal earth moving and excavation equipment. In addition, the excavated soils will be suitable for use as backfill above pipe embedment materials.

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Excavated slopes for the construction of the waterline trench should be designed and constructed in accordance with 29 CFR 1926, Subpart P, and any applicable state or local regulations. The contractor should be responsible for all temporary trench slopes excavated along the proposed waterline and design of any required temporary shoring, as applicable. Shoring, bracing, and benching should be performed by the contractor in accordance with applicable safety standards. In areas where shoring is not required for excavation, trench walls should be laid back at a minimum slope of 2:1 (horizontal: vertical). Spoil piles and heavy equipment should not be allowed within 5 feet of the top of the slope.

Bedding and pipe embedment materials to be used around the water lines should be well graded sand or gravel conforming to the pipe manufacturer's recommendations and should be placed and compacted in accordance with project specifications, local requirements or governing jurisdiction. General fill to be used above pipe embedment materials should be placed and compacted in accordance with the plans and specifications. On-site soils may be used as general fill above pipe embedment materials provided they meet the requirements. Water jetting of trench backfill should not be allowed.

FOUNDATIONS

Midpoint Booster Pump Station

Enclosure Building

The enclosure building can be supported on spread-type footings and slabs on-grade bearing directly on the native soils or on structural fill. An allowable bearing pressure of 2,000 pounds per square foot should not be exceeded in design. This bearing pressure applies to full dead plus realistic live loads and can be safely increased by one-third for total loads including wind and seismic forces. The minimum recommended width of continuous spread-type footings is 16 inches.

The bearing pressure recommended above applies to full dead plus realistic live loads and may be increased by one-third for total loads including wind and seismic forces. The minimum recommended depth of spread-type footings is 24 inches below lowest adjacent finished grade for exterior footings and 12 inches below finished floor elevation for interior footings.

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Enclosure Building

The enclosure building can be supported on spread-type footings and slabs on-grade bearing on a minimum thickness of 3.0 feet of structural fill. An allowable bearing pressure of 2,000 pounds per square foot should not be exceeded in design. This bearing pressure applies to full dead plus realistic live loads and can be safely increased by one-third for total loads including wind and seismic forces. The minimum recommended width of continuous spread-type footings is 1.33 feet.

The bearing pressure recommended above applies to full dead plus realistic live loads and may be increased by one-third for total loads including wind and seismic forces. The minimum recommended depth of spread-type footings is 24 inches below lowest adjacent finished grade for exterior footings and 12 inches below finished floor elevation for interior footings.

ESTIMATED SETTLEMENTS

Settlement of foundations designed and constructed as recommended herein are estimated not to exceed ¾ inches. This estimate is based upon soil moisture contents encountered during test drilling and compaction moisture contents introduced during construction. Differential movements should be less than 75 percent of total movements. Significant post-construction soil moisture increases would increase settlements and could create excessive movements. Thus, the moisture protection provisions as recommended in a following section of this report are considered critical for the satisfactory performance of the structures.

SLABS ON GRADE

Adequate support for lightly loaded slab-on-grade floors will be provided by the structural fill when placed as recommended in a following section of this report. Thus, the use of granular base for structural support of lightly loaded slabs is not considered necessary. However, should it be desired as a working surface, a course of granular base can be placed beneath concrete floor slabs.

Heavily loaded floor slabs bearing directly on densified native soils or on structural fill can be designed using a modulus of subgrade reaction (k) value of 200 pci. This value can be increased to 300 pci provided a 6-inch thickness of granular base is placed and compacted beneath the slabs.

Where granular base is used beneath the slabs, it should have a plasticity index of no greater than 3 and meet the following grading requirements:

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Sieve Size Square Openings	Percent Passing by Dry Weight
1 Inch	100
3/4 Inch	70-100
No. 4	35-85
No. 200	0-10

The granular base should be compacted to at least 95 percent of maximum dry density as determined in accordance with ASTM D1557.

The granular base will act as a capillary barrier, but will not totally eliminate the rise of moisture to the slabs. If floor coverings are proposed which are highly sensitive to moisture, it is recommended the slab be placed in accordance with the procedures recommended by the American Concrete Institute (ACI 302.1R-04).

LATERAL LOADS

Resistance to lateral forces will be provided by soil friction between the base of the foundations and the slabs and by passive earth resistance against the sides of the footings. A coefficient of friction of 0.40 should be used for computing the lateral resistance between base of the foundations and the slabs and the soil. With backfill as recommended in the site grading section of this report, a passive soil resistance equivalent to a fluid weighing 325 pounds per cubic foot should be used for analysis.

SITE-GRADING

The following general guidelines should be included in the project construction specifications to provide a basis for quality control during site grading. It is recommended that all structural fill and backfill be placed and compacted under engineering observation and in accordance with the following:

- 1) After clearing and grubbing, the exposed native soils should then scarified to a depth of 12 inches, brought to near the optimum moisture content or above, and compacted prior to construction or placement of concrete or structural fill. Only scarification and compaction as recommended above will be necessary at the Midpoint booster pump station.
- 2) Most of the on site soils will meet the criteria for structural fill, however, some blending may be required. All structural fill or backfill

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material should be free of vegetation and debris and contain no rocks larger than 3 inches. Gradation of the backfill material, as determined in accordance with ASTM D-422, should be as follows:

Size	Percent Passing
3 inch	100
No. 4	60 - 100
No. 200	15 - 45

- The plasticity index should be no greater than 15 when tested in 3) accordance with ASTM D-4318.
- 4) Fill or backfill, should be placed in 8-inch loose lifts and compacted with approved compaction equipment. Each lift should be firm and non-yielding.
- 5) All compaction of fill or backfill should be accomplished to a minimum of 95 percent of the maximum dry density determined in accordance with ASTM D-1557. The moisture content of the structural fill, during compaction, should be within 2 percent of the optimum moisture content.
- 6) Tests for degree of compaction should be determined by the ASTM D1556 method or ASTM D-6938. Observation and field tests should be performed during fill and backfill placement by the geotechnical engineer to assist the contractor in obtaining the required degree of compaction. If less than 95 percent is indicated, additional compaction effort should be made with adjustment of the moisture content as necessary until 95 percent compaction is obtained.

MOISTURE PROTECTION

Precautions should be taken during and after construction to minimize saturation of the foundation soils. Positive drainage should be established away from the water tank and enclosure buildings at a minimum grade of 3 percent to at least 8 feet from their perimeters. Concrete walks and asphalt pavement should be constructed adjacent to the exterior foundations where possible. All utility trenches leading into the structures should be backfilled with compacted fill. Special care should be taken during installation of the water lines to reduce the possibility of post-construction subsurface saturation.

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FOUNDATION REVIEW AND INSPECTION

This report has been prepared to aid in the evaluation of the various sites and along the proposed waterline and to assist in the design of this project. It is recommended that the geotechnical engineer be provided the opportunity to review the final design drawings and specifications in order to determine whether the recommendations in this report are applicable to the final design. Review of the final design drawings and specifications should be noted in writing by the geotechnical engineer.

Variations from soil and ground water conditions presented herein may be encountered during construction of this project. In order to permit correlation between the conditions encountered during construction and to confirm recommendations presented herein, it is recommended that the geotechnical engineer be retained to perform sufficient review during construction of this project. Observation and testing should be performed during construction to confirm that suitable fill soils are placed upon competent materials and properly compacted and foundation elements penetrate the recommended soils.

CLOSURE

Our conclusions, recommendations and opinions presented herein are:

- 1) Based upon our evaluation and interpretation of the findings of the field and laboratory program.
- 2) Based upon an interpolation of soil conditions between and beyond the explorations.
- 3) Subject to confirmation of the conditions encountered during construction.
- 4) Based upon the assumption that sufficient observation will be provided during construction.
- 5) Prepared in accordance with generally accepted professional geotechnical engineering principles and practice.

This report has been prepared for the sole use of Molzen Corbin & Associates, specifically for the design of proposed waterline, water storage tank, and enclosure building on the TL6S Project to be located in Santa Fe County, New Mexico, and not for the use by any third parties.

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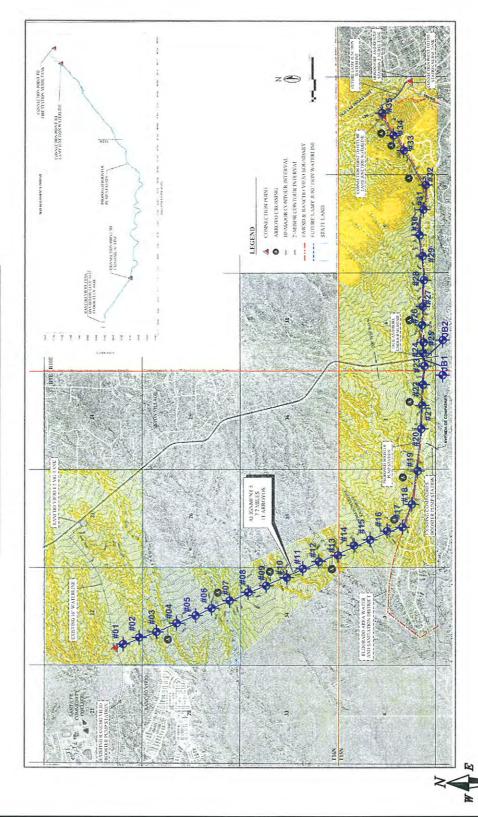
We make no other warranty, either express or implied. Any person using this report for bidding or construction purposes should perform such independent investigation as he deems necessary to satisfy himself as to the surface and subsurface conditions to be encountered and the procedures to be used in the performance of work on this project. If conditions are encountered during construction appear to be different than indicated by this report, this office should be notified.

All soil samples will be discarded 60 days after the date of this report unless we receive a specific request to retain the samples for a longer period of time.

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BORING LOCATION MAP



CEOTECHNICAL ENGINEERING
AND MATERIAL TESTING

SANTA FE - ALBUQUERQUE - LAS CRUCES

ure 1

BORING LOCATION MAP

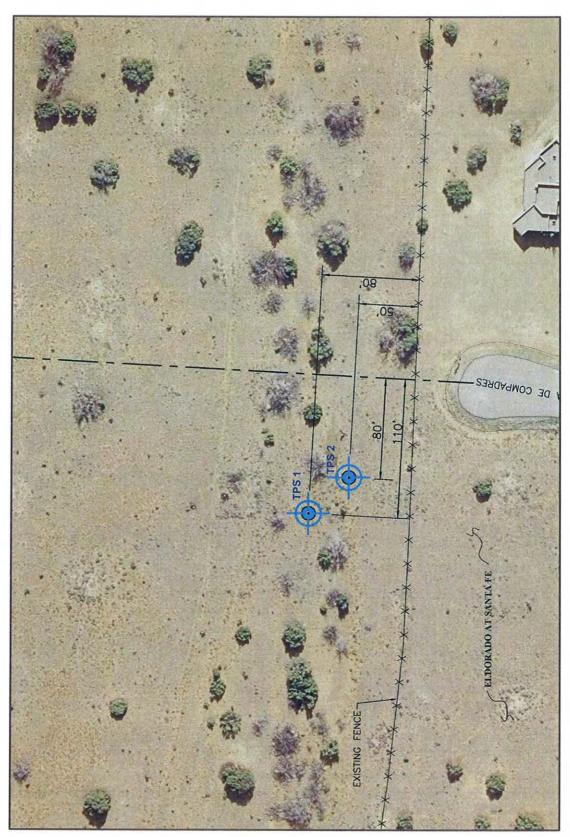


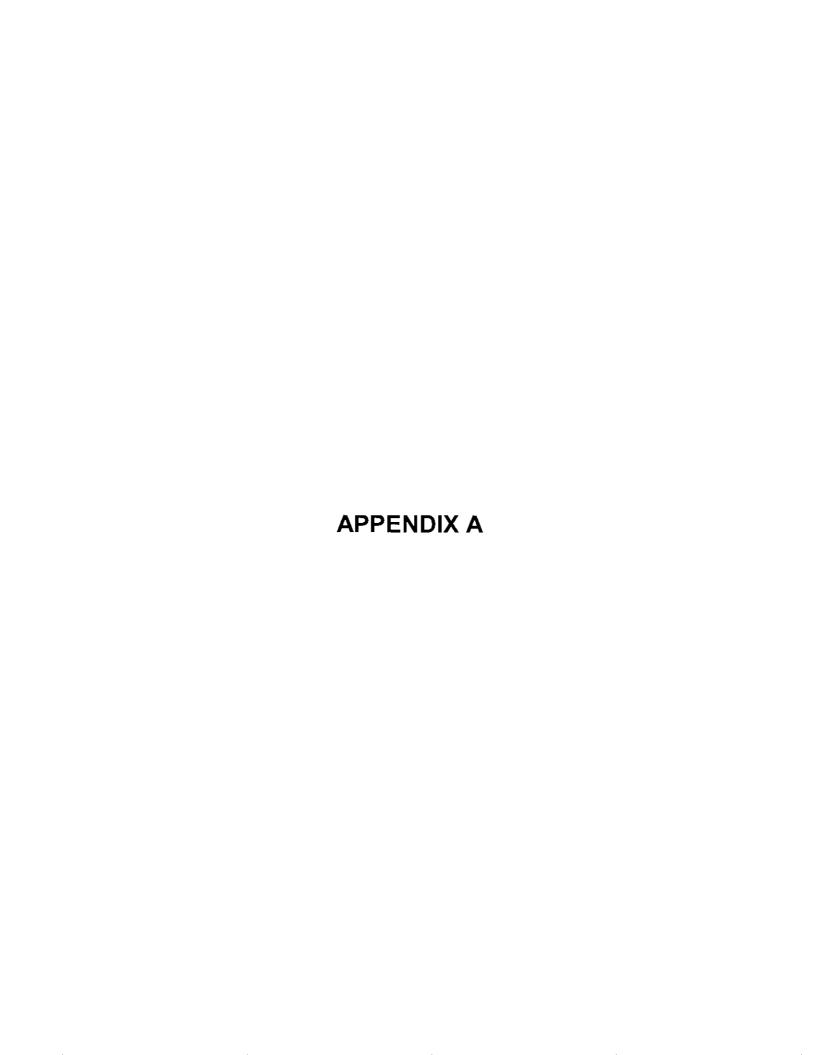


Figure 2

TL6S PROJECT SANTA FE COUNTY, NEW MEXICO JOB NO. 1-30603

CEOTECHNICAL ENGINEERING AND MATERIAL TESTING

SANTA FE - ALBUQUERQUE - LAS CRUCES



NO: 01

Project:

TL6S Project

Date:

07/08/2013

Project No: 1-30603 Type:

5" OD HSA

Elevation:

GROUNDWATER DEPTH

LOG OF TEST BORINGS

During Drilling: None

After 24 Hours:

				SA	MPLE			SUBSURFACE PROFILE					
DЕРТН (Ft)	507	SAMPLE INTERVAL	TYPE	N. BŁOWS/FT	MOISTURE %	DRY DENSITY (pcf)	usc	DESCRIPTION			N blow 40	l /s/ft 60	80
······							SM	SILTY SAND, fine grained, non-plastic, slightly moist, brown	1-	† L	+ L.	-	
5			SS SS	8-12-8 20 4-4-6 10	6	PARTITION OF THE PROPERTY OF THE PARTITION OF THE PARTITI	sc	CLAYEY SAND, fine grained, medium plasticity, medium dense, dry, white/brown *Gravel lense at 7'		20	+ ~ · · · · · · · · · · · · · · · · · ·		
10			SS	20-31-38 69	6	Arts addances as seems to make breakfactories as	sc	CLAYEY SAND, medium grained, low plasticity, very dense, slightly moist, brown			+ -	+-	- + - - + - - 69
- - - 15								STOPPED AUGER AT 9.5' STOPPED SAMPLER AT 11'					2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
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25						Today restrict free to the control of the control o							- 1 - - 1 - - 1 - - 1 -
30										- - - -	† † !	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level CS - Continuous Sampler

UD - Undisturbed

Project: TL6S Project

Date: 07/08/2013

Elevation:

Project No: 1-30603

Type: 5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 02 During Drilling: None After 24 Hours:

.//*				SA	MPLE	,		SUBSURFACE PROFILE				~		********
DEPTH (Ft)	DEPTH (Ft)	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	nsc	DESCRIPTION	2	N blows/i 20 40 6			80	1
	722277				1, mar m g mg/1 g mg/m m m,112,1200,170,170, 1211		SM	SILTY SAND			† L	1	1	
5 ~			SS SS	6-9-9 18 9-12-15 27	4 6		CL	SANDY CLAY, medium plasticity, moderately firm, dry, white/brown		18	7	1	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	
10 -			SS	4-6-12 18	2		GM	SILTY GRAVEL, fine to medium grained, non-plastic, medium dense, dry, brown		18	 - ~ 			
15 -								STOPPED AUGER AT 9.5' STOPPED SAMPLER AT 11'				+ - + - + - + - + - + - + - + - + - + -		***
20 ~											+ ~			
25				THE PROPERTY OF THE PROPERTY O							1 - 1 T - 1 L - 1	1 1		***
30											+ ! 	# - 1 - 1	- + ! 	

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level CS - Continuous Sampler

UD - Undisturbed

Project:

TL6S Project

Date: Elevation: 07/08/2013

Project No: 1-30603

Type:

5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 03

During Drilling: None

After 24 Hours:

				SA	MPLE	**************************************		SUBSURFACE PROFILE				
DEPTH (Ft)	DEPTH (Ft)		TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	nsc	DESCRIPTION	20	blow 40	/s/ft	80
5			SS SS	25-50/3" 50/3" 35-50/4" 50/4"	6 7		sc	CLAYEY SAND, fine to medium grained, low plasticity, very dense, dry, brown				and the state of t
10			SS	4-6-7 13	7		CL	SANDY CLAY, medium plasticity, moderately firm, dry, light brown	•13	1 -	+	
150.14								STOPPED AUGER AT 9.5' STOPPED SAMPLER AT 11'		200		
20	in the second se									1 -	\$ 100 mm m	+
120 OF 1531 BOKING 1-30603 1159 PROJECT GPJ GEO 1531 GDJ 8/2014	, , , , , , , , , , , , , , , , , , ,						THE REAL PROPERTY OF THE PARTY			1 -		1
30										1	4	

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level CS - Continuous Sampler UD - Undisturbed

GEO-IEST

Project:

TL6S Project

Date: Elevation: 07/08/2013

Project No: 1-30603

Type:

5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 04

During Drilling: None

After 24 Hours:

					SA	MPLE			SUBSURFACE PROFILE	7	******			***************************************
	DEPTH (Ft)	POO	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	nsc	DESCRIPTION	20		N blow 40	s/ft	80
	5			SS SS	4-3-3 6 4-2-2 4	1		SM	SILTY SAND, fine to medium grained, low plasticity to non-plastic, loose to medium dense, dry, light brown	6 4				
GPJ GEO TEST.GE	15				14				STOPPED AUGER AT 9.5' STOPPED SAMPLER AT 11'					
LOG OF TEST BORING 1-30603 TLI	25 —							700000000000000000000000000000000000000					! _ + - !	

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level CS - Continuous Sampler UD - Undisturbed

Project:

TL6S Project

Date: Elevation: 07/08/2013

Type:

Project No: 1-30603 5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 05

During Drilling: None

After 24 Hours:

[SAI	MPLE	·····		SUBSURFACE PROFILE		.,			***************************************
	DEPTH (Ft)	907	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	nsc	DESCRIPTION	2		N lows		80
	5				20-29-27 56 17-14-14 28	_		SC	CLAYEY SAND, fine to medium grained, low plasticity, dense to very dense, slightly moist, brown		128		±	And the same and t
BOOKEN TO THE PROPERTY OF THE	10			SS	12-19-19 38	3		SM	SILTY SAND, fine to coarse grained, non-plastic, dense, dry, light brown			38	<u> </u>	
) TEST.GDT 6/26/14	15				VOORANIA AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA				STOPPED AUGER AT 9.5' STOPPED SAMPLER AT 11'					and an all the same that the same two transfers of the same to the same transfers of the
PROJECT.GPJ GEC	20 -	A STATE OF THE STA						The state of the s				+	+ 	
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LOG OF TEST BK	30 —							17 00 70 70 70 70 70 70 70 70 70 70 70 70				<u>.</u>	↓ † ~ + ~ - ~	- and and and and

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level CS - Continuous Sampler

UD - Undisturbed

Project:

TL6S Project

Date:

Elevation:

07/08/2013

Type:

Project No: 1-30603 5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 06

During Drilling: None

After 24 Hours:

[SA	MPLE			SUBSURFACE PROFILE		
	DEPTH (Ft)	907	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	nsc	DESCRIPTION	N blows/ft 20 40 60 80	
	-			SS 1	2-28-50/6 50/6"	7		CL	SANDY CLAY, medium plasticity, hard, slightly moist, dry, brown		1
***************************************	5			SS	50/6" 50/6" 7-6-10	5		SC	CLAYEY SAND, fine to medium grained, low plasticity, very dense to medium dense, dry, brown		,
3/26/14				33	16				STOPPED AUGER AT 9.5' STOPPED SAMPLER AT 11'	•16	
GEO TEST GDT 6	15 				ANTONIO CONTO CONT						
TL6S PROJECT.GPJ	20	dumandani ka andan									
LOG OF TEST BORING 1-30603 TL6S PROJECT,GPJ GEO TEST,GDT 6/26/14	25 ····	Transfer and the same and the s									
LOG OF TEST	30										

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level

CS - Continuous Sampler

UD - Undisturbed

Project:

TL6S Project

Date:

07/08/2013

Project No: 1-30603

Elevation:

Type:

5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 07

During Drilling: None

After 24 Hours:

				SA	MPLE			SUBSURFACE PROFILE				PC-17-200.1 & C. 200.0 L. 20	
DEPTH (Ft)	DEPTH (Ft)		TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	nsc	DESCRIPTION	2		N blows		80
5			SS SS	38-50/6" 50/6" 34-50/6" 50/6"	5		sc	CLAYEY SAND, fine grained, medium plasticity, very dense, dry, white/brown				+	
							GM	GRAVEL LENSE		 	t -	+	1
10			SS	7-9-9	3		SM	SILTY SAND, fine to coarse grained, non-plastic, medium dense, dry, light brown	1-	18	1	 	
†				18				STOPPED AUGER AT 9.5' STOPPED SAMPLER AT 11'				1	1
15				And the state of t] 7
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25										L	 ! T - L _ !		1 - 1 - 1
20 25											ĭ ~ L _ ! ! ~	1	1 -
30				1							+ ! 	+ - 1 - 1	

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level

CS - Continuous Sampler

UD - Undisturbed

Project:

TL6S Project

Date: Elevation: 07/08/2013

Project No: 1-30603

Type:

5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 08

During Drilling: None

After 24 Hours:

pro 1 m m ² m m m m m m m m m m m m m m m m m m m				SA	MPLE			SUBSURFACE PROFILE	
DEPTH (Ft)	907	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	nsc	DESCRIPTION	N blows/ft 20 40 60 80
5 -				24-40-50/3 50/3" 31-39-40 79	_		CL	SANDY CLAY, medium plasticity, hard, dry, white/brown	
10	er and the state of the state o		SS	10-19-12 31	4	TORNA ON I FERRY NATURAL AND ANNIANA	SM	SILTY SAND, fine to medium grained, non-plastic, slightly moist, brown	31 - 1 - 1 - 1 - 1 - 1 - 1
15 -	and the second s					PARANGHIANA MARANGA MA		STOPPED AUGER AT 9.5' STOPPED SAMPLER AT 11'	
20 -				ومام ماران مارام م					
15 - 20 - 25 -									
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LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level CS - Continuous Sampler

UD - Undisturbed

Project:

TL6S Project

Date: Elevation: 07/09/2013

Project No: 1-30603 Type:

5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 09

During Drilling: None

After 24 Hours:

4404 00 4 00 4 00 4 00 00		#		SA	MPLE	·		SUBSURFACE PROFILE		****************	***************	
DEPTH (Ft)	106	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	usc	DESCRIPTION	20	N blow 40	s/ft	80
5 -				16-36-40 76 6-39-50/5 50/5"			CL	SANDY CLAY, medium plasticity, hard, moist, brown			+ - + - + - 1 /	776
10			SS	3-10-14 24	8		CL	SANDY CLAY, trace gravel, medium plasticity, firm, dry, brown		4	+ 1 + 1 1	· · · · · · · · · · · · · · · · · · ·
0 1551.601 6/26/74	,	26/2111/2/2011						STOPPED AUGER AT 9.5' STOPPED SAMPLER AT 11'				
20 -		To the second se							1 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1		+	+
105 07 1251 BURRING 1-30603 1 LbS PROJECT GPJ GEO 1EST GD 6/28/14							TO THE PARTY OF TH			1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -		
30 -			1000, No. 1860 de 1888 100 100 100 100 100 100 100 100 10							+ -	† - - -	4 · · ·

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level CS - Continuous Sampler

UD - Undisturbed

LOG OF TEST BORINGS

Project: TL6S Project

Date: 07/09/2013

Elevation:

Project No: 1-30603

Type:

5" OD HSA

GROUNDWATER DEPTH

NO: 10

During Drilling: None

After 24 Hours:

-					SA	MPLE			SUBSURFACE PROFILE		,			ļ
	DEPTH (Ft)	907	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	nsc	DESCRIPTION	20	plo	N ows/		30
LOG OF TEST BORING 1-30603 TL6S PROJECT GPJ GEO TEST GDT 6/26/14	5	77	δZ	SS SS SS	6-9-10 19 6-19-20 39 7-8-9 17	Σ%	d)	SC-SM	CLAYEY SAND, fine to medium grained, low plasticity, medium dense to dense, dry, brown STOPPED AUGER AT 9.5' STOPPED SAMPLER AT 11' *Borng caved to 3' *Boring in Arroyo		9 : 3	6		80
TEST BORING 1-30603 TL6	25	The same district the same state of the same sta											ſ	
LOG 0F	30										- + - <u> </u>		 	; ;

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level CS - Continuous Sampler

UD - Undisturbed

Project:

Elevation:

TL6S Project

Date:

07/09/2013

Type:

Project No: 1-30603 5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 11

During Drilling: None

After 24 Hours:

ſ					SA	MPLE			SUBSURFACE PROFILE				
	DEРТН (Ft)	POO	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	nsc	DESCRIPTION	20	blow	/s/ft	80
C PROPERTY P	5			SS SS	3-4-5 9 2-2-3 5 5-6-7 13	5		SM	SILTY SAND, fine to medium grained, low to non-plastic, loose to medium dense, dry, brown	79	 		
EST.GDT 6/26/14					13				STOPPED AUGER AT 9.5' STOPPED SAMPLER AT 11'			1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -	
L6S PROJECT.GPJ GEO T	20		The state of the s									+ ~	
LOG OF TEST BORING 1-30603 TL6S PROJECT. GPJ GEO TEST. GDT 6/26/14	25		V 200 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1								· · · · · · · · · · · · · · · · · · ·		
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LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level CS - Continuous Sampler

UD - Undisturbed

Project: TL6S Project

Date: 07/09/2013

Elevation:

Project No: 1-30603

Type:

5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 12

During Drilling: None

After 24 Hours:

ſ					SA	MPLE		***************************************	SUBSURFACE PROFILE	
	DEРТН (Ft)	907	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	nsc	DESCRIPTION	N blows/ft 20 40 60 80
	5			SS SS	6-8-10 18 5-5-10 15	4		SC-SM	CLAYEY SAND, fine to medium grained, low plasticity, medium dense, dry, brown	18 ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ;
***************************************	10			SS	7-14-14 28	1		SM	SILTY SAND, fine to medium grained, non-plastic, medium dense, dry, brown	
LOG OF TEST BORING 1-30603 TL6S PROJECT.GPJ GEO TEST.GDT 6/26/14	 15 ~~ 	and in the second secon			2				STOPPED AUGER AT 9.5' STOPPED SAMPLER AT 11'	
L6S PROJECT.GPJ	20 		3.0							
EST BORING 1-30603 T	25 2	The state of the s						A A A A A A A A A A A A A A A A A A A		
LOG OF T	30 —]					And All Action for the American	transcriberation is the		

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level CS - Continuous Sampler

UD - Undisturbed

LOG OF TEST BORINGS

Project:

TL6S Project

Date:

07/09/2013

Project No: 1-30603 Type:

5" OD HSA

Elevation:

GROUNDWATER DEPTH

NO: 13

During Drilling: None

After 24 Hours:

	}			SA	MPLE			SUBSURFACE PROFILE	
DEPTH (Ft)	907	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	OSC	DESCRIPTION	N blows/ft 20 40 60 80
			SS	5-5-7 12	7		CL-ML	SANDY CLAY, low plasticity, moderately firm, dry, brown	12 1 1 1
5			SS SS	6-7-8 15 3-3-4	3		SM	SILTY SAND, fine grained, low plasticity, medium dense to loose, dry, brown	15 1 1 1 1 1 1 1 1 1
15				,				STOPPED AUGER AT 9.5' STOPPED SAMPLER AT 11'	
20							7411172.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.		
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LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level CS - Continuous Sampler UD - Undisturbed

Project:

TL6S Project

Date:

07/09/2013

Project No: 1-30603

Elevation:

Type:

5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 14

During Drilling: None

After 24 Hours:

	-,-,,				SA	MPLE			SUBSURFACE PROFILE	
	DEPTH (Ft)	907	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	nsc	DESCRIPTION	N blows/ft 20 40 60 80
		The state of the s		SS	16-15-15 30	4		SM	SILTY SAND, fine grained, non-plastic, medium dense, dry, brown	30 1 1
	5			SS	3-3-5 8	4		SM	SILTY SAND, fine grained, non-plastic, loose, dry, brown	8 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
	10			SS 2	26-36-50/1 50/1"	5		SM	SILTY SAND, fine grained, non-plastic, very dense, dry, brown	
TEST.GDT 6/26/14	15								STOPPED AUGER AT 9.5' STOPPED SAMPLER AT 11'	
ILES PROJECT,GPJ GEO	20									
LOG OF TEST BORING 1-30603 TL6S PROJECT.GPJ GEO TEST.GDT 6/26/14	25 		77.							
LOGOFT	30			***************************************	The state of the s					

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level

CS - Continuous Sampler

UD - Undisturbed

Project:

TL6S Project

Date:

07/09/2013

Project No: 1-30603

Elevation:

Type:

5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 15

During Drilling: None

After 24 Hours:

				SA	MPLE	**************************************	~~~	SUBSURFACE PROFILE	
DEPTH (Ft)	907	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	nsc	DESCRIPTION	N blows/ft 20 40 60 80
5 -			SS SS	7-13-11 24 4-8-9 17	4		SC	CLAYEY SAND, fine to medium grained, low to medium plasticity, medium dense, dry, brown	724 1 1 1 1 1 1 1 1 1
10 ·	-		SS	5-7-7	8		CL	SANDY CLAY, low plasticity, moderately firm, dry, brown STOPPED AUGER AT 9.5'	14
15				reform for a state of the state				STOPPED SAMPLER AT 11' *Boring caved to 4.5'	
20 -									
25 -									
30	Tryphonorus post operation	,				A CONTRACTOR ACCUSED			

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level CS - Continuous Sampler

UD - Undisturbed

GEO-IEST

Project:

TL6S Project

Date:

07/09/2013

Type:

Project No: 1-30603 5" OD HSA

Elevation:

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 16

During Drilling: None

After 24 Hours:

		***************************************		SA	MPLE			SUBSURFACE PROFILE	
DEPTH (Ft)	907	SAMPLE	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	osc	DESCRIPTION	N blows/ft 20 40 60 80
5			SS SS	17-26-36 62 20-35-46 81	5		CL	SANDY CLAY, low to medium plasticity, hard, dry, brown	62
10			ss	16-24-35 59	3		SM	SILTY SAND, fine to medium grained, non-plastic, very dense, dry, brown	
1EST.6DT 6/26/14	oden ven den er med kommodenen den en mende mom					***************************************		STOPPED AUGER AT 9.5' STOPPED SAMPLER AT 11'	
20 20 20 20 20 20 20 20 20 20 20 20 20 2									
10G OF 1EST BORING 1-30603 1L6S PROJECT GPJ GEO TEST GDT 6/28/14 CO									
30 30 30									

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level

CS - Continuous Sampler

UD - Undisturbed

OEO-IEST

Project:

Elevation:

TL6S Project

Date:

06/11/2014

Type:

Project No: 1-30603 5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 17

During Drilling: None

After 24 Hours:

				SAI	MPLE			SUBSURFACE PROFILE	
DEРТН (Ft)	907	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	nsc	DESCRIPTION	N blows/ft 20 40 60 80
			SS SS	3-7-15 22 25-27-29 56	4		ML	SANDY SILT, non-plastic, firm to hard, dense, dry, tan	22 56
10			SS	20-30-31 61	10		SM	SILTY SAND, fine grained, low plasticity to non-plastic, very dense, dry, tan	61
15	i voranzad a ventacumbrane com distributional de la comunidad							STOPPED AUGER AT 9.5' STOPPED SAMPLER AT 11'	
20	Account of the control of the contro								
 25 				A total proprieta de la constanta de la consta					
30 —									

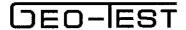
LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level

CS - Continuous Sampler

UD - Undisturbed



Project:

TL6S Project

Date:

06/11/2014

Project No: 1-30603

Elevation:

Type:

5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 18

During Drilling: None

After 24 Hours:

		,			SA	MPLE			SUBSURFACE PROFILE	
DEPTH (£f)	מבו ווו לי ל	907	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	nsc	DESCRIPTION	N blows/ft 20 40 60 80
	5			AC AC		3		SW-SM	SAND, fine to medium grained, some gravel, silt and clay, low plasticity to non-plastic, dry, tan	
11	0			AC		2			STOPPED AUGER AT 9.5'	
) GEO TEST.GDT 6/26/14	5									
0603 TL6S PROJECT.GPJ	0									
LOG OF TEST BORING 1-30603 TL6S PROJECT GPJ GEO TEST GDT 6/28/14	5									

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level

CS - Continuous Sampler

UD - Undisturbed

GEO-IEST

Project:

TL6S Project

Date:

Elevation:

06/11/2014

Project No: 1-30603

Type:

5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 19

During Drilling: None

After 24 Hours:

		1.0.00.00.00.00			SA	MPLE		,	SUBSURFACE PROFILE				3
	DEPTH (Ft)	907	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	nsc	DESCRIPTION	20	blow 40	/s/ft	80
	5			AC AC		5		CL	SANDY CLAY, medium plasticity, dry, tan	2	- !		
	-	minor to the second						SM	SILTY SAND, fine grained, non-plastic, dry, tan	1	1 -		
	10 ····			AC		3			* 1' fine gravel layer at 5' - 6' STOPPED AUGER AT 9.5'		· + -	+ -	1
DT 6/26/14											- L - f - L	+-	+
J GEO TEST.GL			7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7								1 -		
S PROJECT.GP.	20										. 1 -	+ -	
4G 1-30603 TL6	 25										1	. <u>L</u>	
LOG OF TEST BORING 1-30603 TL6S PROJECT.GPJ GEO TEST.GDT 6/26/14											- r + -	. T ~	1
ğ	30	1								<u> </u>		1	1

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level CS - Continuous Sampler

UD - Undisturbed

Project:

TL6S Project

Date:

Elevation:

06/11/2014

Type:

Project No: 1-30603 5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 20

During Drilling: None

After 24 Hours:

					SA	MPLE			SUBSURFACE PROFILE	
AND STATE OF THE PARTY OF THE P	DЕРТН (Ft)	907	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	usc	DESCRIPTION	N blows/ft 20 40 60 80
			Þ	AC		9				
	5		B	AC		6		CL	SANDY CLAY, medium plasticity, dry, tan/brown	
	10			AC		5			STOPPED AUGER AT 9.5'	
ST.GDT 6/26/14	15	on szinnes varibennesia dinasvazonia negreson					ACLILITA DIANGANIANI DANGANIANI DANGANI			
LOG OF TEST BORING 1-30603 TL6S PROJECT.GPJ GEO TEST.GDT 6/26/14	20	Anne es aris summand hanne societa es remailies								
1-30603 TL6S PRC	 25	re construir de construir de production de p								
OF TEST BORING		on engineers and engineers and one of the control o								
20	30	<u> </u>								

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level

CS - Continuous Sampler

UD - Undisturbed

Project:

TL6S Project

Date:

Elevation:

06/11/2014

Type:

Project No: 1-30603 5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 21

During Drilling: None

After 24 Hours:

					SA	MPLE			SUBSURFACE PROFILE	
***************************************	DEPTH (Ft)	907	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	nsc	DESCRIPTION	N blows/ft 20 40 60 80
OPEN PARAMETER AND	5			SS SS	12-13-16 29 7-10-12 22	9		CL	SANDY CLAY, medium plasticity, firm, dry, brown	729
	- - - 10			SS	5-13-13 26	1		SM	SILTY SAND, medium to coarse grained, non-plastic, medium dense, dry, brown	26
TEST.GDT 6/26/14	- 15	man province for many							STOPPED AUGER AT 9.5' STOPPED SAMPLER AT 11'	
L6S PROJECT.GPJ GEO	20									
LOG OF TEST BORING 1-30603 TL6S PROJECT.GPJ GEO TEST.GDT 6/26/14	25 - - -									
LOG OF T	30							1 m		1 1 1 1

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level CS - Continuous Sampler

UD - Undisturbed

Project:

TL6S Project

Date: Elevation: 06/11/2014

Project No: 1-30603

Type:

5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 22

During Drilling: None

After 24 Hours:

ſ					SA	MPLE			SUBSURFACE PROFILE					
	DЕРТН (Ft)	907	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	nsc	DESCRIPTION	20	blo	N ws/ft 60		
	5			AC AC		6		CL	SANDY CLAY, medium plasticity, dry, tan/brown	1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	- +		
			Ь	AC		7		SM	SILTY SAND, fine grained, non-plastic, dry, tan/brown		· · · · · · · · · · · · · · · · · · ·	1	- ! -	ī
6/14	10	Propose to be designed to the propose of the propos							STOPPED AUGER AT 9.5'		- T	- T	- 1 -	ilement in second beautiful second
O TEST.GDT 6/2	15 										- T	- 1 - 1 - 1	1 - 1 - - 1 -	7
S PROJECT.GPJ GE	20	4									- + - - + - + - 1	- + - + - + - +	- 4 -	, , , , , , , , , , , , , , , , , , ,
LOG OF TEST BORING 1-30603 TL6S PROJECT GPJ GEO TEST GDT 6/26/14	25											- 1		months of the control
LOG OF TEST BO	30	The state of the s									-	-	- i - i - i i -	

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level CS - Continuous Sampler

UD - Undisturbed

Project:

TL6S Project

Date:

Elevation:

06/11/2014

Type:

Project No: 1-30603 5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 23

During Drilling: None

After 24 Hours:

[5			SA	MPLE			SUBSURFACE PROFILE				
	DEPTH (Ft)	907	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	nsc	DESCRIPTION	20	N blow 40	/s/ft	80
THE PROPERTY OF THE PROPERTY O	5			AC AC		8		CL	SANDY CLAY, low plasticity, dry, tan/brown	200		1	
	10					9			STOPPED AUGER AT 9.5'		. <u>+ -</u>	1 -	1
LOG OF TEST BORING 1-30603 TL6S PROJECT GPJ GEO TEST GDT 6/26/14	- - - 15 - -	i innovani dessente de l'assente dessente dessente dessente de l'assente de l'assen									1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -		
.6S PROJECT.GPJ G	20										. <u> </u>	- + - + - +	1
T BORING 1-30603 TL	25	CONTRACTOR OF THE PROPERTY OF										. i	
LOG OF TES	30		***************************************								† -	† + !	

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level

CS - Continuous Sampler

UD - Undisturbed

Project:

TL6S Project

Date:

06/11/2014

Project No: 1-30603

Elevation:

Type:

5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 24

During Drilling: None

After 24 Hours:

				SA	MPLE		ATTOR . 1 - COLUMN / AND	SUBSURFACE PROFILE		vv			
DEPTH (Ft)	. 907	SAMPLE INTERVAL	ТҮРЕ	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	nsc	DESCRIPTION	20		N ows		80
			AC							· · · †		<u> </u>	1
5		.	AC				CL	SANDY CLAY, low plasticity, dry, tan/brown		# 			1 - 1
-			AC						- +	1 † [[1 + ~ 1 1 + -	4
10								STOPPED AUGER AT 9.5'		I		<u> </u>	
15					:					!		† - 1 - 1 -	+
									1	i i i i			1 .
20										1		1 -	4
25													J
-										T ! 		 	
30	,									· +		- - - - -	4 -

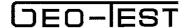
LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level

CS - Continuous Sampler

UD - Undisturbed



Project:

TL6S Project

Date:

Elevation:

06/11/2014

Project No: 1-30603

Туре:

5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 25

During Drilling: None

After 24 Hours:

		-		SA	MPLE			SUBSURFACE PROFILE					
DEPTH (Ft)	SAMPLE	INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	nsc	DESCRIPTION	2		N plows		80
10 -			AC AC		3 2		sw-sc	SAND, some silt and gravel, medium to coarse grained, low plasticity, dry, brown STOPPED AUGER AT 9.5'					
30 —			the most of chair chair a set in many and a chair and							! !	+ 1 	+	-i

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level CS - Continuous Sampler

UD - Undisturbed

Project:

TL6S Project

Date:

06/11/2014

Project No: 1-30603

Elevation:

Type:

5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 26

During Drilling: None

After 24 Hours:

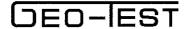
[-			SA	MPLE			SUBSURFACE PROFILE			***************************************	
	DEРТН (Ft)	907	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	nsc	DESCRIPTION	20	N blow 40	s/ft	80
	5			AC AC		4	***************************************	SC-SM	CLAYEY SAND, fine to medium grained, low plasticity, dry, dark brown				
	10	-							STOPPED AUGER AT 9.5'		<u>1</u>	1 -	i
LOG OF TEST BORING 1-30603 TL6S PROJECT GPJ GEO TEST GDT 6/26/14	15	ddummidment descriptions of the second										±	
6S PROJECT.GPJ C	20 ····· 		200000000000000000000000000000000000000										200 Oct 100 Oc
T BORING 1-30603 TL	25			THE PARTY AND TH						The state of the s	1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -		1 1
LOG OF TES	30	-	7								† † T	† + !	

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level

CS - Continuous Sampler UD - Undisturbed



Project:

TL6S Project

Date:

06/11/2014

Project No: 1-30603

Elevation:

Type:

5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 27

During Drilling: None

After 24 Hours:

***************************************					SA	MPLE			SUBSURFACE PROFILE				
	DEPTH (Ft)	L06	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	nsc	DESCRIPTION	20	blov	1 vs/ft 60	80
	5			AC AC		8 6		CL	SANDY CLAY, medium plasticity, dry, dark brown				
.GDT 6/26/14	10 - - - 15	1 1 1 1							STOPPED AUGER AT 9.5'				
LOG OF TEST BORING 1-30603 TL6S PROJECT.GPJ GEO TEST.GDT 6/26/14	20	والمستودة										+ - + + +	
EST BORING 1-30603 TL6	25												
LOG OF T	30										- + - 	- + - - 	- + -

LEGEND

SS - Split Spoon AC - Auger Cuttings

AMSL - Above Mean Sea Level CS - Continuous Sampler

Project:

Elevation:

TL6S Project

Date:

06/11/2014

Type:

Project No: 1-30603 5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 28

During Drilling: None

After 24 Hours:

1					SA	MPLE	······································		SUBSURFACE PROFILE		***************************************			
	DEPTH (Ft)	907	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	nsc	DESCRIPTION	20	blo	N ws/ft 60	80	The second secon
	5			SS SS	8-7-6 13 7-7-8 15	7		CL	SANDY CLAY, low to medium plasticity, moderately firm, dry, tan	13	- 1 - 1 - 1 - 1 - 1 - 1	- 1	- +	
asan delemandele andre asan este delemande andre a	10			SS	8-13-14 27	2	en ioni i delegatannon delegatan etangatan i jogotannon	SW-SM	SAND, fine grained, some silt, non-plastic, medium dense, dry, tan/brown STOPPED AUGER AT 10.5'		27	- + + +		
T.GDT 6/26/14	15	. A supposed designation interestingly and the supposed of the					randraduration designation are conditioned designations for the conditions of the co		OTOTT ED MODERNAT 10.5		- T		- 1	
LOG OF TEST BORING 1-30603 TL6S PROJECT.GPJ GEO TEST.GDT 6/26/14	- - - - 20		socializasi possovali ili abili i i associili ab				Videnskrivensk flerfer flerader stæders ferskrivederferen.			1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -	- 	- + - + - 4 - 3	- 1 - 4 - 1 - 4	- 1 : : : : : : : : : : : : : : : : : :
NING 1-30603 TL6S PF	 25		a def a voca de la desta de la desta de la defenimenta del defenimenta de la defenimenta del defenimenta de la defenimen				1000 Y 650 100 15 15 15 10 10 10 10 10 10 10 10 10 10 10 10 10				- 1. 1	- T		
LOG OF TEST BOF	30		·		THE VALUE OF THE PROPERTY OF T								+ + +	

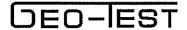
LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level

CS - Continuous Sampler

UD - Undisturbed



Project:

TL6S Project

Date:

06/12/2014

Project No: 1-30603

Elevation:

Type:

5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 29

During Drilling: None

After 24 Hours:

[**************************************			****************	SA	MPLE			SUBSURFACE PROFILE	
	DEPTH (Ft)	907	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	nsc	DESCRIPTION	N blows/ft 20 40 60 80
	5			AC AC		9 8		CL	SANDY CLAY, medium to high plasticity, slightly moist, dark brown	
.GDT 6/26/14	10								STOPPED AUGER AT 9.5'	
LOG OF TEST BORING 1-30603 TL6S PROJECT.GPJ GEO TEST.GDT 6/26/14	20									
TEST BORING 1-30603 TL	25	A control of the cont								
LOG OF .	30									

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level CS - Continuous Sampler

UD - Undisturbed

Project:

TL6S Project

Date:

Elevation:

06/12/2014

Type:

Project No: 1-30603 5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 30

During Drilling: None

After 24 Hours:

***************************************				SA	MPLE			SUBSURFACE PROFILE	
DEPTH (Ft)	907	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	nsc	DESCRIPTION	N blows/ft 20 40 60 80
5			AC AC		11 6		CL	SANDY CLAY, medium plasticity, slightly moist, dark brown	
10	The state of the s							STOPPED AUGER AT 9.5'	
15									5 3 1 i i i i i i i i i i i i i i i i i i
20 20									
25	- Comment of the comm								
30									

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level CS - Continuous Sampler

UD - Undisturbed

Project:

TL6S Project

Date:

06/12/2014

Project No: 1-30603

Elevation:

Type:

5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 31

During Drilling: None

After 24 Hours:

		1			SA	MPLE		,	SUBSURFACE PROFILE				~	
01 EVALUATION OF	DEPTH (Ft)	907	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	nsc	DESCRIPTION	20	blo	N ows/t		30
	5			AC AC		9.		CL	SANDY CLAY, medium plasticity, slightly moist, dark brown		- I - I - I		: ·	
	10			AC		3		A A I A i bheathabh A Beathal I d Bei	STOPPED AUGER AT 9.5'		1		L	+ <u> </u>
LOG OF TEST BORING 1.30803 TL6S PROJECT.GPJ GEO TEST.GDT 6/26/14	15									The state of the s		- i		
LES PROJECT.GPJ GE	20			TO THE PARTY OF TH							- +			+ ! ! !
T BORING 1-30603 T	25										- + 1	- 1		
LOG OF TES	30	-				V - 0011 • • 000 • V 0000 • V 000					- +		r - r - ! !	i

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level CS - Continuous Sampler

UD - Undisturbed

Project:

TL6S Project

Date:

Elevation:

06/12/2014

Type:

Project No: 1-30603 5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 32

During Drilling: None

After 24 Hours:

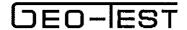
			ļ	SA	MPLE	·		SUBSURFACE PROFILE					
DEPTH (Ft)	LOG	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	nsc	DESCRIPTION	2		N ows <i>i</i>		80
-			AC		3								1.
5			AC		4		CL	SANDY CLAY, medium plasticity, slightly moist, tan/brown				: 	1 -
10			AC		6	endelinera terreta etterri principali en en entre en en		STOPPED AUGER AT 9.5'		 T 1		! ! !	1 .
 15													1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
20												+ ~ ! ! ! !	*
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30		2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0								F - 7 L _		1 - 1 - 1 - 1 -	4

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level CS - Continuous Sampler

UD - Undisturbed



Project:

TL6S Project

Date:

06/12/2014

Project No: 1-30603

Elevation:

Type:

5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 33

During Drilling: None

After 24 Hours:

3			,	SA	MPLE		,	SUBSURFACE PROFILE	1
DEРТН (Ft)	907	SAMPLE INTERVAL	ТҮРЕ	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	nsc	DESCRIPTION	N blows/ft 20 40 60 80
5			AC AC		3		SC	CLAEY SAND, fine to medium grained, low to medium plasticity, slightly moist, dark brown	
10	in the state of th							STOPPED AUGER AT 9.5'	
OG OF TEST BORING 1.30603 TL6S PROJECT GPJ GEO TEST GDT 6/26/14 9 2 5 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7									
SST BORING 1-30603 TISS 5 7									
30									

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level CS - Continuous Sampler

UD - Undisturbed

Project:

TL6S Project

Date:

06/11/2014

Type:

Project No: 1-30603 5.5" OD HSA

Elevation:

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: JB 1

During Drilling: None

After 24 Hours:

					SAI	MPLE			SUBSURFACE PROFILE	
(0) 14000	DEPIH (Ft)	LOG	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	nsc	DESCRIPTION	N blows/ft 20 40 60 80
	5			SS SS	13-14-16 30 7-8-8 16	6		SC-SM	CLAYEY SAND, low plasticity, medium dense, dry, tan/brown	30 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1	10			SS	12-12-14 26	7		CL	SANDY CLAY, medium plasticity, slightly moist, tan/brown	26
LOG OF TEST BORING 1-30603 TL6S PROJECT.GPJ GEO TEST.GDT 6/26/14 C	15				20				STOPPED AUGER AT 10' STOPPED SAMPLER AT 11'	
LES PROJECT.GPJ G	20 —						TO A			
ST BORING 1-30603 T	25		A 6/3-11 (201-14 1/12)							
20G OF TE	30									

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level CS - Continuous Sampler

UD - Undisturbed

Project:

TL6S Project

Date:

06/12/2014

Project No: 1-30603

Elevation:

Type:

5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: JB 2

During Drilling: None

After 24 Hours:

["					SA	MPLE		I	SUBSURFACE PROFILE	
	DEPTH (Ft)	907	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	nsc	DESCRIPTION	N blows/ft 20 40 60 80
######################################	5			SS SS	3-3-4 7 3-4-4 8	4		SC-SM	CLAYEY SAND, fine to medium grained, low plasticity, loose, dry, tan	7 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
	10			SS	9-10-14 24	2	TOTAL	SM	SILTY SAND, medium to coarse grained, non-plastic, medium dense, dry, brown	24
LOG OF TEST BORING 1:30603 TL6S PROJECT GPJ GEO TEST GDT 6/26/14	 15 	,					PARTICIPATION OF THE PARTICIPA		STOPPED AUGER AT 9.5' STOPPED SAMPLER AT 11'	
6S PROJECT.GPJ G	20	· · · · · · · · · · · · · · · · · · ·					ATTENION CONTRACTOR OF THE PROPERTY OF THE PRO			
F BORING 1-30603 TI	25 						TA A LA SERVININA ANNO ANTI II I			
LOG OF TEST	30						TANANA TANANA TANANA			

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level

CS - Continuous Sampler

UD - Undisturbed

Project:

TL6S Project

Date:

06/11/2014

Project No: 1-30603

Elevation:

Type:

5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: TPS 1

During Drilling: None

After 24 Hours:

				SA	MPLE		,	SUBSURFACE PROFILE				******	
DEPTH (Ft)	907	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	nsc	DESCRIPTION	2		N olows 40	s/ft	80
5			SS SS	8-10-11 21 6-7-8 15	8		SC	SANDY CLAY, fine grained, low plasticity, medium dense, dry, tan		7 21		4	
4			SS	5-7-8 15	4		SM	SILTY SAND, fine graned, non-plastic, medium dense, dry, brown		L 	<u>+</u> - <u>+</u>	±	1
15 20 25			SS	10-11-11 22	6					22	T - 1		+
20			SS	12-16-18 34			SC-SM	CLAYEY SAND, fine to medium grained, low plasticity, medium dense to dense, dry, brown	200		34	1 -	4
25			SS	14-18-21 39				STOPPED AUGER AT 24.5' STOPPED SAMPLER AT 26'			39	+	
30										I I I	T - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -	* :	T

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level CS - Continuous Sampler

UD - Undisturbed

Project:

TL6S Project

Date: Elevation: 06/11/2014

Project No: 1-30603 Type:

5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: TPS 2

During Drilling: None

After 24 Hours:

				SA	MPLE		,.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	SUBSURFACE PROFILE					***************************************
DEPTH (Ft)	907	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	usc	DESCRIPTION	2		N plows		80
5			UD SS	7-37 44 15-18-20 38	9		SC	CLAYEY SAND, fine grained, low plasticity, dense, dry, tan			44	1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -	
10	Andreas and Andrea		SS	7-13-18 31	5							± ± ± ± ± ± ± ± -	
15 ~			SS	15-21-24 45	3		SM	SILTY SAND, fine grained, some clay, low to non-plastic, dense, dry, brown			45	+	1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -
20	POWER PROPERTY OF THE PARTY OF		SS	14-20-24 44							44	1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -	+
20 25	- Surveyor Conserved to Conserve de Conserved		SS	12-18-21 39				STOPPED AUGER AT 24.5' STOPPED SAMPLER AT 26'			39	; 1 - 1 T - 1 L - 1	
30 -	-									† ! 	· - - - -	+ -	

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level

CS - Continuous Sampler

UD - Undisturbed



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	1 1/2"						PRE-1000 - 1 1-06-00 POOL 10 10						<u> </u>								
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											100										S Project nta Fe Co 0603
rsis	3/4"										96				100						Project: TL6S Project Location: Santa Fe County Number: 1-30603
SIEVE ANALYSIS PERCENT PASSING	1/2"	100				100					98		-		97		d change in a contraction	And Andrews at the Second State			Proj _e Loce
SIE PER(3/8"	66				66				100	85				96						LUE
	0N 4	66			And the second s	66				26	80				93		100		100		LL = LIQUID LIMIT PI = PLASTICITY INDEX NP = NON PLASTIC or NO VALUE
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	0N 0A	82				82				85	46				58		82		93		LL = [= PLA JON PL
	86	58				70				75	27				47		77	***************************************	7.1		9 9 1 8
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	Ⅎ	36				29				29	19	7777			26		37		28		<u> </u>
	(%) MOIST	5.7	4.0	5.8	4.0	5.8	ç. G.	6.2	6.5	7.1	1.6	4.1	5.0	6.0	3.5	2.6	7.0	4.9	4.6	4.8	EST
	UNIFIED CLASS	သင				ر ا				٦ ت	SM				၁Տ		占		SC)E0-
6	DEPTH (FEET)	2.5	5.0	10.0	2.5	5.0	10.0	2.5	5.0	10.0	2.5	5.0	10.0	2.5	5.0	10.0	2.5	5.0	2.5	5.0	
	TEST HOLE	01	10	01	02	02	02	03	03	03	04	04	04	90	92	90	90	90	20	20	

SUMMARY OF LABORATORY RESULTS 1-30603 TL6S PROJECT.GPJ GEO TEST.GDT 9/2/14

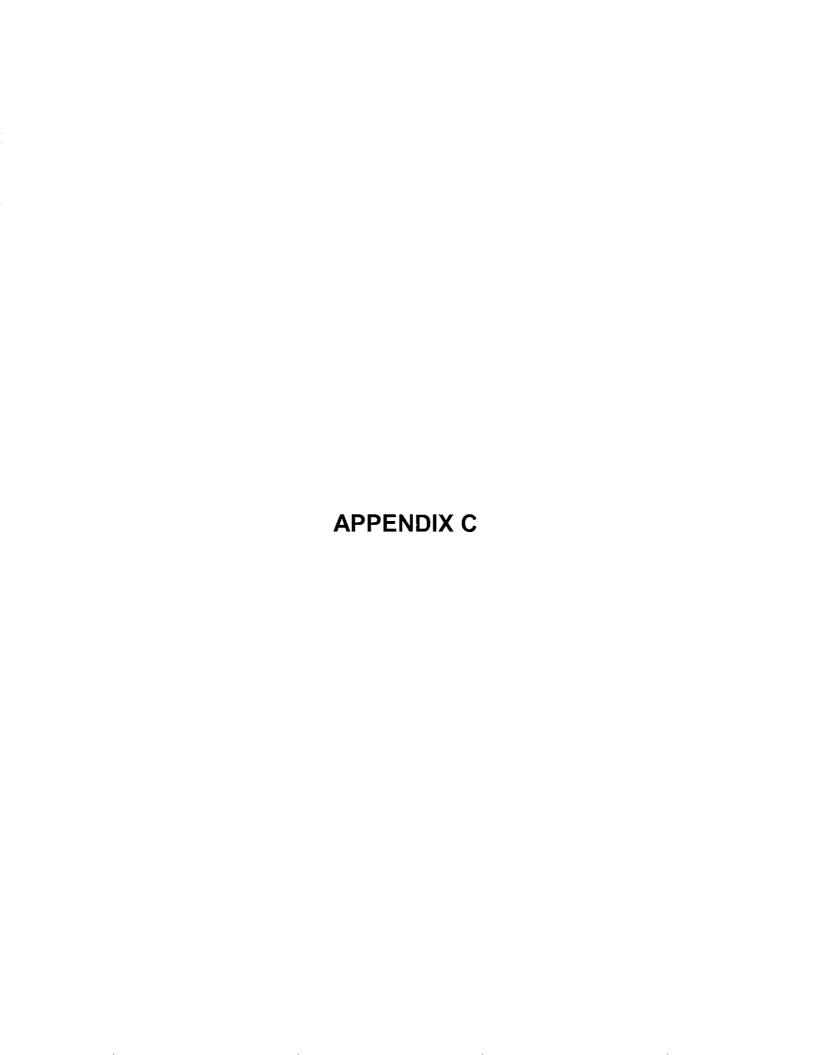
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	-			NA PARA PARA PARA PARA PARA PARA PARA PA												****	The second state and second se				Project a Fe Count
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SIE	3/8"			100		100	100	100	100	66		86				100		100			LUE
	Š 4			66		66	98	66	66	26		95		100		86		26		100	LL = LIQUID LIMIT PI = PLASTICITY INDEX NP = NON PLASTIC or NO VALUE
	86			95		95	95	92	91	06		85		86		88		06		94	LL = LIQUID LIMIT = PLASTICITY IND DN PLASTIC or NO
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7664 a de a com aca anno acamona	(%) MOIST	3.0	4.2	4.5	3.5	8.1	7.5	3.4	2.1	4.5	4.0	3.9	1.3	7.0	3.4	3.4	4.1	3.9	5.4	<u>1.</u>	ES.
Account to the second s	UNIFIED CLASS			ر ا		ರ	ರ	SC-SM	SM	SM		SC-SM		CL-ML		SM		SC-SM		SC	- 0 =
America	DEPTH (FEET)	10.0	2.5	5.0	10.0	2.5	9.5	4.5	2.5	4.5	2.5	4.5	9.5	2.5	4.5	9.5	2.5	4.5	9.5	2.5	
	TEST HOLE	20	80	80	90	60	60	10	£	7	12	12	12	13	13	13	14	14	14	15	

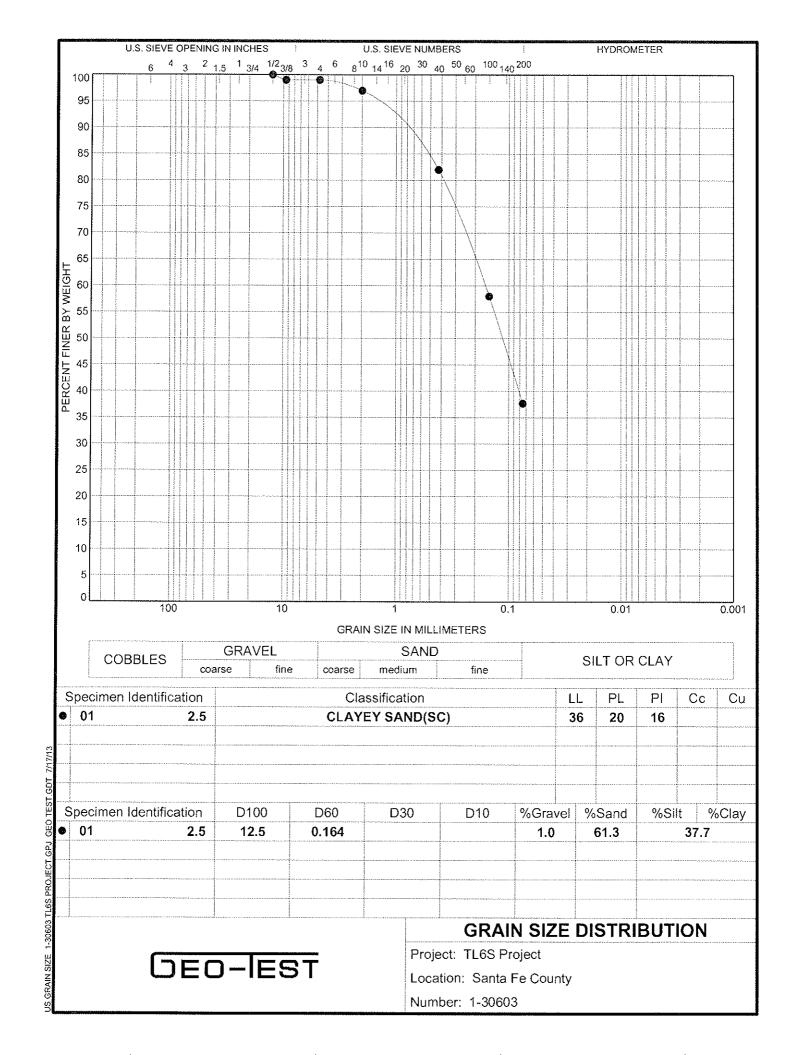
TEST HOLE 15 16 16 17 17	DEPTH (FEET) 4.5 9.5 2.5 4.5 9.5 4.5 9.5 9.5	UNIFIED CLASS CLASS CL CL CL SM	(%) MOIST 4.3 8.0 5.2 2.5 2.5 4.4 4.4	21 25 28 28 28 28 24 24 25 24 28 28 28 28 28 28 28 28 28 28 28 28 28	I	NO 200 74 60 60 64	NO 100 100 100 100 100 100 100 100 100 10	NO 4 05 86 86 08	CN 66 86 86 96	NO 100 100 66 69 99	SIEN 3/8" 3/8" 100	SIEVE ANAL YSIS PERCENT PASSING 1/2" 3/4" 00	YSIS SSING 3/4"	1-1-1	1 1/2"	5**	- *
₩ ₩ ₩ ₩ ₩ ₩ ₩ ₩ ₩ ₩ ₩ ₩ ₩ ₩ ₩ ₩ ₩ ₩ ₩	2.5 4.5 9.5 7.5	SW-SC SW-SM	3.3	23 NP	4 GN	2 7	15 17	26	88	. 84 84	96 66	100	100				
2 PROJECT GPJ GEO TEST	9.5	ਹ	9.4 0 8. 6. 6. 6. 6. 6. 6. 6. 6. 6. 6. 6. 6. 6.	26	13	62	08	88	26	66	100						
21 20 0 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	5.0 10.0 2.5 4.5	ರ ರ ರ	5.7 5.1 8.6 6.1	29 24 28	10 10 12	53 53 76	70 70 85	08 08 68	96 96 26	100	100						
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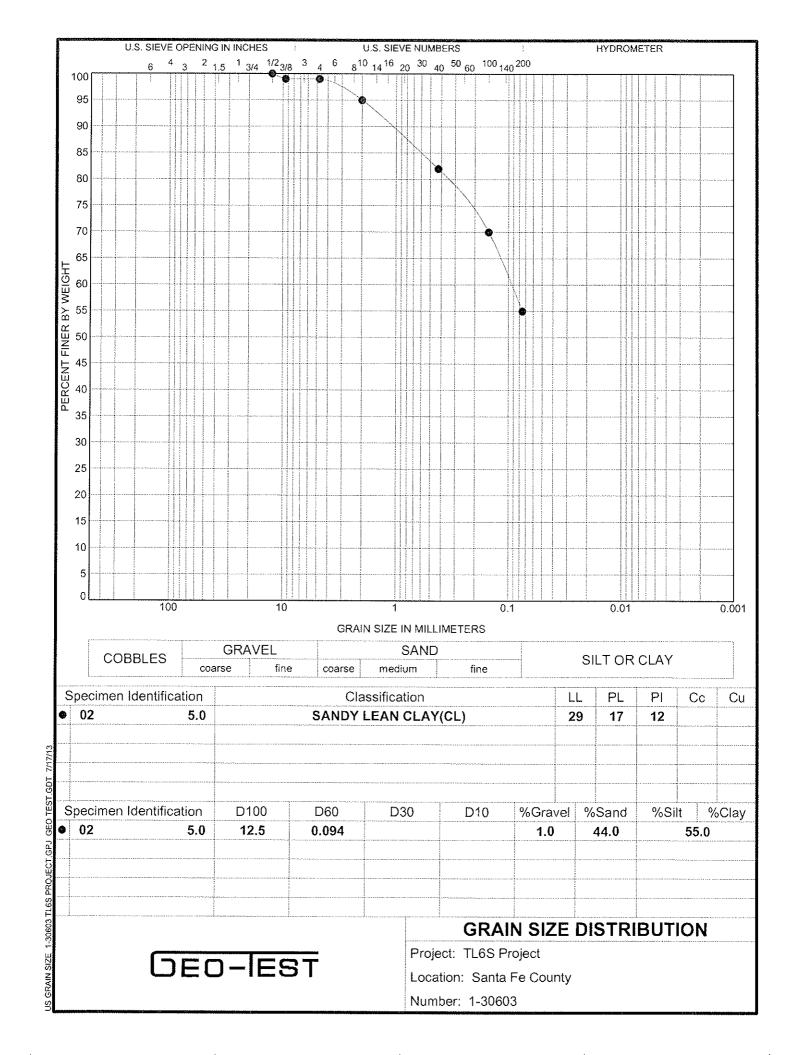
SUMMARY OF LABORATORY RESULTS 1-30603 TL6S PROJECT GPJ GEO TEST.GDT 9/2/14

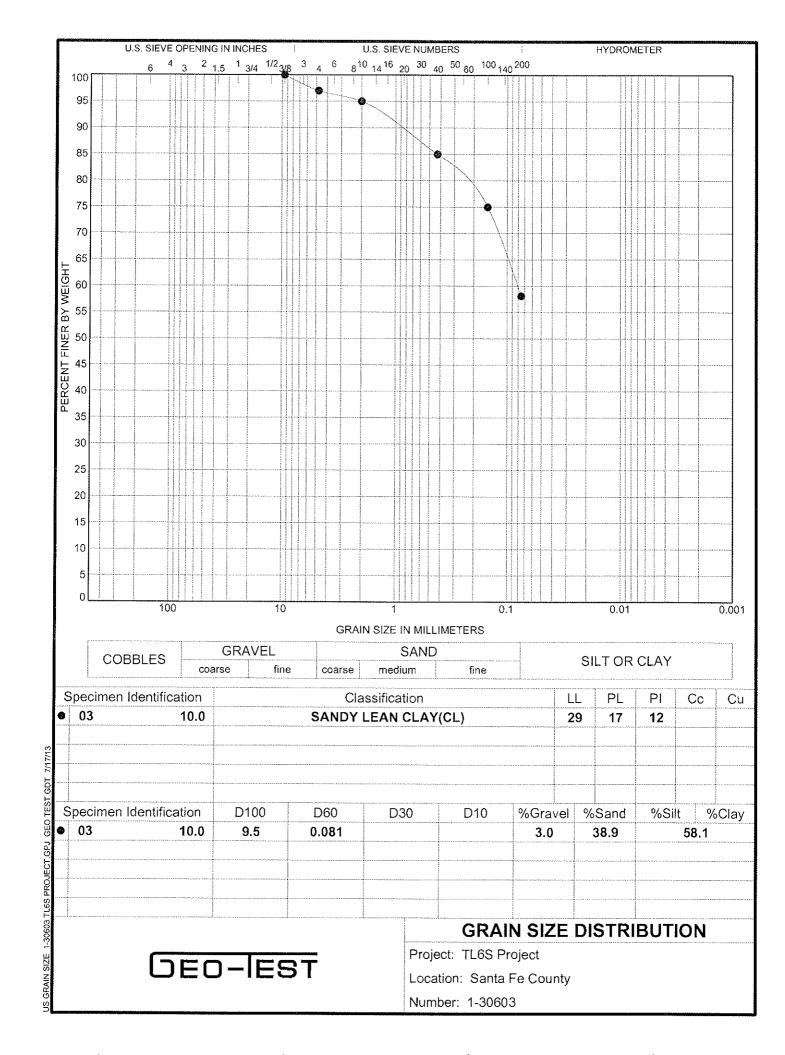
2.5 5.0 CHA 9.0 CUA 2.5 5.0 CU 9.0 CU 2.5 5.0 CU 9.0 CU 2.5 5.0 CU 9.0 CU 2.5 5.0 CU 9.0 CU 2.5 5.0 CU 9.0 CU 2.5 5.0 CU 2.5 5.0 CU	SIEVE ANALYSIS PERCENT PASSING	DEPTH UNIFIED (%) LL PI NO NO NO NO 3/8" 1/2" 3/4" 1" 1 1/2" 2" 4"	2.5	5.0 CH 7.6 64 48 75 82 88 97 100	9.0	10.0 CL 29 15 60 69 80 93 98 100	2.5	5.0 CL 6.3 31 18 54 61 71 91 99 100	9.0	10.0 CL 34 18 51 60 71 90 97 100	2.5 8.5	5.0 CL 6.3 27 11 56 67 77 93 99 100	9.0	2.5	5.0	9.0	10.0 CL 28 12 67 75 80 92 97 99 100	2.5	5.0 SC-SM 3.2 23 7 30 38 51 81 95 100	8.5 SC 3.7 25 10 30 37 49 78 92 98 100	2.5 5.5	LL = LIQUID LIMIT PI = PLASTICITY INDEX NP = NON PLASTIC or NO VALUE Location: Santa Fe County
2.5 5.0 9.0 9.0 9.0 9.0 9.0 9.0 9.0 9.0 9.0 2.5 5.0 8.5 8.5 6.0 8.5 6.0	**************************************		2.5		9.0		2.5		0.6		2.5		9.0	2.5	5.0	0.6		2.5			2.5	DEC

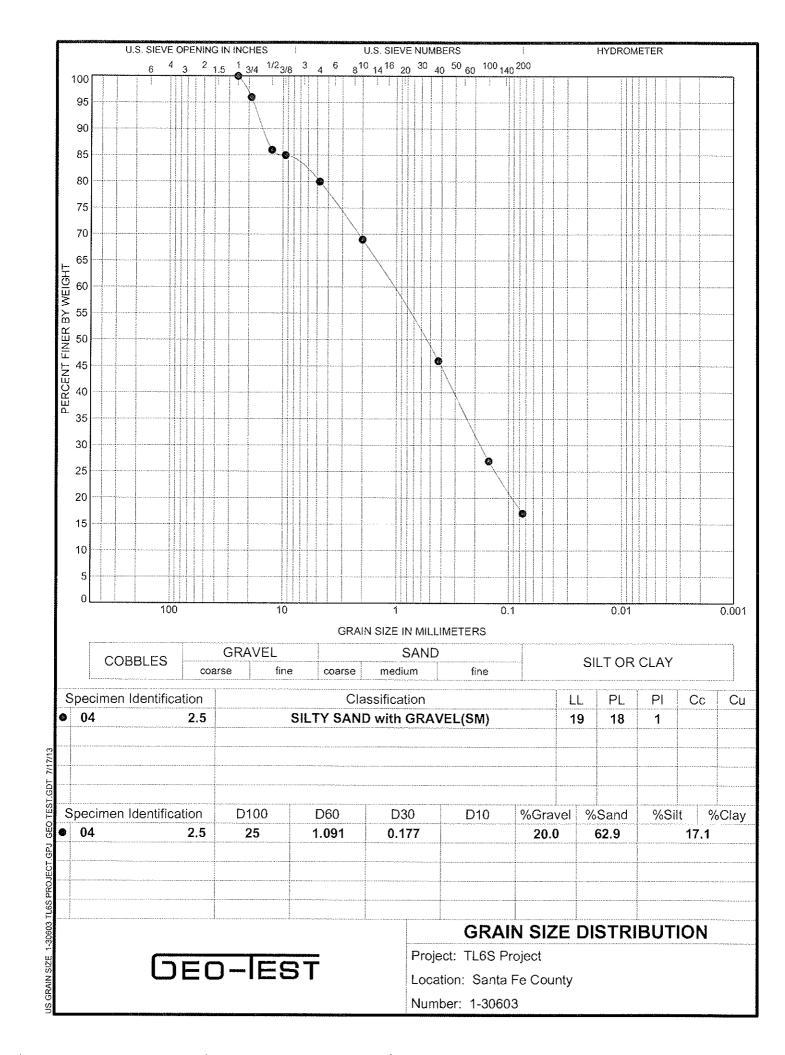
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	1 1/2"						000000000000000000000000000000000000000							***************************************		1		
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	3/4"	85											- Postato Anna					
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	NO 200	39	54		28	15			33	43	45		44	25				
	ā	12	16		9	Ð			Ą	5	14		ΝP	9				
]	25	29		28	ᅙ		* Videon and the second and the seco	dΝ	24	36		ΩŽ	22			OEO-IEST	
	(%) MOIST	3.9	9.9	3.6	4.4	2.1	7.8	9.1	3.9	6.1	9.2	9.2	5.1	3.0				
	UNIFIED	SC	C	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	SC-SM	SM			SM	SC-SM	SC		SM	SC-SM				
	DEPTH (FEET)	4.5	9.5	2.5	4.5	9.5	2.5	4.5	9.5	14.5	2.5	4.5	9.5	14.5				
	TEST HOLE	JB 1	JB 1	JB 2	JB 2	JB 2	TPS 1	TPS 1	TPS 1	TPS 1	TPS 2	TPS 2	TPS 2	TPS 2				

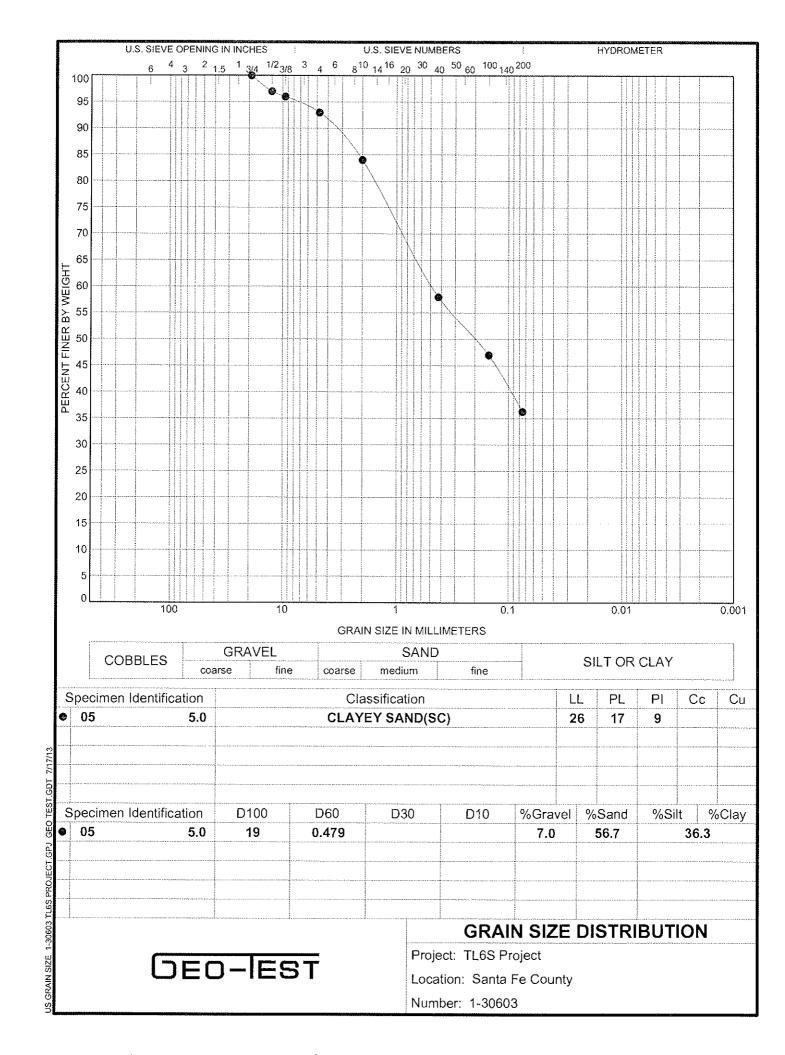


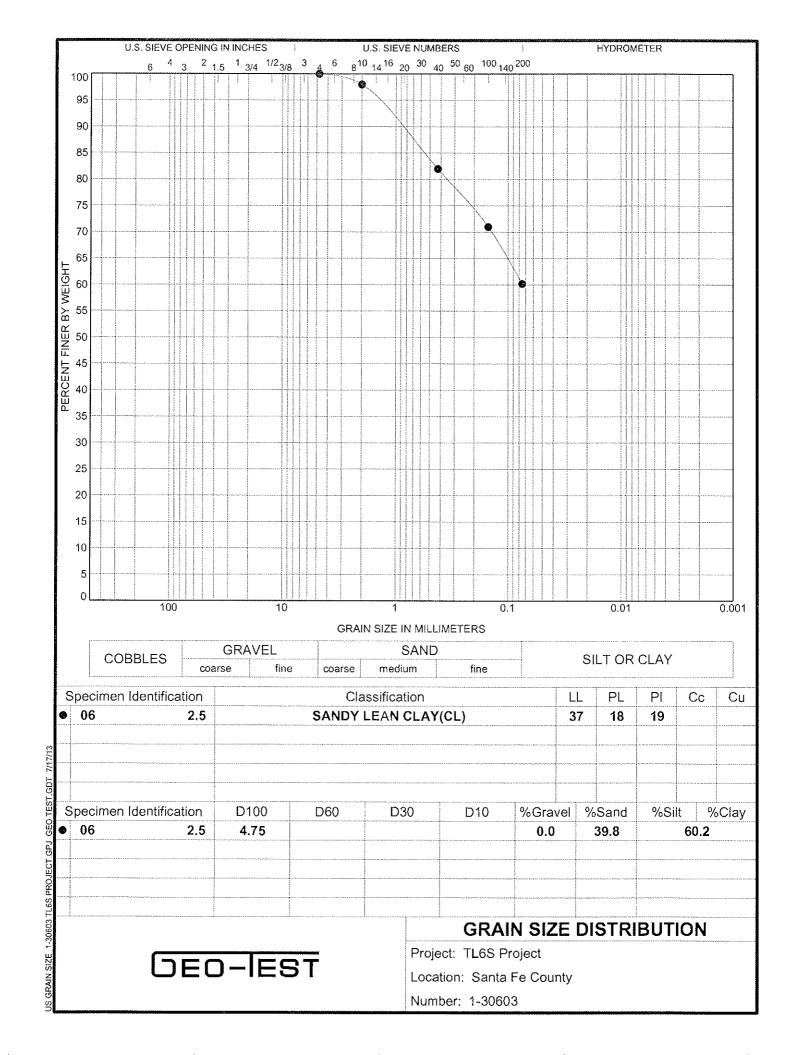


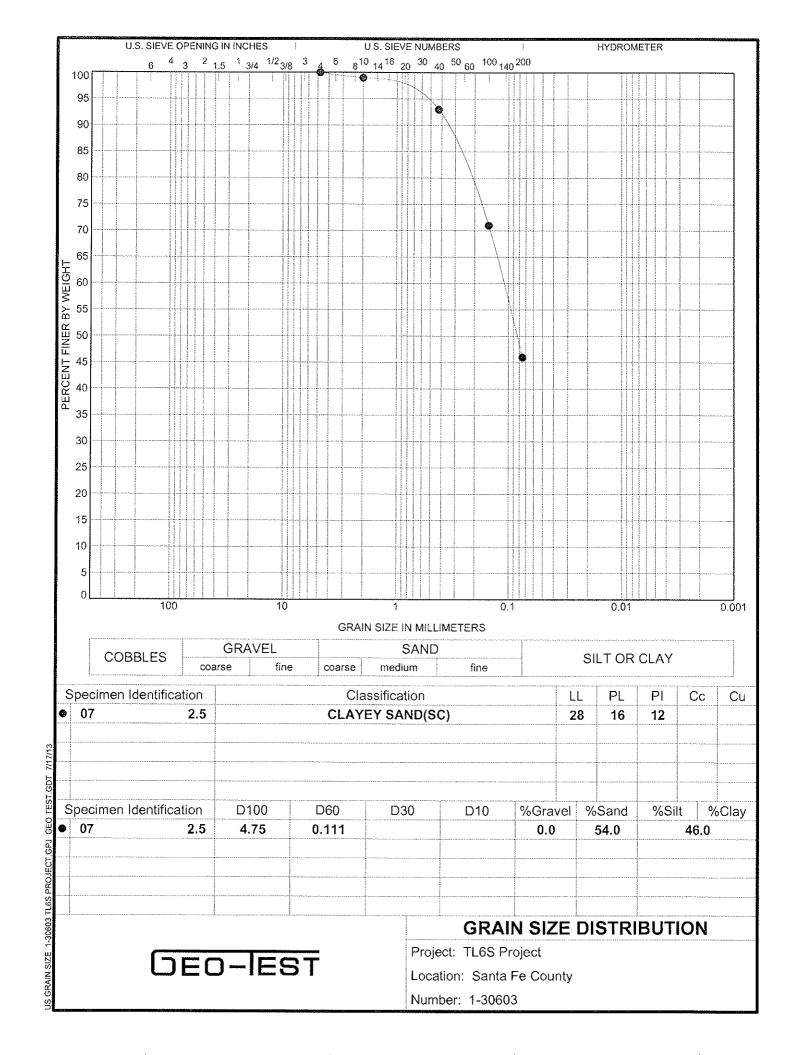


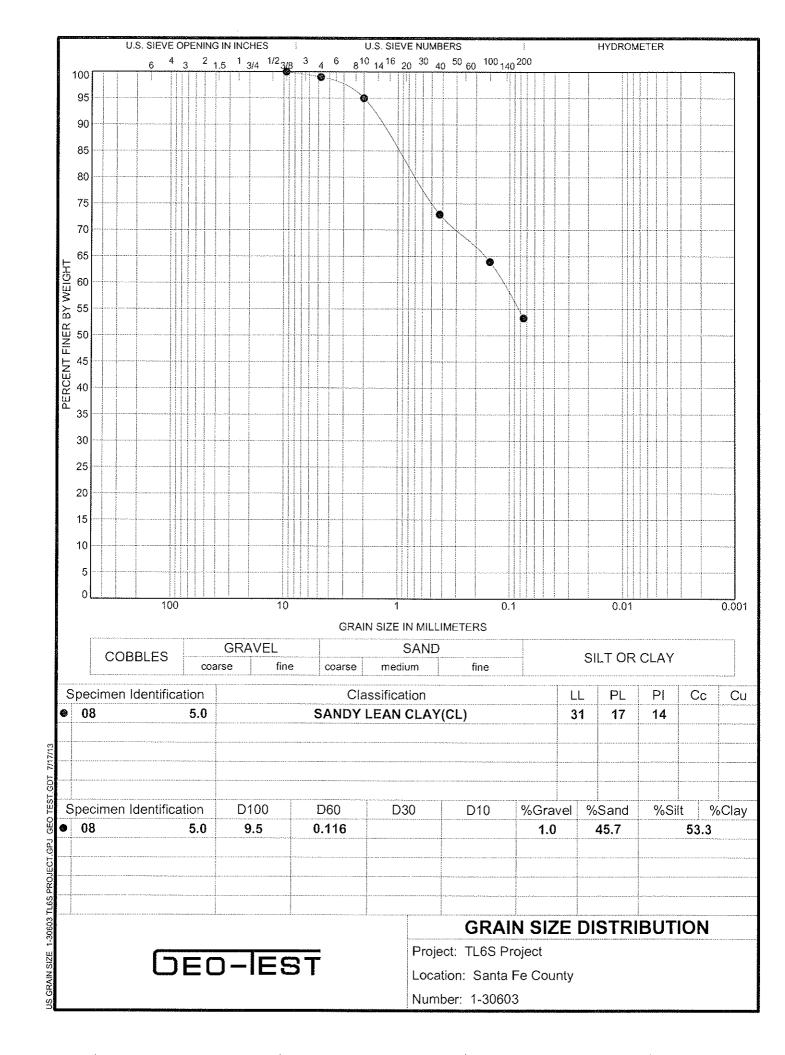


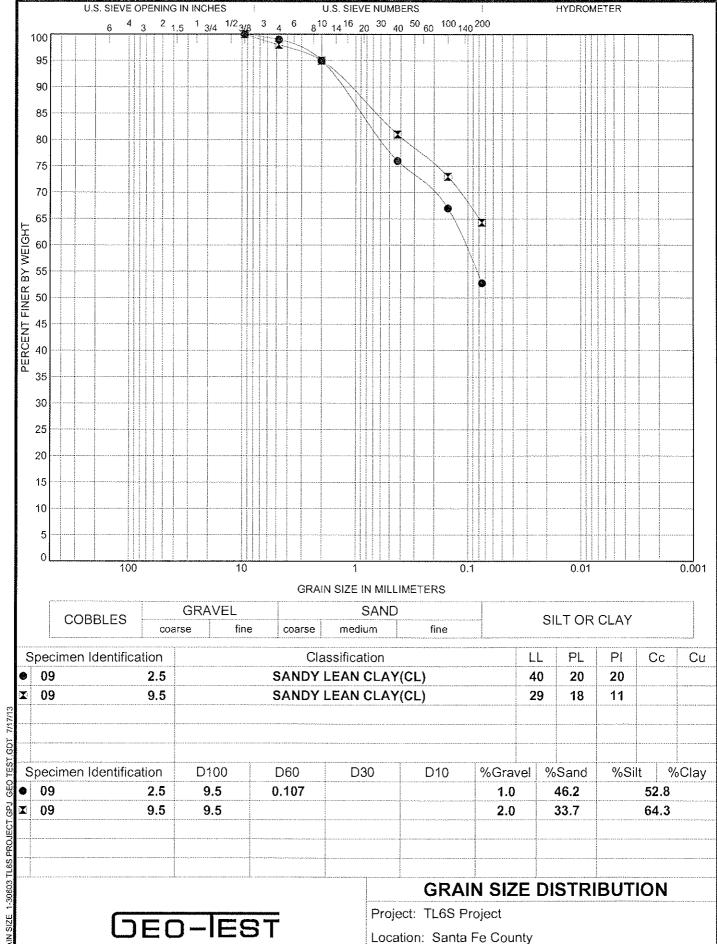




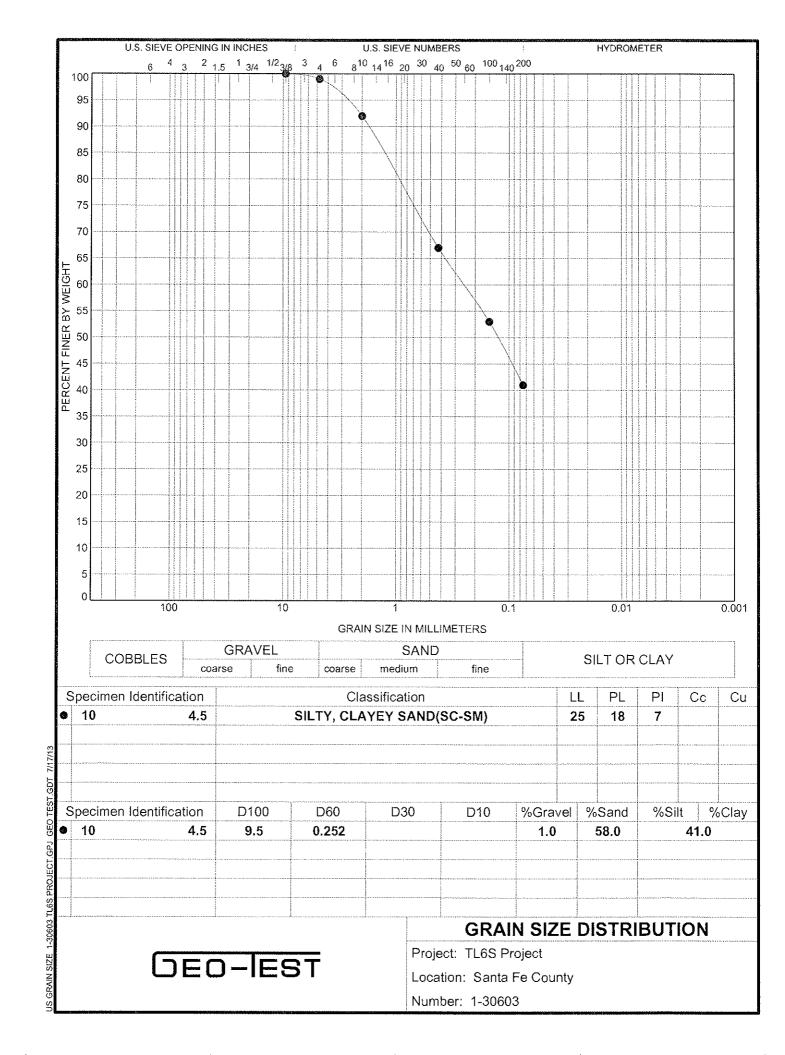


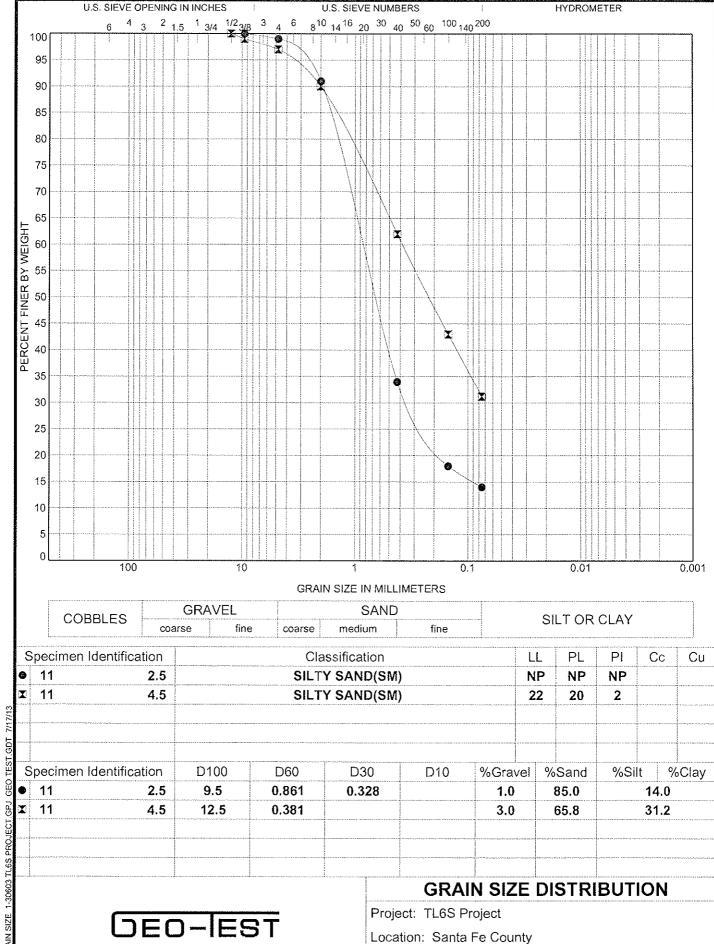


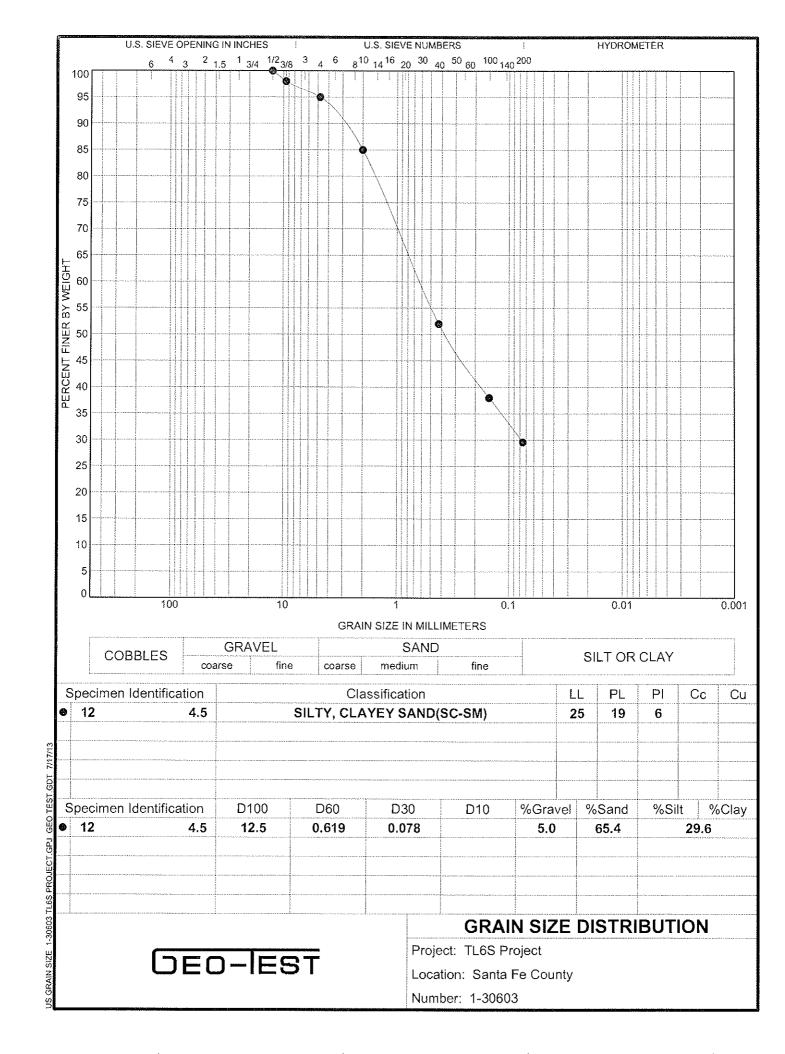


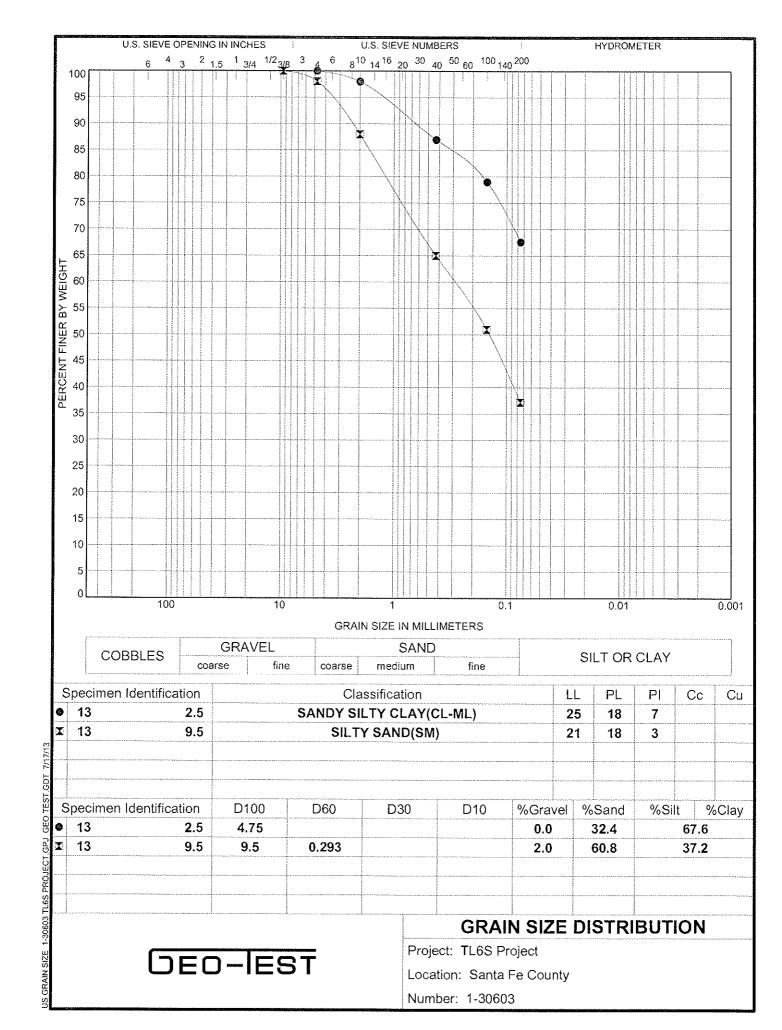


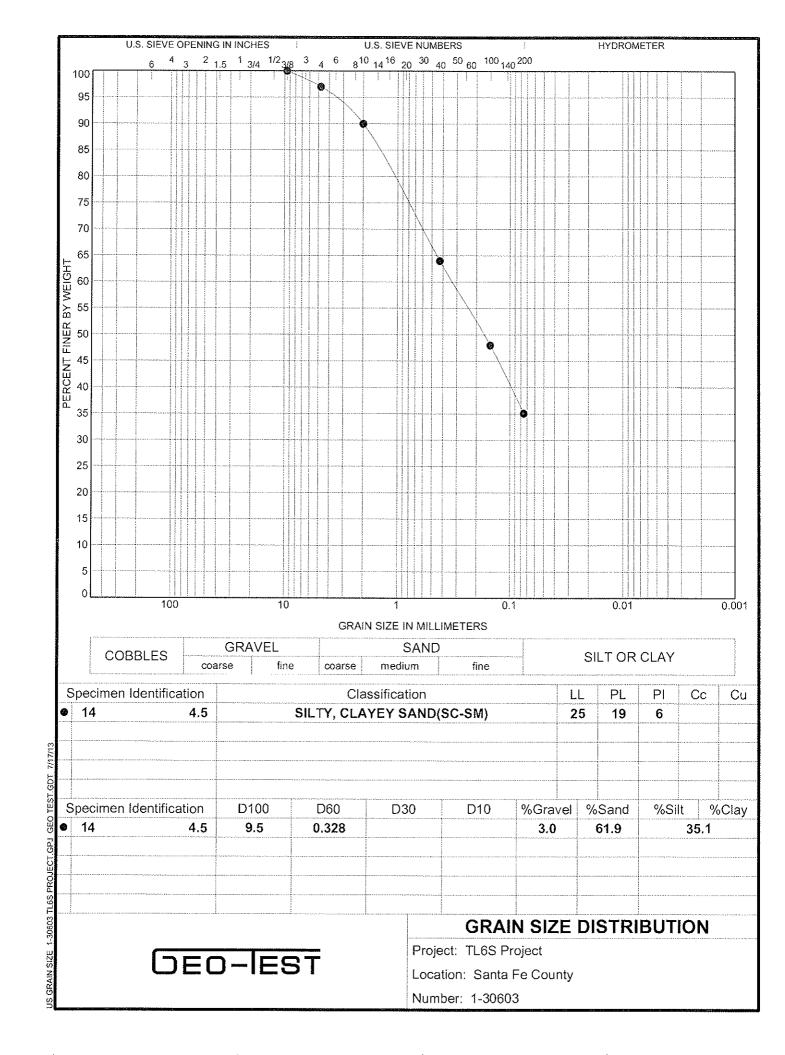
Number: 1-30603

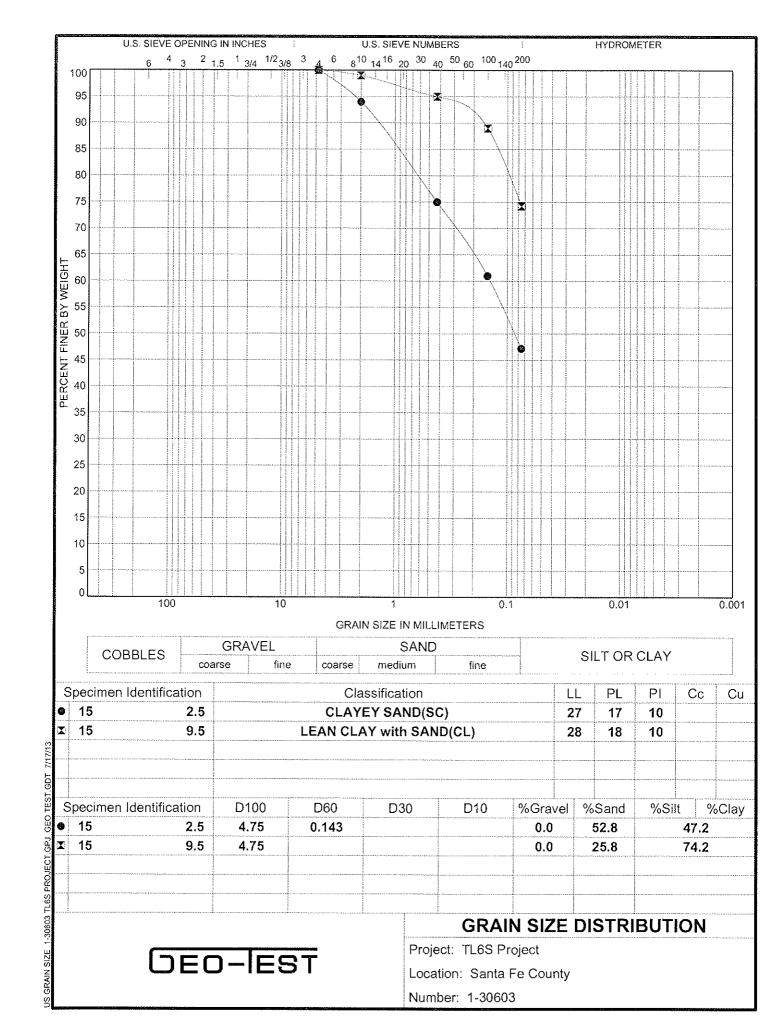


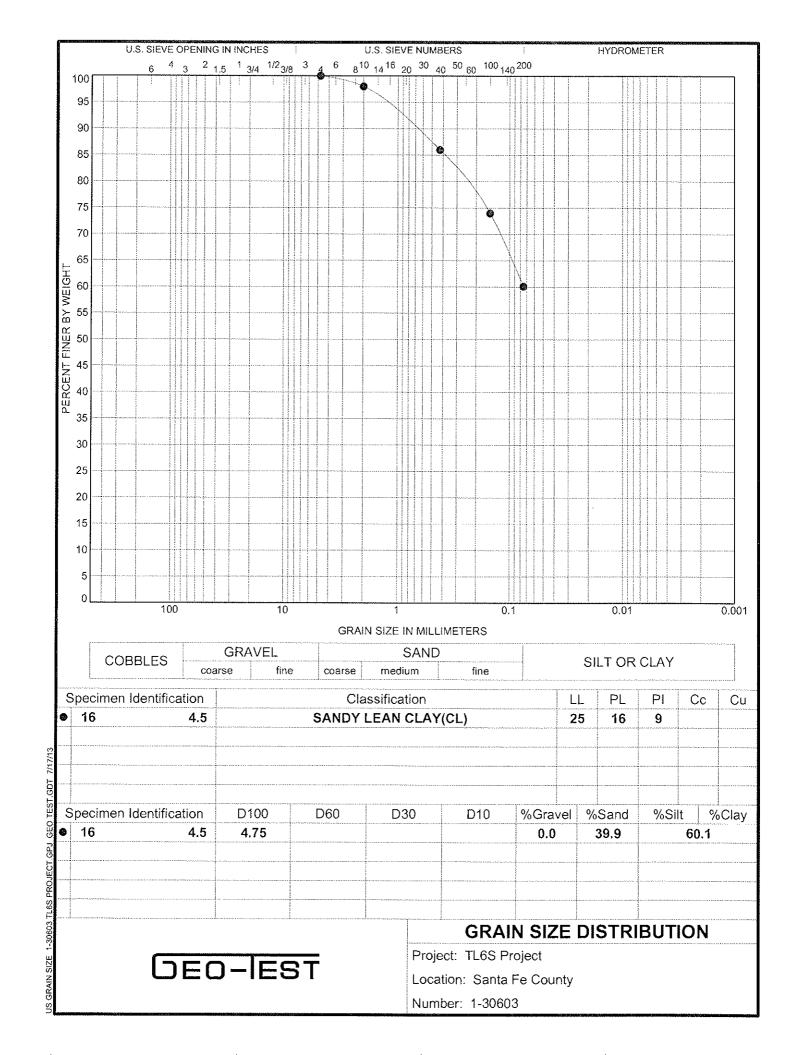


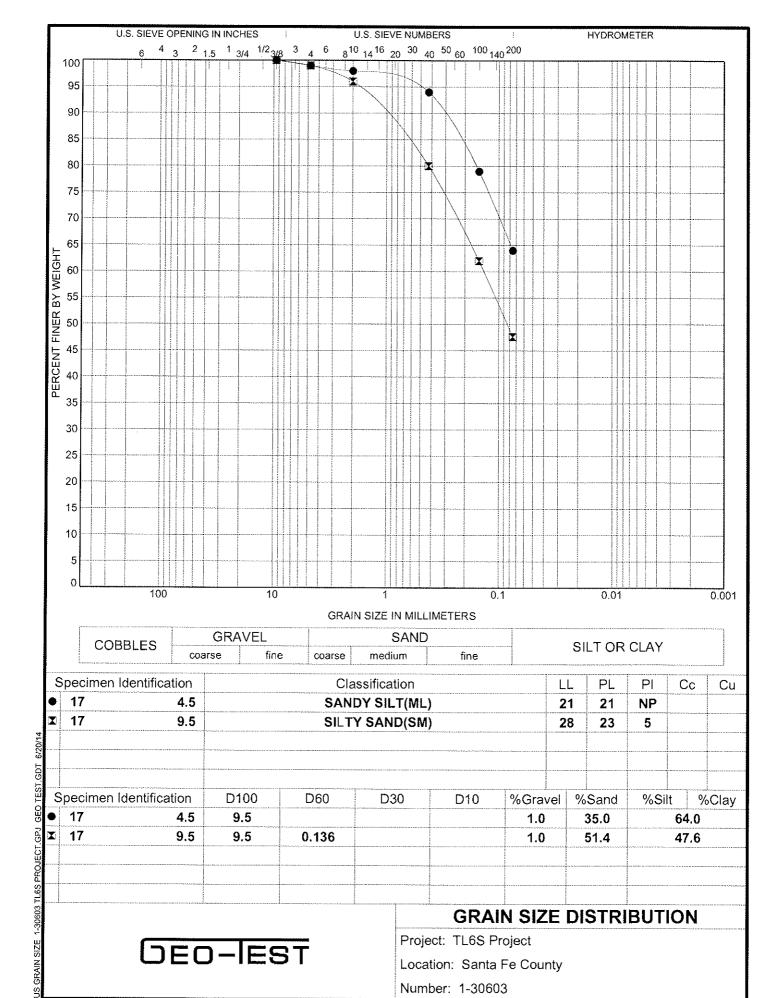


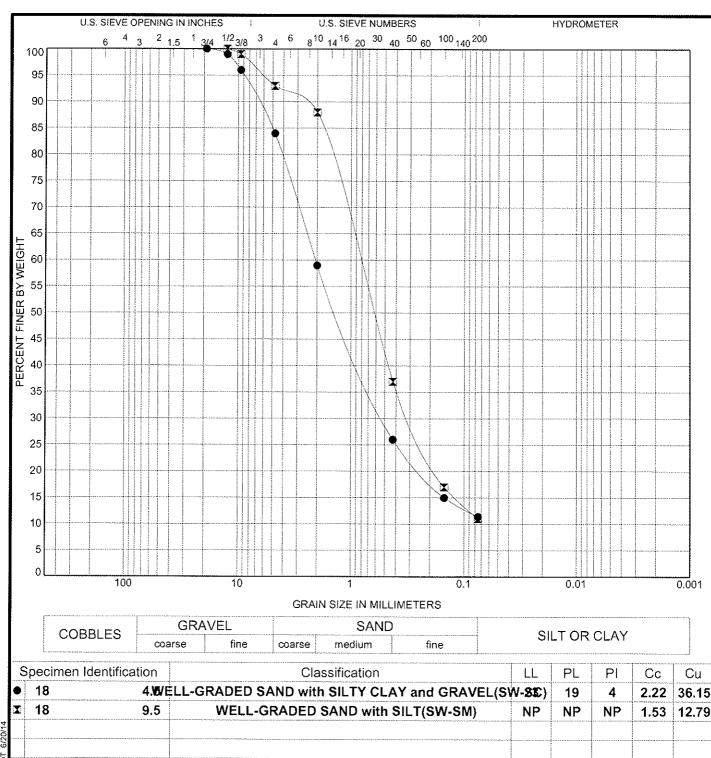












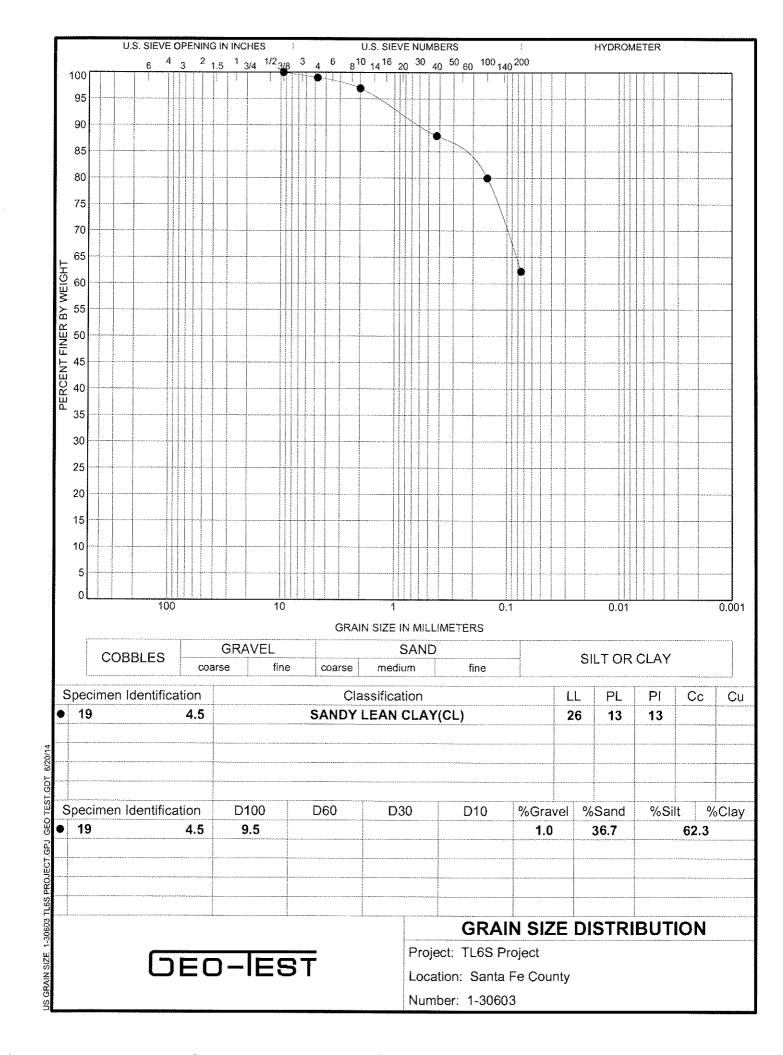
Specimen Identification			Classification					L PL	PI	Сс	Cu
•	18	18 4.WELL-GRADED SAND with SILTY CLAY and GRAVEL(SW-31)							4	2.22	36.15
X	18	9.5	WELL-GRADED SAND with SILT(SW-SM)					P NP	NP	1.53	12.79
		- 416	D400		500						
			D100	D60	D30	D10	%Gravel		%S	ilt 9	6Clay
•	18	4.5	19	2.07	0.513	·	16.0	72.6	11.4		
X	18	9.5	12.5	0.855	0.295		7.0	82.0	32.0 11.0		

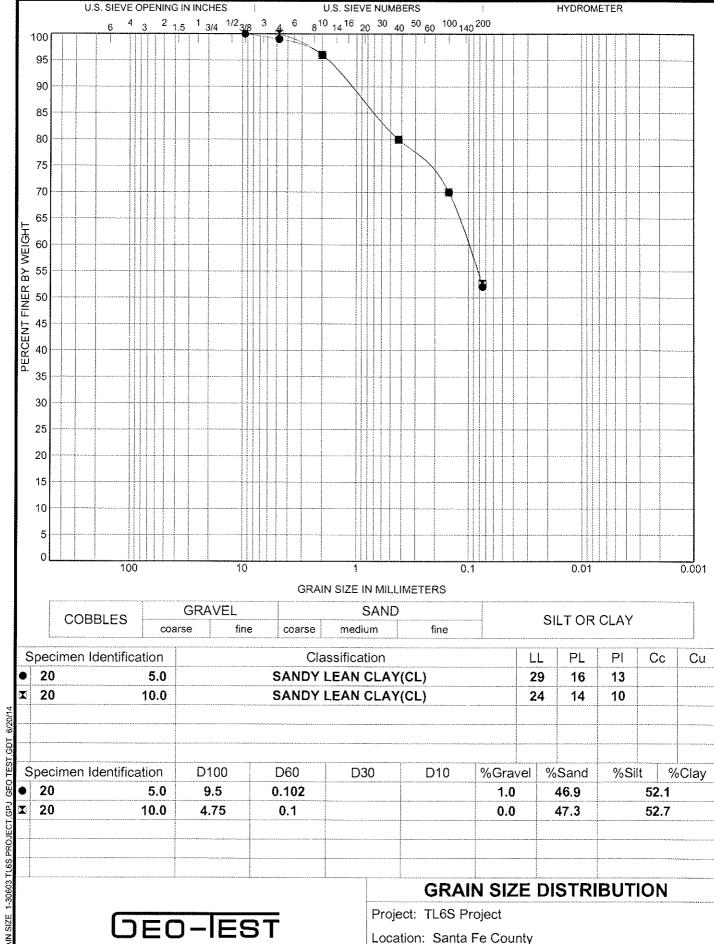
			TO THE POST OF THE PARTY OF THE	1794				,		***************************************	
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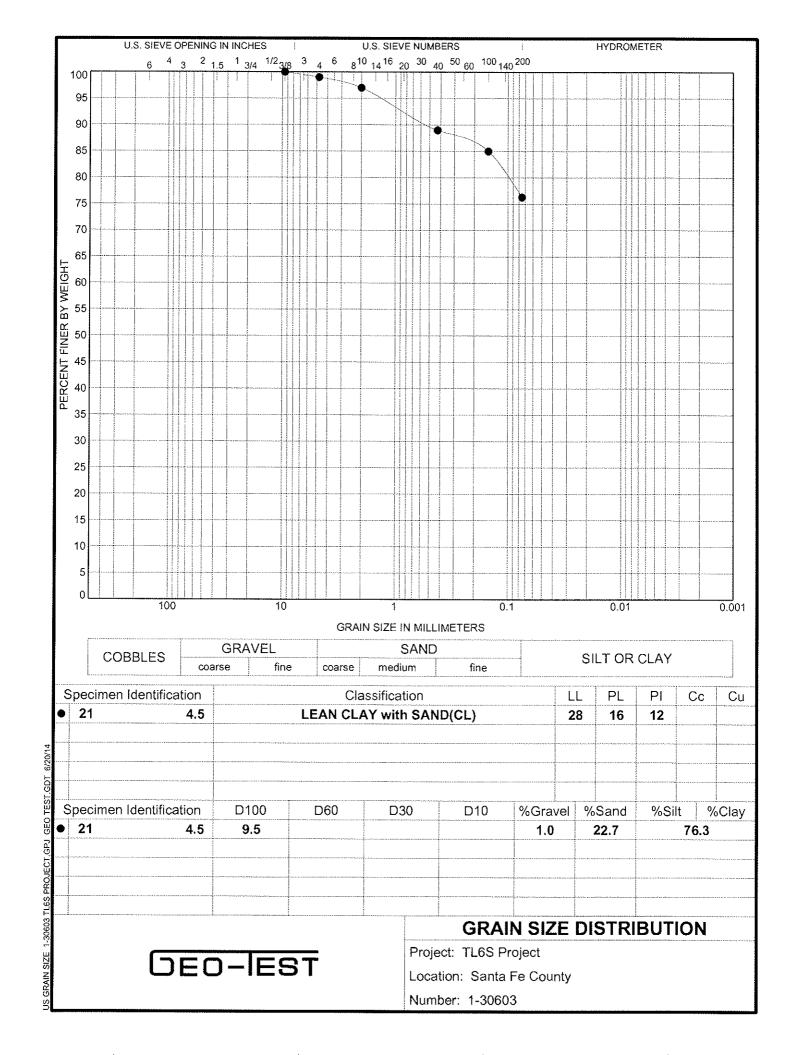
GRAIN SIZE DISTRIBUTION

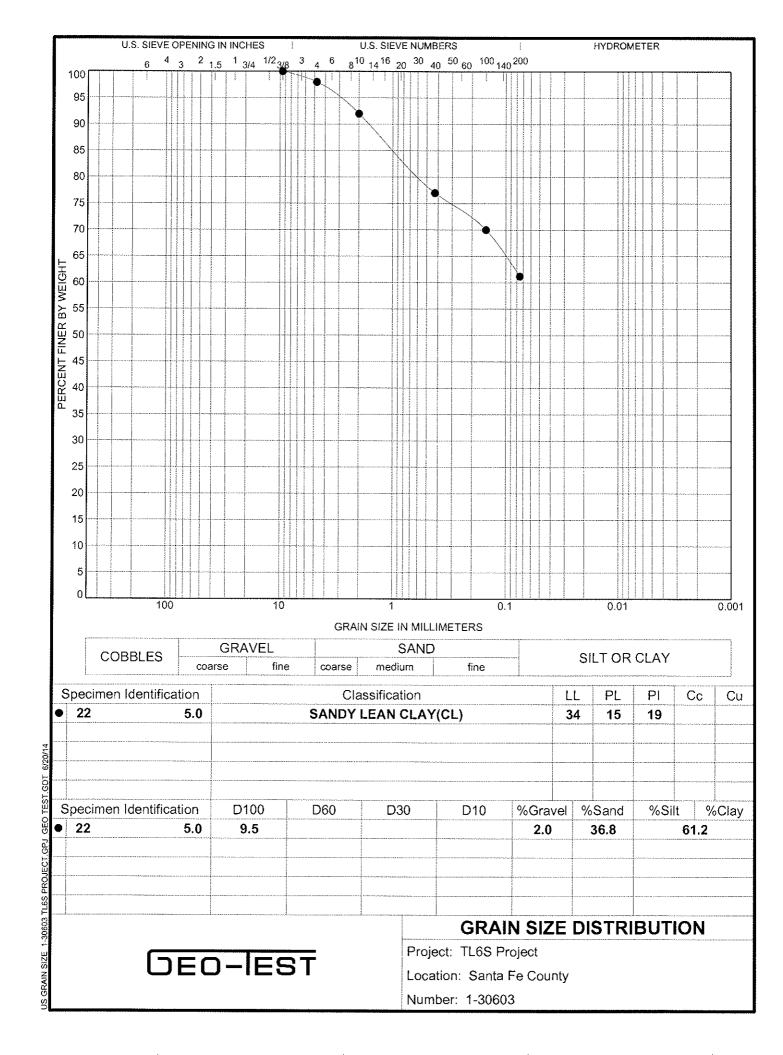
Project: TL6S Project

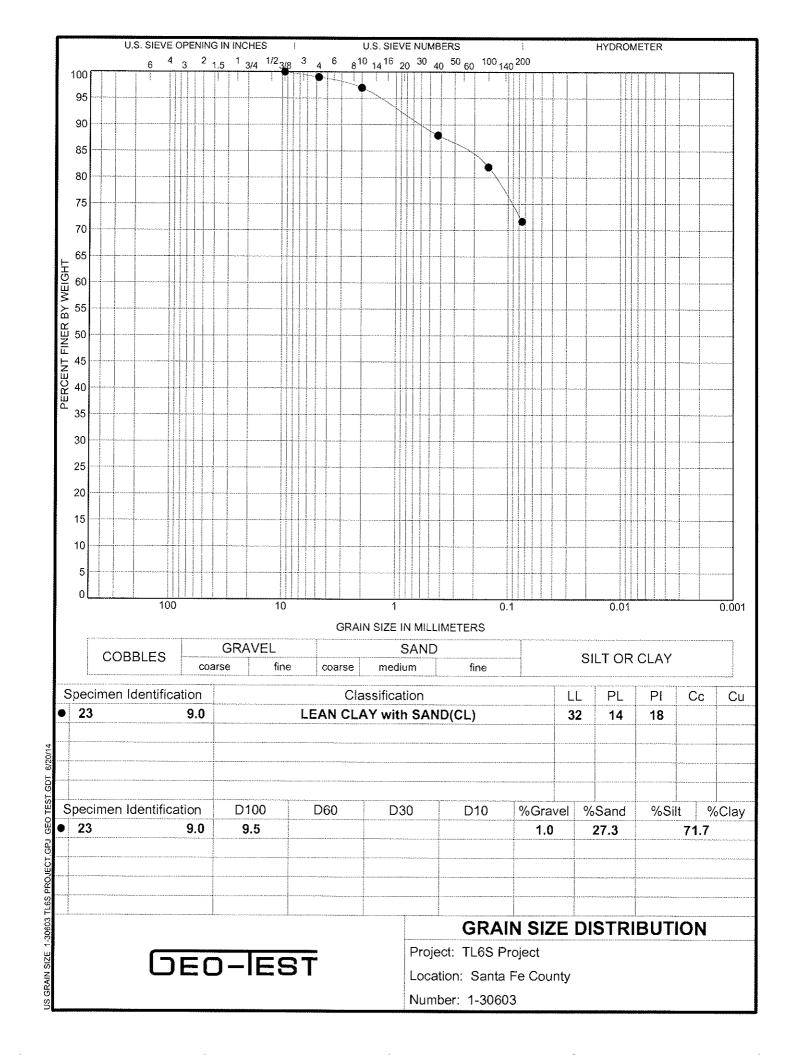
Location: Santa Fe County

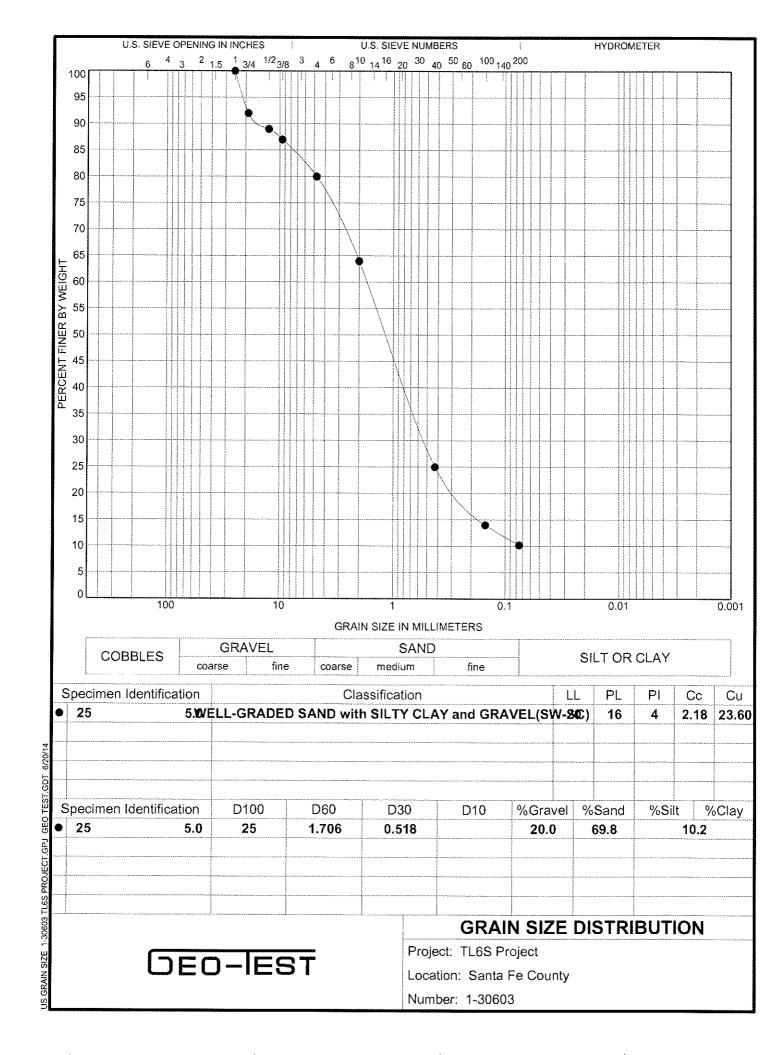


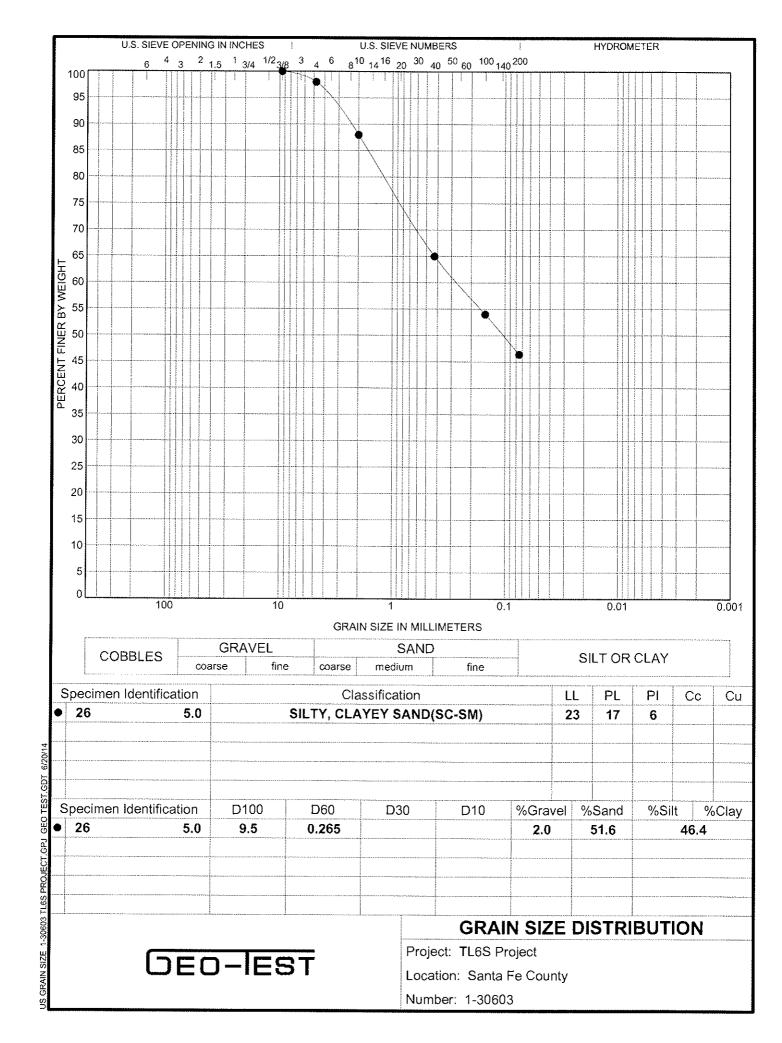


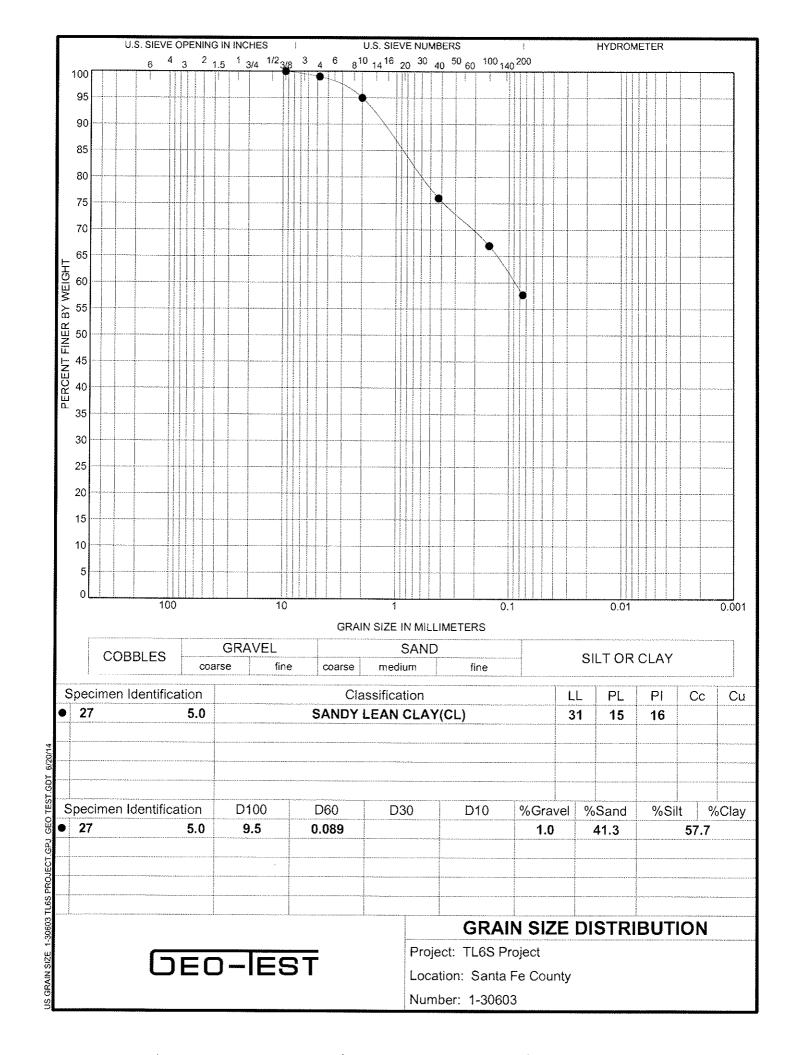


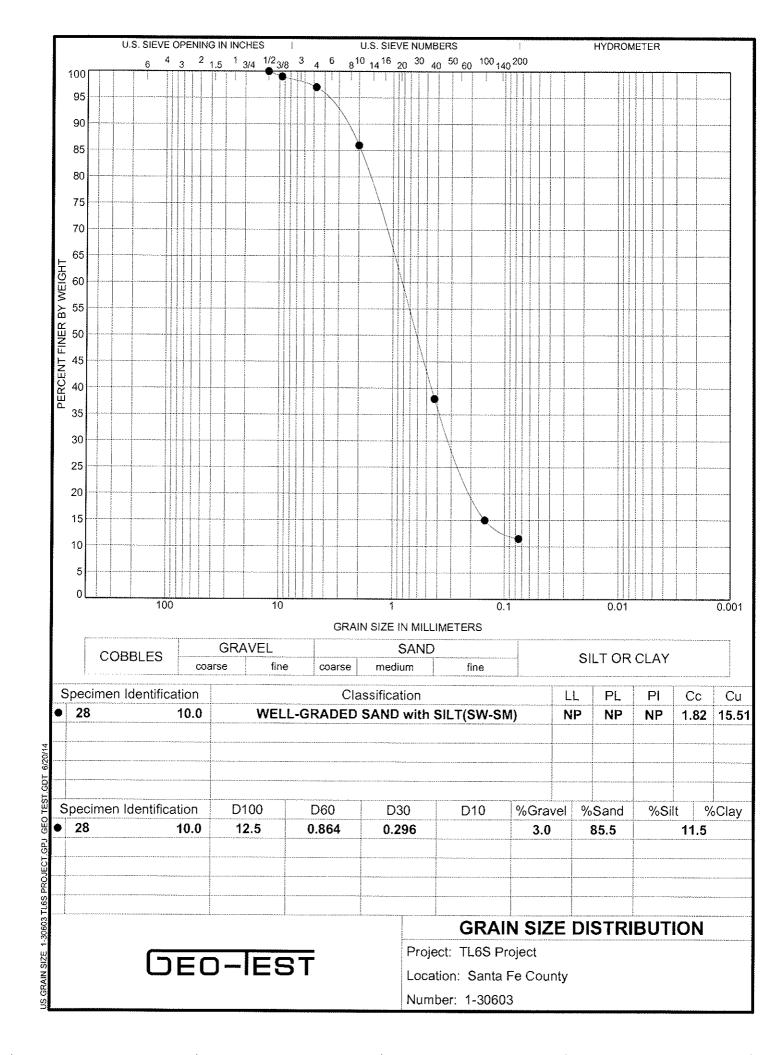


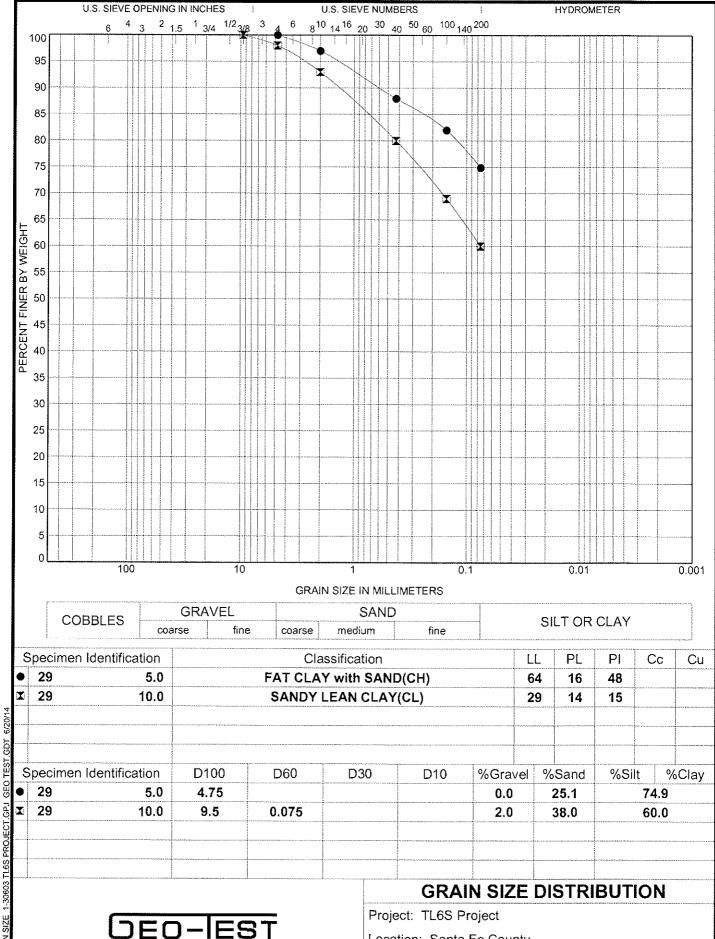




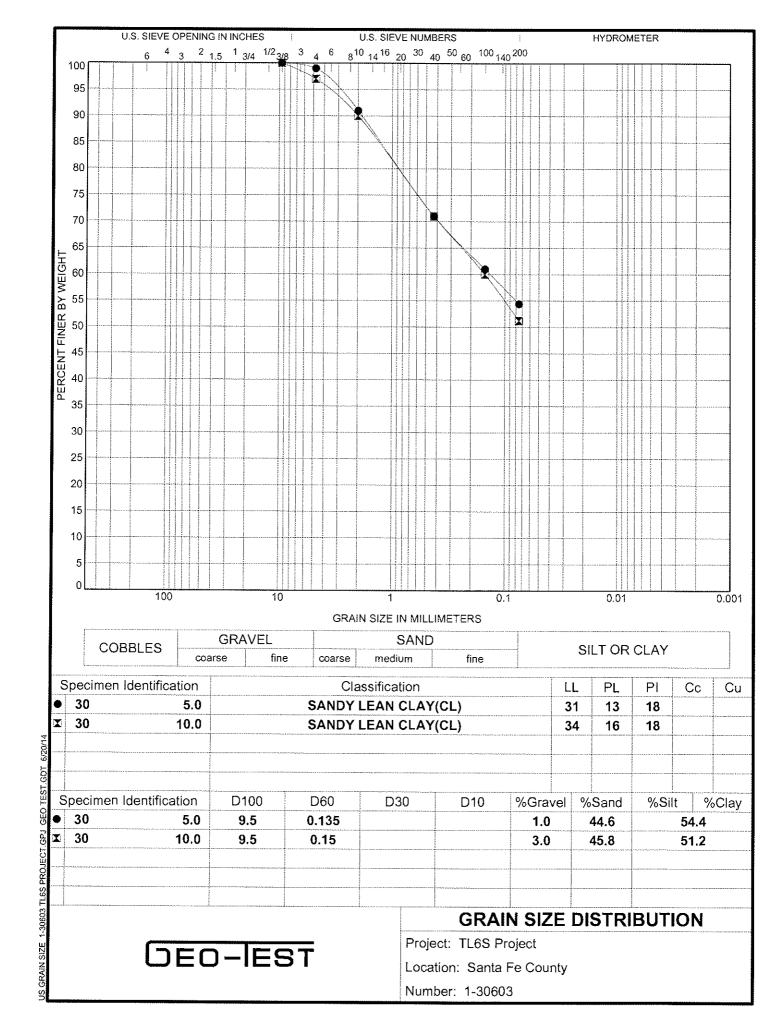


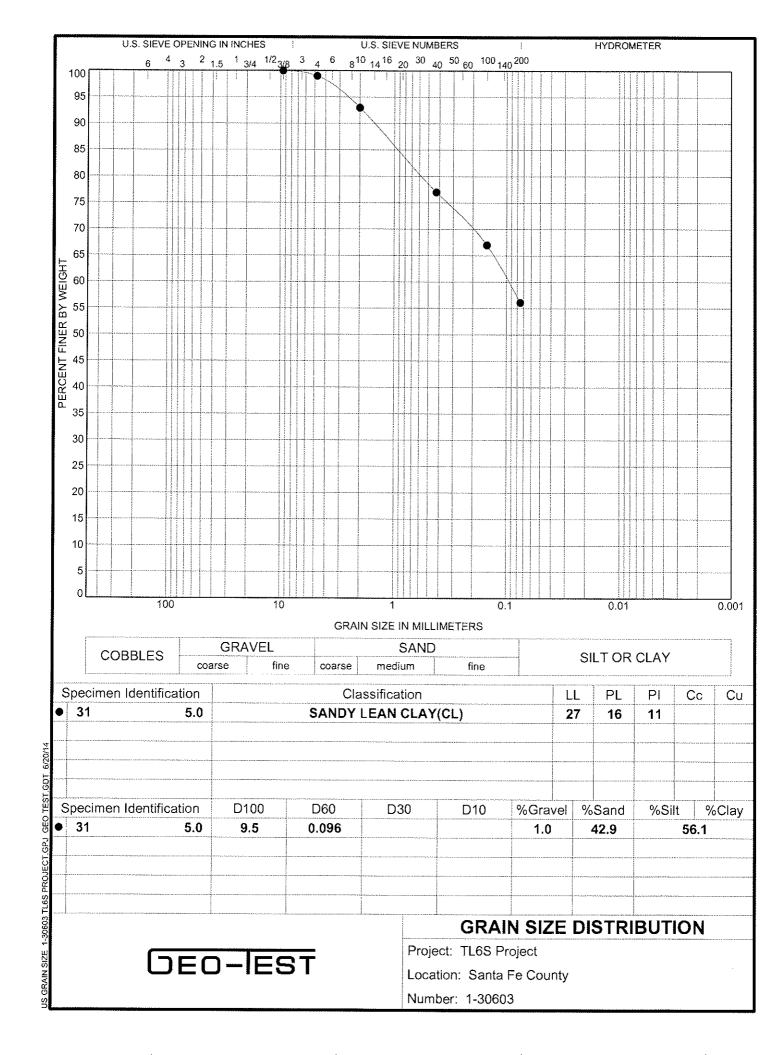


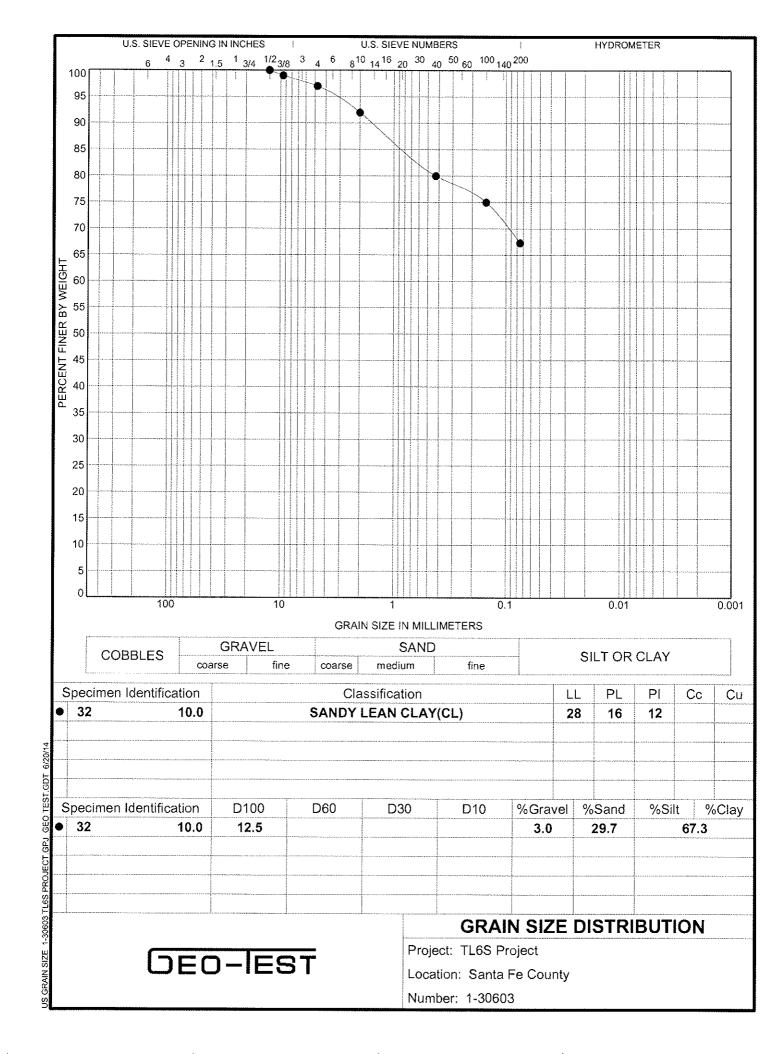


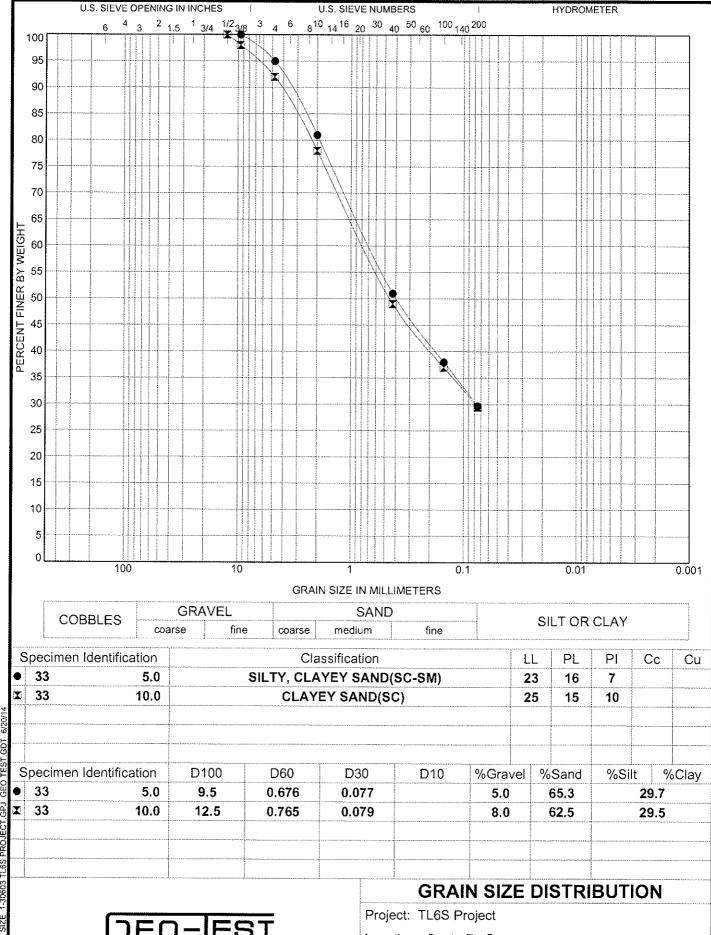


Location: Santa Fe County

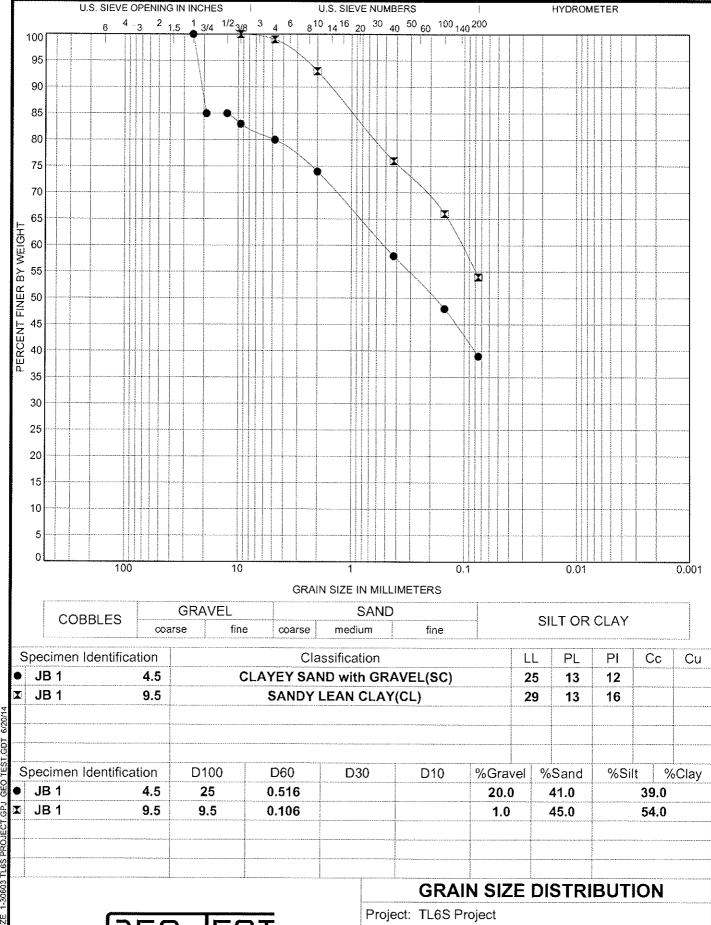






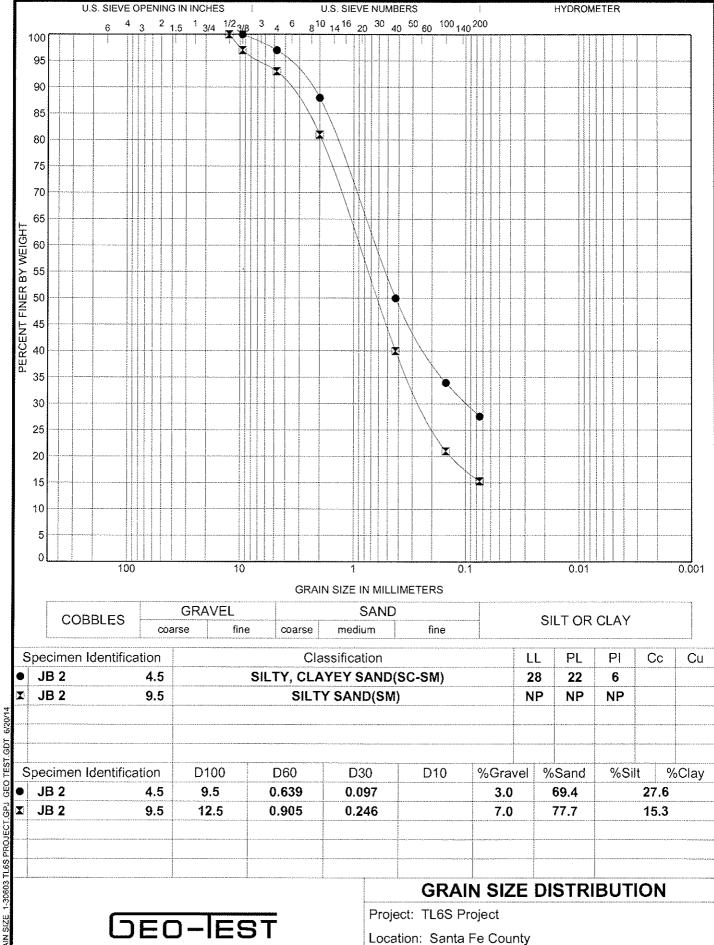


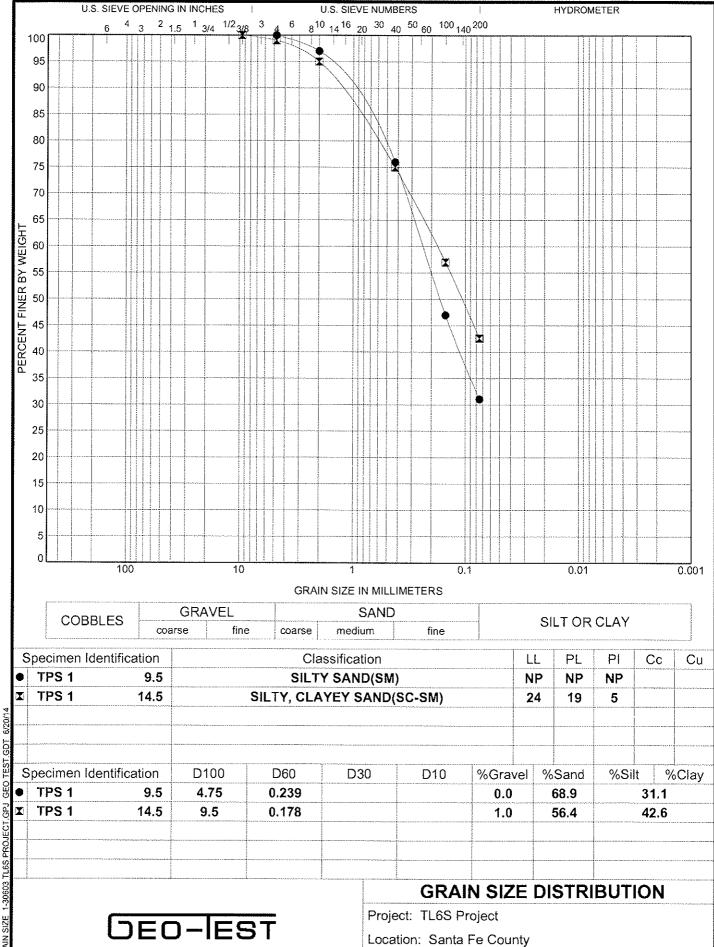
Location: Santa Fe County



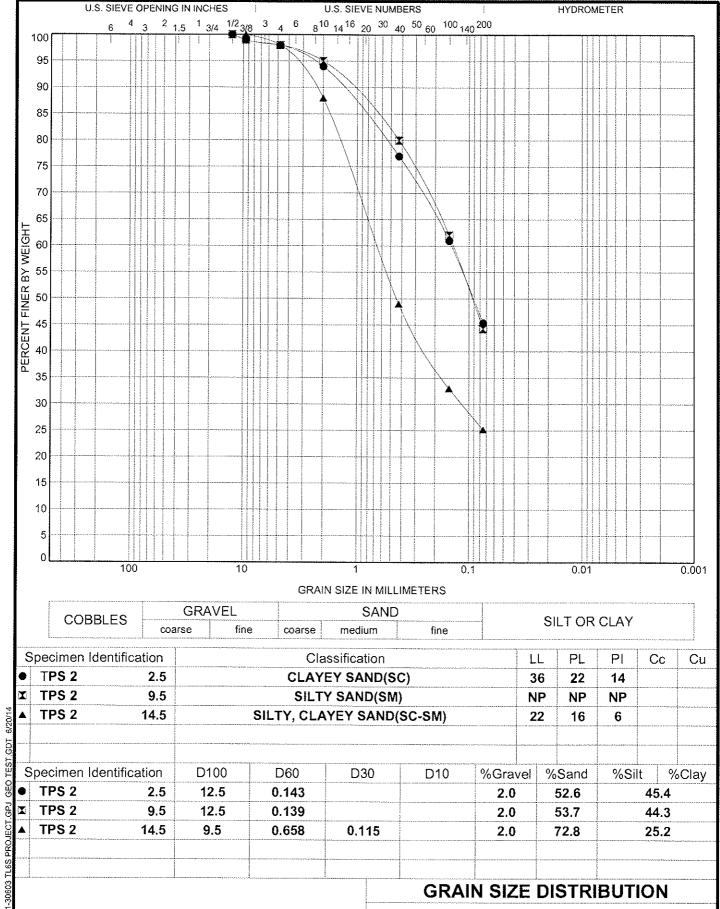
OEO-IEST

Location: Santa Fe County





SOC + DESS MINGO SIT



Project: TL6S Project

Location: Santa Fe County

Appendix B

GEOTECHNICAL ENGINEERING REPORT

Lines #2 & #3
(CAÑONCITO-ELDORADO
WATERLINE PROJECT)
December 12, 2019

GEOTECHNICAL INFORMATION

A geotechnical report was prepared specifically for this project by Geo-Test, Inc., dated December 12, 2019, entitled: Geotechnical Engineering Services Report – Cañoncito-Eldorado WaterLine. Santa Fe County, New Mexico, Job No. 1-30404

Contractor may rely upon the general accuracy of the "technical data" contained in the following geotechnical investigation report. Contractor may not rely upon or make a claim against the Owner, Engineer, or any of the Engineer's Consultants with respect to:

- A. the completeness of such report for Contractor's purposes, including, but not limited to all of the construction criteria to be employed by Contractor during the construction process, or
- B. other data, interpretations, opinions and information contained in the report, or
- C. any Contractor interpretation of or conclusion drawn from any "technical data" or any such data interpretation, opinions or information.

GEOTECHNICAL ENGINEERING SERVICES REPORT NO. 1-30404

CAÑONCITO-ELDORADO WATERLINE

SANTA FE COUNTY, NEW MEXICO

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2805-A LAS VEGAS CT. LAS CRUCES, NEW MEXICO 88007 (575) 526-6260 FAX (575) 523-1660 PREPARED FOR:

MOLZEN CORBIN & ASSOCIATES



December 12, 2019 Job No. 1-30404

Molzen Corbin & Associates 2701 Miles Road SE Albuquerque, NM 87109

Attn: Steven K. Morrow, P.E.

RE: Geotechnical Engineering Services

Cañoncito-Eldorado Waterline Santa Fe County, New Mexico

Dear Mr. Morrow:

Submitted herein is the Geotechnical Engineering Services Report for the above referenced project. The report contains the results of our field investigation and laboratory testing, and recommendations for foundation design as well as criteria for site grading, trenching and backfill.

It has been a pleasure to serve you on this project. If you should have any questions, please contact this office.

Respectfully submitted:

Patrick R. Whorton, E.I.

Reviewed by:

POFESSION

Robert D Booth,

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INTRODUCTION

This report presents the results of our geotechnical engineering services investigation performed by this firm for the proposed new Cañoncito-Eldorado waterline in Santa Fe County, NM.

The objectives of this investigation were to:

- 1) Evaluate the nature and engineering properties of the subsurface soils and/or rock underlying the proposed waterline alignment.
- 2) Provide recommendations for foundation design as well as criteria for site grading, trenching and backfill.

The investigation includes subsurface exploration, selected soil/rock sampling, laboratory testing of the samples, performing an engineering analysis and preparation of this report.

PROPOSED CONSTRUCTION

It is understood that the project consists of the design and construction of a new water system consisting of approximately 0.6 miles of new 8 inch diameter PVC water transmission line which will run from Ave. de Amistad in Eldorado north along the east side of US 285, across I-25 to the Hondo 2 Fire station. A new booster station and storage tank will be installed at the fire station location. The booster station will consist of a 770 square foot single story masonry building with wall loads not anticipated to exceed 2.5 kips per lineal foot. The new storage tank will have a diameter of 49 feet and a capacity of 175,000 gallons with unit loading on the base of the tank on the order of 800 pounds per square foot. From the Hondo 2 Fire Station, approximately 3.4 miles of new 8 and 10 inch diameter PVC transmission line will be installed along Old Las Vegas Highway to Johnson Ranch Rd. in Cañoncito.

It should be noted that Geo-Test Inc. began the field investigation for this project in June of 2013 and completed 22 borings along Old Las Vegas Highway between Ellis Ranch Road and Johnson Ranch Road. After these borings were completed, the investigation was put on hold. Then in June of 2014, Geo-Test, Inc. returned to the site and performed 3 borings at the Hondo Booster Station Site. The investigation was once again put on hold until recently when the final 6 borings were performed.

Should structural loads or other project details vary significantly from those outlined above, this firm should be notified for review and revision of recommendations contained herein.

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FIELD EXPLORATION

A total of thirty-one (31) exploratory borings were drilled at the site. Twenty-two (22) borings were drilled to a depth of 10 feet below roadway elevation or practical auger refusal along the proposed Old Las Vegas Highway alignment (Line 3). Three (3) borings were drilled at the Hondo 2 Fire Station to a depth of 25 feet below existing grades within the booster station and storage tank footprints. Six (6) borings were drilled to depths of about 10 to 15 feet below existing grades or practical auger refusal along the proposed US 285 waterline alignment (Line 2). The locations of the borings are shown on the attached Boring Location Maps, Figures 1, 2 and 3. The soils encountered in the borings were continuously examined, visually classified and logged during the drilling operations. The boring logs are presented in a following section of this report. Drilling was accomplished using a truck mounted drill rig equipped with a 5.5 inch diameter continuous flight hollow stem auger. Subsurface materials were sampled at five foot intervals or less utilizing an open tube split barrel sampler or a ring-lined sampler driven by a standard penetration test hammer.

LABORATORY TESTING

Selected samples were tested in the laboratory to determine certain engineering properties of the soils/rock. Moisture contents were determined to evaluate the various soil/rock deposits with depth. The results of these tests are shown on the boring logs.

Sieve analysis and Atterberg limits tests were performed to aid in soil classification. The results of these tests are presented in the Summary of Laboratory Results and on the individual test reports presented in a following section of this report.

SURFACE CONDITIONS

The Old Las Vegas Highway portion of the alignment runs from the Hondo 2 Fire Station near the I-25/US 285 interchange and follows the highway east to Johnson Ranch Rd. The roadway is two lane and paved with asphalt. The thickness of the asphalt varies from 8 inches thick near US 285 to 2 inches near Johnson Ranch Rd. A majority of the asphalt is underlain by aggregate base course, the thickness of which also varies from 18 inches to non-existent. The roadway travels southeast from US 285 around the southern foothills of the Sangre de Cristo Mountains where it turns northeast. For a majority of the alignment, the roadway was constructed at approximately native grade or raised slightly with fill. At the southern portion of the alignment where the turn is made, the road has been cut into the existing foothills which consist of granite overlain with mudstone/sandstone.

The Hondo 2 Fire Station is located east of the I-25 / US 285 interchange. The new booster station and tank site will be installed approximately 150 feet south of the existing building. The tank site is on an old helipad which is paved with 2 inches of asphalt that is presently greatly deteriorated. There are also

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several storage sheds/containers in the area which will be removed as part of this project. The fire station site is also used to stockpile road materials such as sand, gravel and scoria. The existing haul road for the stockpiles is located near the proposed booster station site and material associated with the stockpiles was encountered in the upper 3 feet.

The US 285 portion of the new waterline alignment will be installed between Ave. de Amistad and the Hondo 2 Fire Station. The new line will be installed on the east side of the existing US 285 highway. The terrain through this area is hilly and the proposed line will follow the existing topography.

SUBSURFACE SOIL/ROCK CONDITIONS

As indicated by the exploratory borings, the soil underlying the Old Las Vegas Highway alignment primarily consists of alluvial deposits consisting of clays, sands and gravels as well as man-made fills. The rock encountered along this portion of the alignment consists of Sangre de Cristo Formation mudstone and sandstone and Proterozoic granite. The consistency and density of the soil/rock encountered varies throughout the alignment, see attached boring logs for site specific profiles. The man-made fills encountered consist of road fill and culvert backfill which primarily consist of native soils with lesser amounts of aggregate base course.

As indicated by the exploratory borings, the soils underlying the Hondo 2 Booster Station and Tank site consists of layers of loose to medium dense non-plastic silty and clean sands with gravel which extend to depths between 13 and 17 feet below existing grades. Below these layers, poorly graded sand with gravel was encountered to the full depth explored. Free ground water was encountered at depths of 19 to 24 feet below grade.

As indicated by the exploratory borings, the soils underlying the US 285 alignment vary at each location explored. In general, the soils consist of sands and clays with lesser amounts of gravel. See boring logs for site specific soil profiles. At boring location 26, auger refusal was encountered on competent rock at a depth of 6.5 feet below grade.

No free groundwater was encountered along the transmission line alignment and soil moisture contents were low to moderate throughout the extent of the borings.

CONCLUSIONS AND RECOMMENDATIONS

As indicated by the standard penetration test data, the near surface soils encountered at the Hondo 2 booster station and tank site are loose in their present condition. These soils have the potential to create excessive settlements of shallow foundations, even with the use of low bearing pressures in design. As such, these soils are not considered suitable to provide reliable support of shallow footings and slabs on-grade. Foundations bearing on these soils would be susceptible to excessive differential settlement, particularly

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upon significant increases in moisture content. However, with the recommended site preparation and very careful moisture protection, as recommended in a following section of this report, the proposed booster station may be supported on shallow spread-type footings bearing directly on properly compacted structural fill and the proposed water storage tank may be supported on a reinforced concrete ring-wall footing (AWWA Type 1) bearing directly on properly compacted structural fill.

The site preparation would involve an overexcavation of the existing soils throughout each building area to such an extent as to provide for at least 3.0 feet of properly compacted, non-expansive structural fill below all foundations and floor slabs (tank bottom) or to such an extent as to remove all existing man-made fill soils in their entirety, whichever is the greater depth of overexcavation. The limits of the overexcavation should also extend laterally from the footing perimeters a distance equal to the depth of fill beneath their bases. The exposed native soils at the base of the excavation should be densified prior to placement of structural fill. The overexcavated soils may be blended and used as structural fill provided, they meet the structural fill requirements outlined in the Site Grading section of this report. Detailed recommendations for foundation design and the required site grading are presented in the following sections of this report.

Post-construction moisture increases beneath the structures could cause some differential foundation movements. Therefore, moisture protection is considered an important design consideration and should be reflected in overall site grading and drainage details as recommended in the Moisture Protection section of this report.

Based on the results of this investigation, the majority of the soils along the proposed waterline alignment may be excavated using normal earthmoving equipment and may be re-used as general trench backfill. However, shallow bedrock and/or very dense gravels were encountered in some areas which may require heavy ripping or rock breaking equipment.

BOOSTER STATION FOUNDATION

Shallow spread-type footings bearing directly on a minimum thickness of 3.0 feet of properly compacted structural fill are recommended for the support of the proposed booster station. An allowable bearing pressure of 2,000 pounds per square foot is recommended for footing design. This bearing pressure applies to full dead load plus realistic live loads and can be safely increased by one-third for totals loads including wind and seismic forces.

Exterior footings should be established a minimum of 2.0 feet below lowest adjacent finished grade, while interior footings should be at least 12 inches below finished floor grade. The minimum recommended width of square and continuous footings is 2.0 and 1.33 feet, respectively.

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Total settlements of foundations designed and constructed as recommended herein are estimated not to exceed ¾ inch for the soil moisture contents encountered during this investigation or moisture contents introduced during construction. Differential movements should be less than 75 percent of total movements. Significant post-construction moisture increases in the supporting soils could create additional movements and could cause excessive movements at least in some areas of the site. Accordingly, the moisture protection provisions as recommended in a following section of this report are considered critical for the satisfactory performance of the structure.

TANK FOUNDATION

The proposed water tank may be supported on a reinforced concrete ring-wall footing (AWWA Type 1) bearing directly on a minimum of 3.0 feet of properly compacted structural fill placed as recommended within the Site Grading section of this report. The footing should be designed using an allowable soil bearing pressure not exceeding 2,500 pounds per square foot. The recommended bearing pressure applies to full dead plus realistic live loads and may be increased by one-third for total loads including wind and seismic forces. The ring-wall footing should be established a minimum of 2.0 feet below the lowest adjacent finished grade for frost protection purposes. The minimum recommended width of the ring-wall footing is 16 inches. The floor of the tank should be supported on a sand cushion at least 3 inches thick placed directly on a minimum thickness of 3.0 feet of compacted structural fill.

It is estimated that total settlement of the tank and ring-wall footing, designed and constructed as recommended herein, will not exceed about 1.0 inch. Differential movement, or tilt across the entire tank bottom, is estimated to be less than 0.5 inches.

The above settlement estimates are based upon the soil moisture contents encountered during test drilling or moisture contents introduced during construction. Post construction moisture increases in the supporting soils could create additional movements and, thus, the moisture protection procedures as recommended in a following section of this report are considered important for the satisfactory performance of the tank structure.

LATERAL FOUNDATION LOADS

Resistance to lateral forces will be provided by soil friction between the base of floor slabs and footings and the soil and by passive earth resistance against the sides of the footings and stem walls. A coefficient of friction of 0.40 should be used for computing the lateral resistance between bases of footings and slabs and the soil. With backfill placed as recommended in the site grading section of this report, a passive soil resistance equivalent to a fluid weighing 325 pounds per cubic foot should be used for analysis.

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SLABS ON GRADE

Concrete slabs on grade should be founded on a minimum of 3.0 feet of properly compacted, non-expansive structural fill and constructed in conformance with the methods outlined in ACI 302.1R-04.

Adequate support for lightly loaded slab-on-grade floors will be provided by the structural fill when compacted as recommended in the Site Grading section of this report. Thus, the use of granular base for structural support of lightly loaded slabs is not considered necessary. However, should it be desired as a working surface, or to increase the modulus of subgrade reaction, a course of granular base can be placed beneath concrete floor slabs.

Where granular base is used beneath the slabs, it should have a plasticity index of no greater than 3 and meet the following grading requirements:

Sieve Size Square Openings	Percent Passing by Dry Weight
1 Inch	100
¾ Inch	70-100
No. 4	35-85
No. 200	0-10

The granular base should be compacted to at least 95 percent of maximum dry density as determined in accordance with ASTM D1557.

Any heavily loaded slabs on the project bearing on structural fill should be designed using a modulus of subgrade reaction of 200 pounds per square inch per inch of deflection. If a 6 inch thickness of granular base is placed and compacted beneath the slabs, the modulus of subgrade reaction can be increased to 300 pounds per square inch per inch of deflection.

The granular base may act as a capillary barrier but will not totally eliminate the rise of moisture to the slabs. If floor coverings are proposed which are highly sensitive to moisture, or highly moisture sensitive equipment will be installed within the buildings, a synthetic vapor barrier should be installed to prevent moisture intrusion through the slab. A minimum of 4 inches of granular base as recommended above should be placed between the vapor barrier and the slab. Barriers should be overlapped a minimum of 6 inches at joints, should be carefully fitted around service openings and should conform with ACI 302.1R-04 specifications.

UTILITY TRENCHING AND BACKFILL

A majority of the subsurface soils encountered in the borings can be readily excavated using normal earth moving or trenching equipment. These soils are also considered suitable for use as trench backfill.

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Very dense soils and/or bedrock were encountered which will result in difficult excavations in some areas of the site. As indicated on the boring logs, the depth to these very dense soils or rock varies from the surface/beneath existing pavement to depths of 8 or 9 feet below pavement grade. As such, difficult excavation will likely be encountered sporadically throughout the proposed alignments and it is recommended that an earthwork contractor familiar with excavating in mountainous areas be retained to performed excavations and should be prepared to use heavy ripping or rock breaking equipment (hoe-rams) as required to excavate into these deposits.

Excavated slopes for the construction of trenches should be designed and constructed in accordance with OSHA 29 CFR 1926, Subpart P, and any applicable state or local regulations. The contractor should be responsible for all temporary trench slopes excavated along the proposed waterlines and the design of any required temporary shoring, as applicable. Shoring, bracing, and benching should be performed by the contractor in accordance with applicable safety standards. In areas where shoring is not required for excavation, trench walls in the overburden soils should be laid back at a minimum slope of 1.5:1 (horizontal: vertical). Spoil piles and heavy equipment should not be allowed within 5 feet of the top of the slopes.

Once the trench excavations are complete, and prior to the placement of piping or bedding materials, all loose or disturbed soils in the bottom of the excavations should be removed so that undisturbed native soils are exposed throughout. Bedding and pipe embedment materials to be used around the pipes should conform to the pipe manufacturer's recommendations and should be placed and compacted in accordance with project specifications, local requirements or governing jurisdiction. General fill to be used above pipe embedment materials should be placed and compacted in accordance with the Site Grading section of this report or the plans and specifications. On-site soils may be used as general fill above pipe embedment materials provided they meet the backfill requirements outlined within the Site Grading Section of this report. Water jetting of trench backfill should not be allowed.

SITE GRADING

The following general guidelines should be included in the project construction specifications to provide a basis for quality control during site grading. It is recommended that all structural fill and backfill be placed and compacted under engineering observation and in accordance with the following:

1) The existing soils throughout the site should be overexcavated to such an extent as to provide for at least 3.0 feet of properly compacted structural fill beneath all footings and floor slabs, or to such an extent as to remove all existing man-made fill soils in their entirety, whichever is the greater depth of overexcavation. The overexcavation limits should extend laterally beyond the footing perimeters equal to the depth of fill beneath their bases. The soils exposed at the base of the overexcavation should be densified before placement of structural fill.

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- 2) Densification of the native soils should consist of scarifying to a depth of 8 inches, moisture conditioning to the optimum moisture content or above to as deep as practicable and compacting the area to a minimum of 95 percent of maximum dry density as determined in accordance with ASTM D-1557.
- 3) The results of this investigation indicate that most of the native soils will be suitable for use as structural fill, however, some blending and/or processing may be required. Import material may also be used as structural fill provided it meets the specifications presented below.
- 4) All structural fill and backfill should be free of vegetation and debris and contain no rocks larger than 3 inches. Gradation of the backfill material, as determined in accordance with ASTM D-422, should be as follows:

Size	Percent Passing			
3 inch	100			
No. 4	60 - 100			
No. 200	15 - 45			

- 5) The plasticity index of the structural fill should be no greater than 15 when tested in accordance with ASTM D-4318.
- 6) Native excavated soils may be used as general trench backfill.
- 7) Fill or backfill, consisting of soil approved by the geotechnical engineer, shall be placed in 8 inch loose lifts and compacted with approved compaction equipment. Loose lifts should be reduced to 4 inches if hand held compaction equipment is used. All compaction of fill or backfill shall be accomplished to a minimum of 95 percent of the maximum dry density as determined in accordance with ASTM D-1557. The moisture content of the structural fill during compaction should be within 2 percent of the optimum moisture content.
- 8) Tests for degree of compaction should be determined by the ASTM D-1556 method or ASTM D-6938. Observation and field tests should be performed during fill and backfill placement by the geotechnical engineer to assist the contractor in obtaining the required degree of compaction. If less than 95 percent is indicated, additional compaction effort should be made with adjustment of the moisture content as necessary until 95 percent compaction is obtained.

MOISTURE PROTECTION

Precautions should be taken during and after construction to minimize moisture increase of foundation soils. Accumulations of excessive moisture could be harmful to some types of interior flooring, to HVAC ductwork beneath the slabs, and can weaken or cause other changes in the soils supporting the

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foundations and slabs. This can cause differential movement of the foundations and can result in cosmetic or structural damage to the structures.

Positive drainage should be established away from the exterior walls of the structures. A typical adequate slope is 6 inches in the first 5 feet with positive drainage being provided from those points to streets, pavement or natural water courses. If necessary, to provide positive drainage, the building areas should be raised above adjacent grades with structural fill.

Roof runoff from the structures should be collected by gutters and downspouts or roof canales and discharged to splash blocks which carry water rapidly away from the structure's foundation. Should lot size or other factors impede positive drainage away from the structure or undeveloped portions of the pad, to less than 5 feet from foundations or the pad perimeter, a non-perforated drain system should be installed to carry water to a minimum of five feet away from foundations or to streets or natural water courses.

Utility backfill should be well compacted and should meet the specifications outlined in the Site Grading section of this report. Special care should be taken during installation of the subfloor sewer and water lines to reduce the possibility of future subsurface saturation.

Irrigation within 10 feet of foundations is discouraged or at the very least should be carefully controlled. Proper landscaping and drainage maintenance are required to preclude accumulation of excessive moisture in the soils below the structure and throughout the site. This should include but is not limited to routine maintenance checks of the irrigation system to ensure no leakage and proper functionality and that irrigation is adjusted and maintained seasonally so that over watering does not occur. Native drought resistant plants are recommended for use in landscaping. Landscape features should not impede positive drainage away from foundations as recommended above.

Retention ponds or any other drainage/landscaping feature which allows for surface waters to infiltrate the subsurface soils should not be placed within 20 feet of building foundations.

The foregoing recommendations should only be considered minimum requirements for overall site development. It is recommended that a civil/drainage engineer be consulted for more detailed grading and drainage recommendations.

FOUNDATION REVIEW AND INSPECTION

This report has been prepared to aid in the evaluation of this site and to assist in the design of this project. It is recommended that the geotechnical engineer be provided the opportunity to review the final design drawings and specifications in order to determine whether the recommendations in this report are applicable to the final design. Review of the final design drawings and specifications should be noted in writing by the geotechnical engineer.

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In order to permit correlation between the conditions encountered during construction and to confirm recommendations presented herein, it is recommended that the geotechnical engineer be retained to perform continuous observations and testing during the foundation construction and earthwork portions of this project. Observation and testing should be performed during construction to confirm that suitable fill soils are placed upon competent materials and properly compacted and foundation elements penetrate the recommended materials.

CLOSURE

Our conclusions, recommendations and opinions presented herein are:

- 1) Based upon our evaluation and interpretation of the findings of the field and laboratory program.
- 2) Based upon an interpolation of soil conditions between and beyond the explorations.
- 3) Subject to confirmation of the conditions encountered during construction.
- 4) Based upon the assumption that sufficient observation will be provided during construction.
- 5) Prepared in accordance with generally accepted professional geotechnical engineering principles and practice.

This report has been prepared for the sole use of Molzen Corbin & Associates, specifically to aid in the design of the proposed Cañoncito-Eldorado Waterline in Santa Fe County, NM and not for use by any third parties without consent.

We make no other warranty, either expressed or implied. Any person using this report for bidding or construction purposes should perform such independent investigation as they deem necessary to satisfy themselves as to the surface and subsurface conditions to be encountered and the procedures to be used in the performance of work on this project. If conditions encountered during construction appear to be different than indicated by this report, this office should be notified.

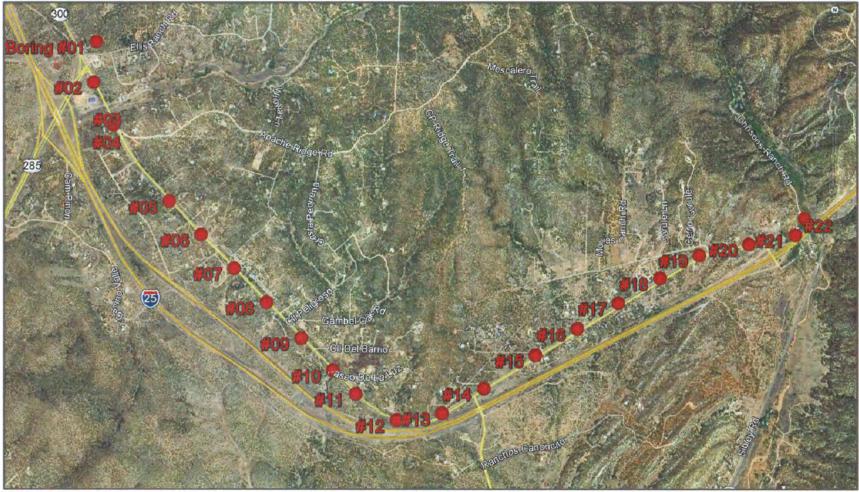
All soil samples will be discarded 60 days after the date of this report unless we receive a specific request to retain the samples for a longer period of time.

GEO-TEST, INC. 3204 RICHARDS LANE SANTA FE, NEW MEXICO 87507 (505) 471-1101 FAX (505) 471-2245

8528 CALLE ALAMEDA NE ALBUQUERQUE, NEW MEXICO 87113 (505) 857-0933 FAX (505) 857-0803

BORING LOCATION MAP

NOT TO SCALE





Cañoncito-Eldorado Waterline Santa Fe County, NM Job No. 1-30404

Figure 1 Old Las Vegas Highway





Cañoncito-Eldorado Waterline Project:

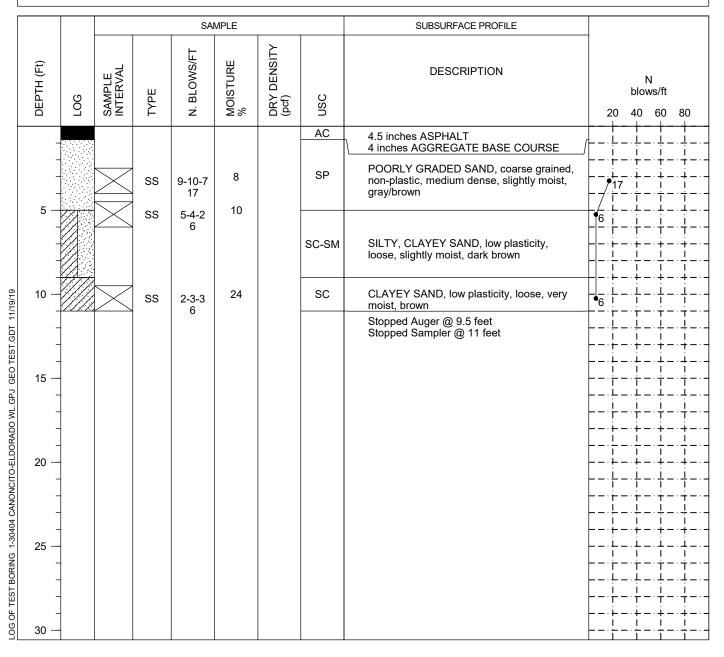
Date: 06/04/2013 Project No: 1-30404

Elevation: Type: 5" OD HSA

LOG OF TEST BORINGS

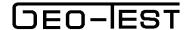
GROUNDWATER DEPTH

NO: 01 During Drilling: none After 24 Hours:



LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve AMSL - Above Mean Sea Level CS - Continuous Sampler **UD** - Undisturbed



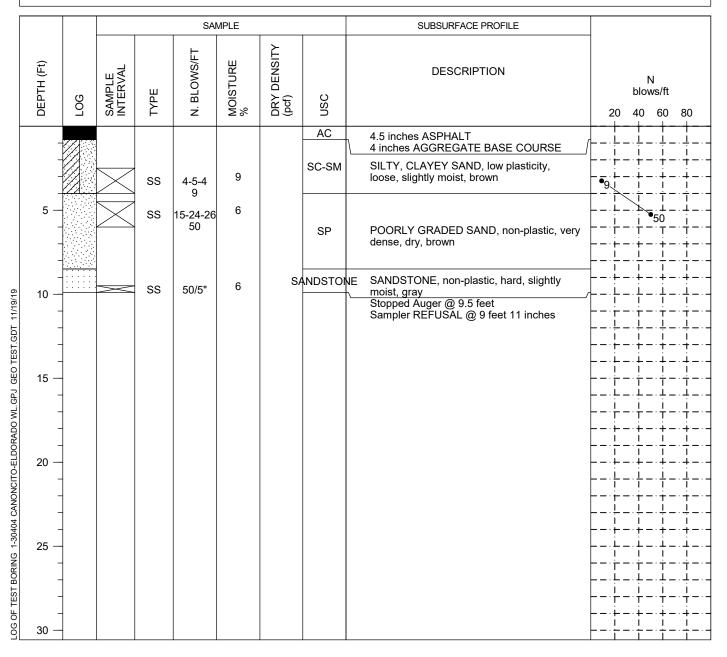
Date: 06/04/2013 Project No: 1-30404 Type: 5" OD HSA

Elevation:

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 02 During Drilling: none After 24 Hours:



LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve AMSL - Above Mean Sea Level CS - Continuous Sampler **UD** - Undisturbed



05/31/2013 Date: Project No: 1-30404 5" OD HSA

Elevation: Type:

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 03 During Drilling: none After 24 Hours:

					SAI	MPLE			SUBSURFACE PROFILE	
	DEPTH (Ft)	907	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	nsc	DESCRIPTION	N blows/ft 20 40 60 80
	-							AC	8 inches ASPHALT 18 inches AGGREGATE BASE COURSE	
	- 5 — - -			SS SS	7-6-8 14 4-4-3 7	9		SC	CLAYEY SAND, low plasticity, medium dense to loose, slightly moist, dark brown	14 + - + - +
/19/19	10 —			SS	14-17-17 34	7		GW-GM	WELL GRADED GRAVEL with SILT and SAND, non-plastic, dense, slightly moist, gray	
WL.GPJ GEO TEST.GDT 11	- - 15 — -				31				Stopped Auger @ 9.5 feet Stopped Sampler @ 11 feet	
CANONCITO-ELDORADO	20 —									
LOG OF TEST BORING 1-30404 CANONCITO-ELDORADO WL.GPJ GEO TEST.GDT 11/19/19	25 — - - - - 30 —									

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve AMSL - Above Mean Sea Level CS - Continuous Sampler **UD** - Undisturbed



05/31/2013 Date: Project No: 1-30404

Elevation: Type: 5" OD HSA

LOG OF TEST BORINGS

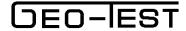
GROUNDWATER DEPTH

NO: 04 During Drilling: none After 24 Hours:

					SAI	MPLE			SUBSURFACE PROFILE	
, i i i	DEPTH (Ft)	907	SAMPLE INTERVAL	ТҮРЕ	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	nsc	DESCRIPTION	N blows/ft 20 40 60 80
	-							AC	8 inches ASPHALT 18 inches AGGREGATE BASE COURSE	
	5 —			SS SS	12-28-18 46 11-17-18 35	,		SC	CLAYEY SAND with GRAVEL, low plasticity, dense, slightly moist to dry, brown/green/gray	35 - - - - - - - - -
/19/19	10 —			SS	3-7-17 24	14		CL	SANDY CLAY, medium plasticity, firm, slightly moist, dark brown	
WL.GPJ GEO TEST.GDT 11.	- - - 15 — -				24				Stopped Auger @ 9.5 feet Stopped Sampler @ 11 feet	
CANONCITO-ELDORADC	- 20 — - -									
S OF TEST BORING	25 — - - - - - 30 —									

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve AMSL - Above Mean Sea Level CS - Continuous Sampler **UD** - Undisturbed



05/31/2013 Date: Project No: 1-30404

Elevation: Type: 5" OD HSA

LOG OF TEST BORINGS

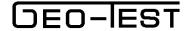
GROUNDWATER DEPTH

NO: 05 During Drilling: none After 24 Hours:

					SAI	MPLE			SUBSURFACE PROFILE	
	DEPTH (Ft)	907	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	nsc	DESCRIPTION	N blows/ft 20 40 60 80
	-							AC	8 inches ASPHALT 18 inches AGGREGATE BASE COURSE	
	_			SS	5-21-34 55	4		SC	CLAYEY SAND with GRAVEL, low plasticity, very dense, dry, dark brown	55
	5 —			SS	23-25-20 45	4		GW-GM	WELL GRADED GRAVEL with SILT and SAND, non-plastic, dense, dry, pink/gray	45
/19/19	10 —			SS	3-2-3 5	8		SM	SILTY SAND with GRAVEL, non-plastic, loose, slightly moist, dark brown	•5 · · · · · · · · · · · · · · · · · · ·
OG OF TEST BORING 1-30404 CANONCITO-ELDORADO WL.GPJ GEO TEST.GDT 11/19/19	15 —				5				Stopped Auger @ 9.5 feet Stopped Sampler @ 11 feet	
0907	30 —									

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve AMSL - Above Mean Sea Level CS - Continuous Sampler **UD** - Undisturbed



05/31/2013 Date: Project No: 1-30404

Elevation: Type: 5" OD HSA

LOG OF TEST BORINGS

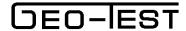
GROUNDWATER DEPTH

NO: 06 During Drilling: none After 24 Hours:

					SAI	MPLE			SUBSURFACE PROFILE		
	DEPTH (Ft)	POOT	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	nsc	DESCRIPTION	N blows/ft 20 40 60	80
Ī	_							AC	8 inches ASPHALT 2 inches AGGREGATE BASE COURSE		
	- - 5 —			AC SS	50/3" 50/5"	2		GW-GM	WELL GRADED GRAVEL with SILT and SAND, non-plastic, very dense, dry, pink/gray		+ - · - + - · - + - · -
	-			AC		2	SA	NDSTO	IE SANDSTONE, non-plastic, hard, dry, red		+ - · -
GDT 11/19/19	- 10 — -								Auger REFUSAL @ 8 feet Stopped Sampler @ 5.5 feet		+ - · - + - · - + - · - + - · -
WL.GPJ GEO TEST.	- 15 — -										+ - · - · - · - · · · · · · · · · · · ·
IONCITO-ELDORADO	20 —										+ - · - · - + - · - · - + - · -
LOG OF TEST BORING 1-30404 CANONCITO-ELDORADO WL.GPJ GEO TEST.GDT 11/19/19	25 — - - - - - 30 —										

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve AMSL - Above Mean Sea Level CS - Continuous Sampler **UD** - Undisturbed



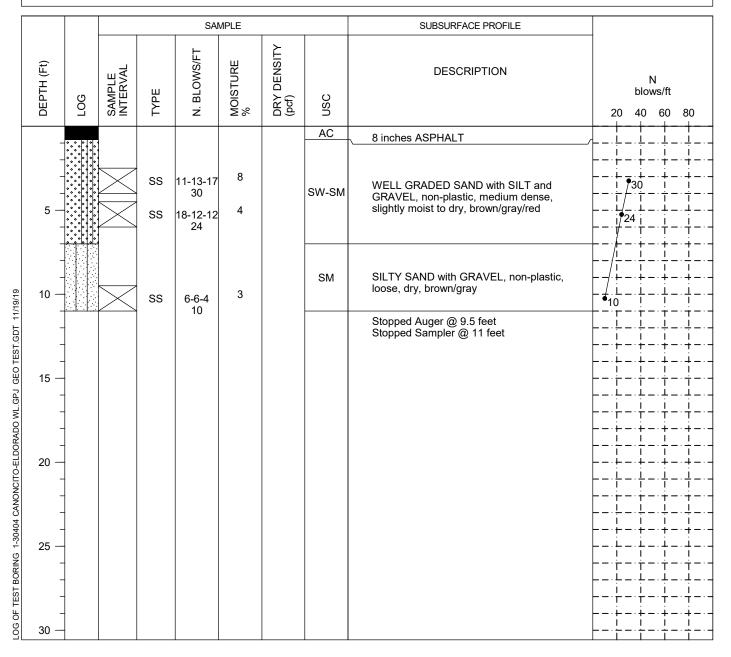
Date: 05/31/2013 Project No: 1-30404

Elevation: Type: 5" OD HSA

LOG OF TEST BORINGS

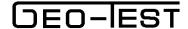
GROUNDWATER DEPTH

NO: 07 During Drilling: none After 24 Hours:



LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve AMSL - Above Mean Sea Level CS - Continuous Sampler **UD** - Undisturbed

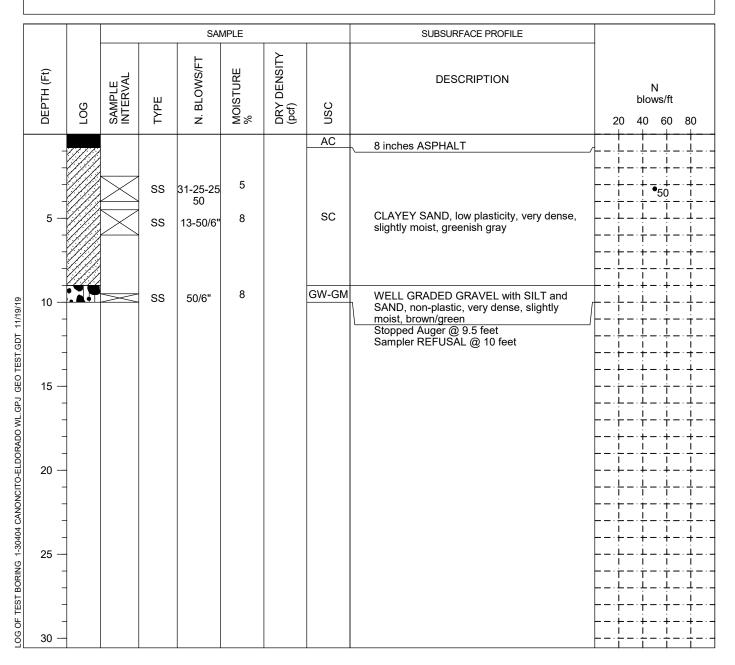


Date: 05/31/2013 Project No: 1-30404 Elevation: Type: 5" OD HSA

LOG OF TEST BORINGS

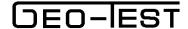
GROUNDWATER DEPTH

NO: 08 During Drilling: none After 24 Hours:



LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve AMSL - Above Mean Sea Level CS - Continuous Sampler **UD** - Undisturbed



Cañoncito-Eldorado Waterline Project:

Date: 06/03/2013 Project No: 1-30404

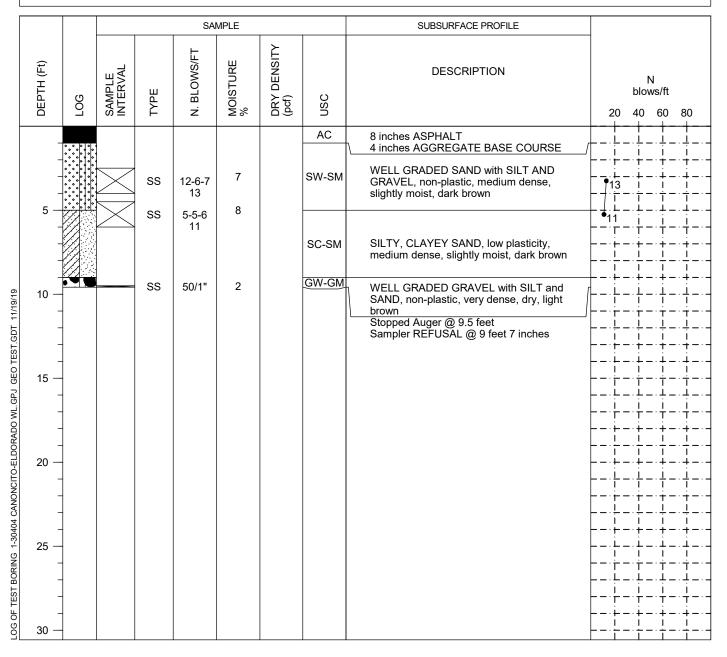
Elevation:

Type: 5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 09 During Drilling: none After 24 Hours:



LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve AMSL - Above Mean Sea Level CS - Continuous Sampler **UD** - Undisturbed



06/03/2013 Date: Project No: 1-30404 5" OD HSA

Elevation: Type:

LOG OF TEST BORINGS

GROUNDWATER DEPTH

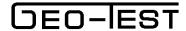
NO: 10 During Drilling: none After 24 Hours:

					SAI	MPLE			SUBSURFACE PROFILE	
	DEPTH (Ft)	P00	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pdf)	usc	DESCRIPTION	N blows/ft 20 40 60 80
Ī	_							AC	6 inches ASPHALT 4 inches AGGREGATE BASE COURSE	f
	5 —			SS	10-9-8 17 5-7-7 14	3		GW-GM	WELL GRADED GRAVEL with SILT and SAND, non-plastic, medium dense, dry, reddish brown	17
1/19/19	10 —			SS	7-8-10 18	2				18 ! ! !
WL.GPJ GEO TEST.GDT 17	- - 15 — -								Stopped Auger @ 9.5 feet Stopped Sampler @ 11 feet	
ANONCITO-ELDORADC	20 —									
LOG OF TEST BORING 1-30404 CANONCITO-ELDORADO WL.GPJ GEO TEST.GDT 11/19/19	25 — - - - - 30 —									

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve AMSL - Above Mean Sea Level CS - Continuous Sampler

UD - Undisturbed



Cañoncito-Eldorado Waterline Project:

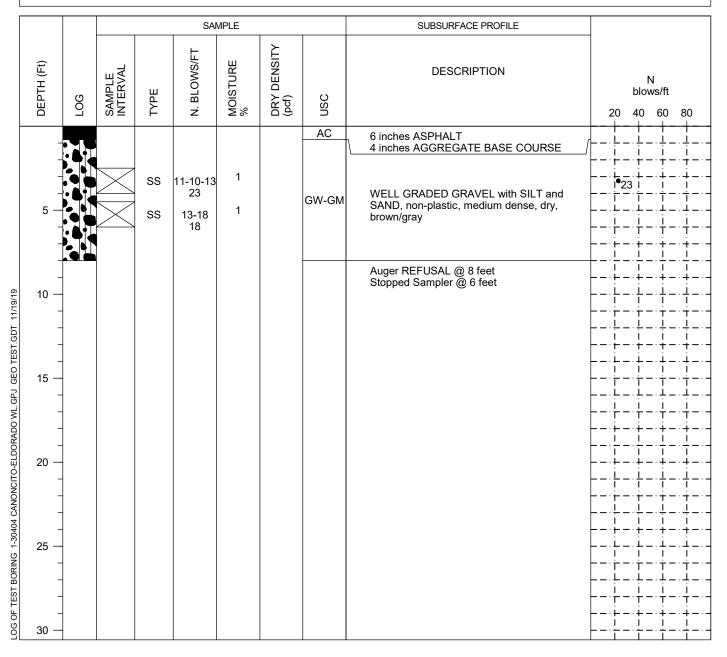
Date: 06/03/2013 Project No: 1-30404

Elevation: Type: 5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 11 During Drilling: none After 24 Hours:



LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve AMSL - Above Mean Sea Level CS - Continuous Sampler **UD** - Undisturbed

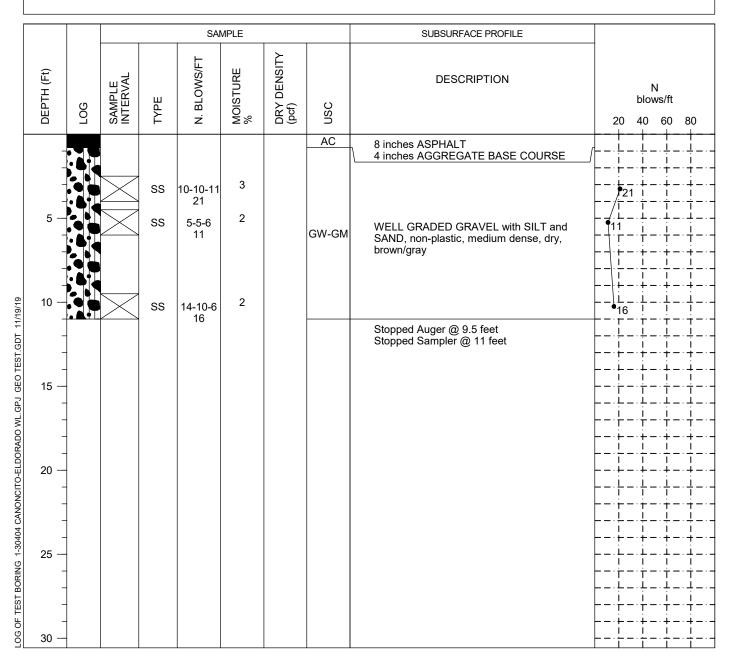


Date: 06/03/2013 Project No: 1-30404 Elevation: Type: 5" OD HSA

LOG OF TEST BORINGS

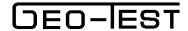
GROUNDWATER DEPTH

NO: 12 During Drilling: none After 24 Hours:



LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve AMSL - Above Mean Sea Level CS - Continuous Sampler **UD** - Undisturbed



Cañoncito-Eldorado Waterline Project:

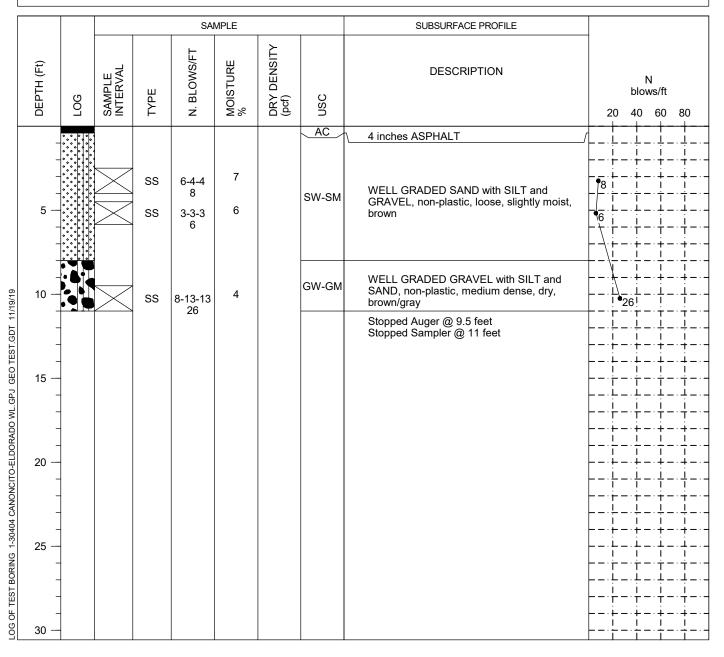
Date: 06/03/2013 Project No: 1-30404

Elevation: Type: 5" OD HSA

LOG OF TEST BORINGS

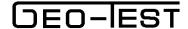
GROUNDWATER DEPTH

NO: 13 During Drilling: none After 24 Hours:



LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve AMSL - Above Mean Sea Level CS - Continuous Sampler **UD** - Undisturbed



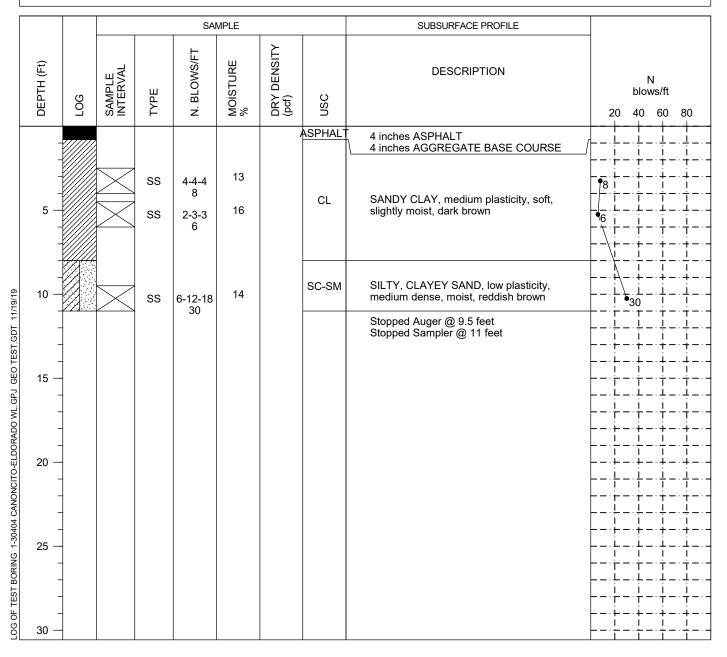
Date: 06/03/2013 Project No: 1-30404

Elevation: Type: 5" OD HSA

LOG OF TEST BORINGS

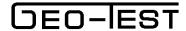
GROUNDWATER DEPTH

NO: 14 During Drilling: none After 24 Hours:



LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve AMSL - Above Mean Sea Level CS - Continuous Sampler **UD** - Undisturbed



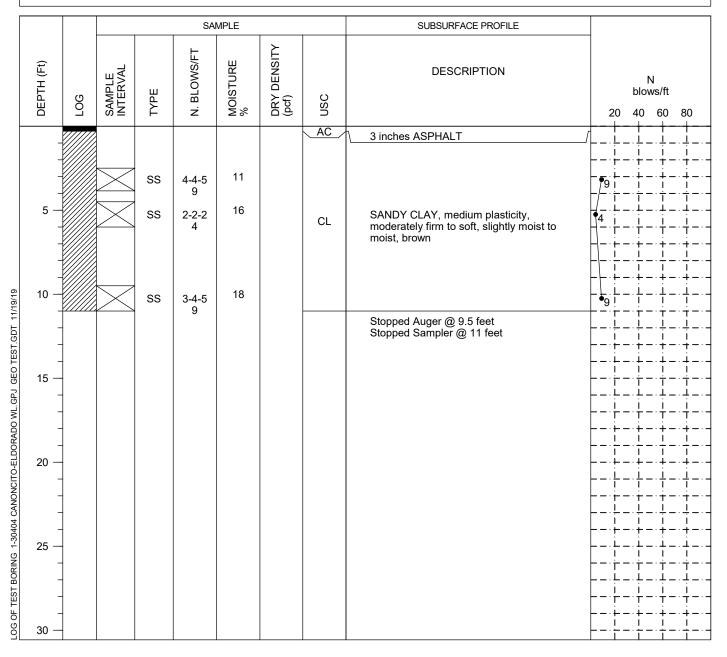
06/03/2013 Date: Project No: 1-30404 5" OD HSA

Elevation: Type:

LOG OF TEST BORINGS

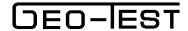
GROUNDWATER DEPTH

NO: 15 During Drilling: none After 24 Hours:



LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve AMSL - Above Mean Sea Level CS - Continuous Sampler **UD** - Undisturbed



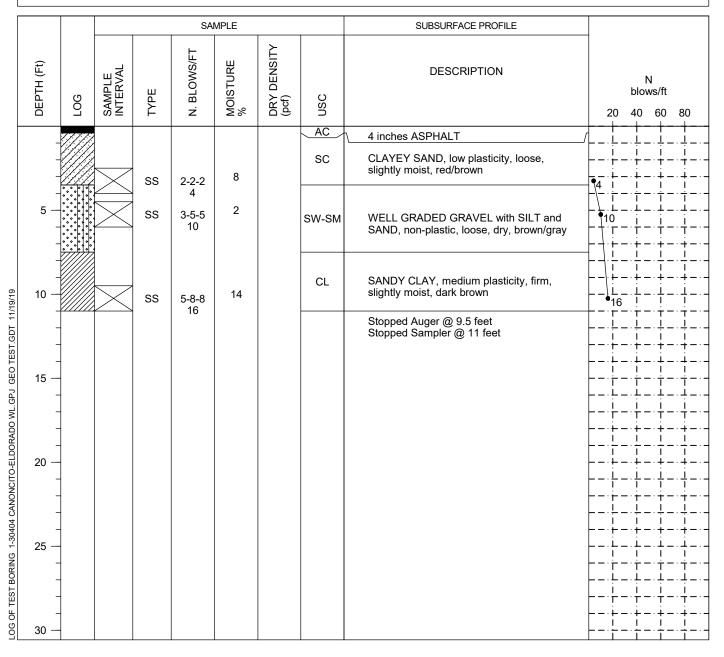
Date: 06/03/2013 Project No: 1-30404

Elevation: Type: 5" OD HSA

LOG OF TEST BORINGS

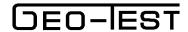
GROUNDWATER DEPTH

NO: 16 During Drilling: none After 24 Hours:



LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve AMSL - Above Mean Sea Level CS - Continuous Sampler **UD** - Undisturbed



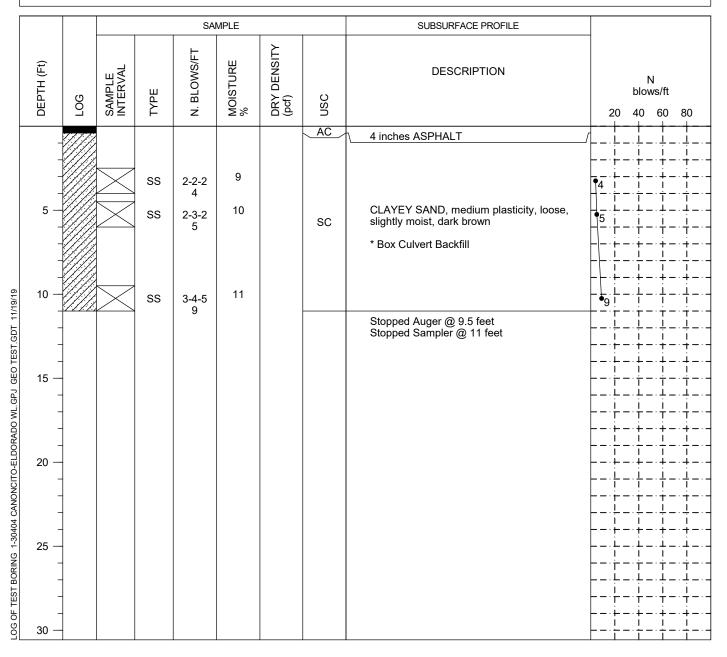
Date: 06/04/2013 Project No: 1-30404

Elevation: Type: 5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 17 During Drilling: none After 24 Hours:



LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve AMSL - Above Mean Sea Level
CS - Continuous Sampler

UD - Undisturbed

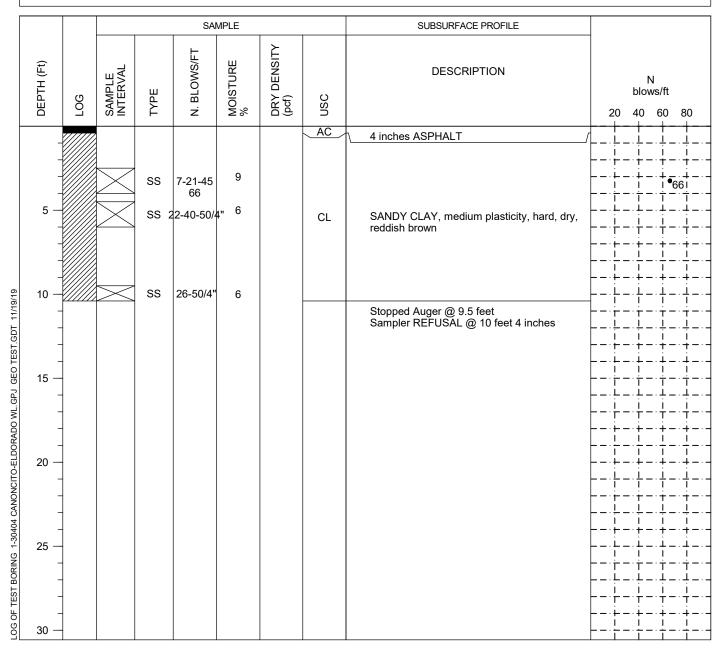


Date: 06/04/2013 Project No: 1-30404 Elevation: Type: 5" OD HSA

LOG OF TEST BORINGS

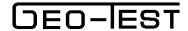
GROUNDWATER DEPTH

NO: 18 During Drilling: none After 24 Hours:



LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve AMSL - Above Mean Sea Level CS - Continuous Sampler **UD** - Undisturbed



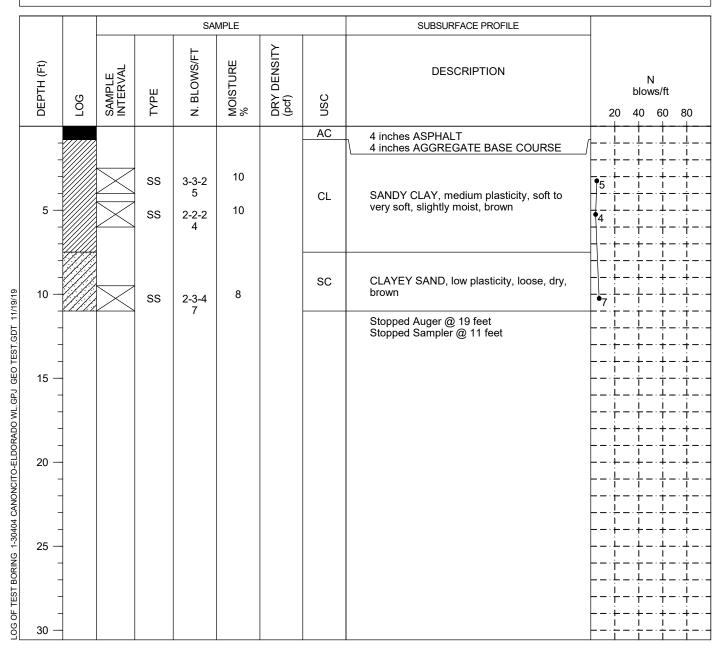
Date: 06/04/2013 Project No: 1-30404 5" OD HSA

Elevation: Type:

LOG OF TEST BORINGS

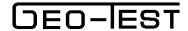
GROUNDWATER DEPTH

NO: 19 During Drilling: none After 24 Hours:



LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve AMSL - Above Mean Sea Level CS - Continuous Sampler **UD** - Undisturbed



Cañoncito-Eldorado Waterline Project:

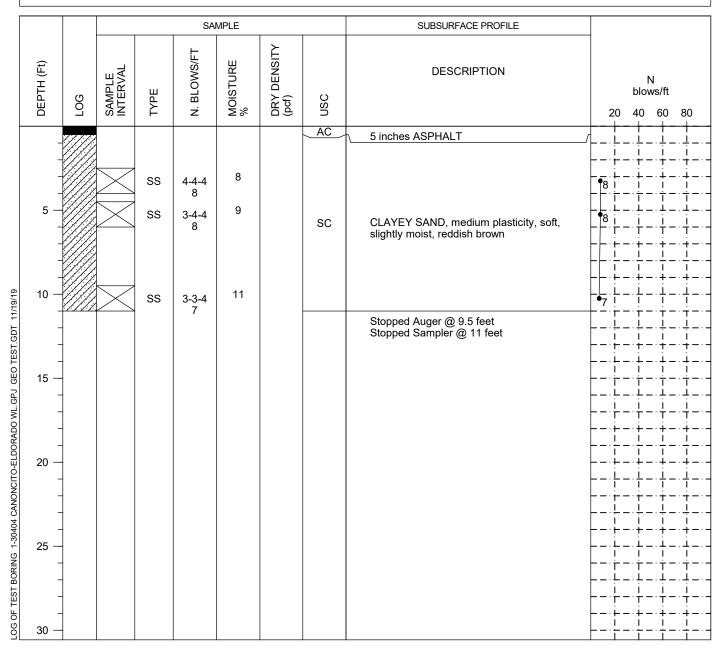
06/04/2013 Date: Project No: 1-30404

Elevation: Type: 5" OD HSA

LOG OF TEST BORINGS

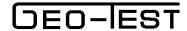
GROUNDWATER DEPTH

NO: 20 During Drilling: none After 24 Hours:



LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve AMSL - Above Mean Sea Level CS - Continuous Sampler **UD** - Undisturbed



Cañoncito-Eldorado Waterline Project:

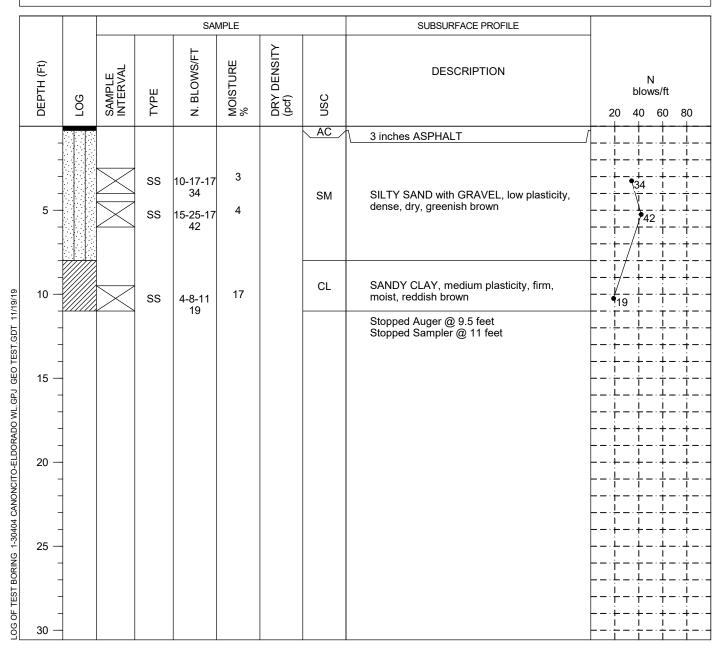
Date: 06/04/2013 Project No: 1-30404 5" OD HSA

Elevation: Type:

LOG OF TEST BORINGS

GROUNDWATER DEPTH

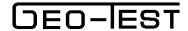
NO: 21 During Drilling: none After 24 Hours:



LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve AMSL - Above Mean Sea Level CS - Continuous Sampler

UD - Undisturbed



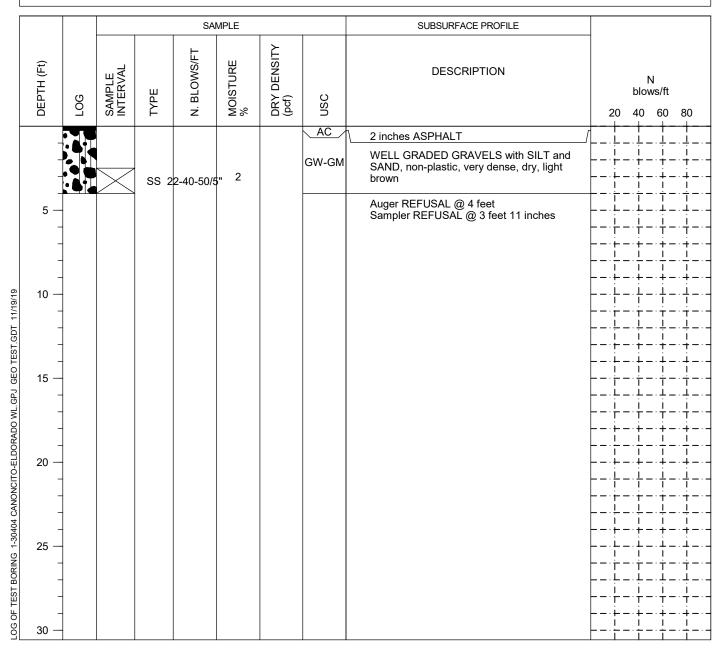
Date: 06/04/2013 Project No: 1-30404

Elevation: Type: 5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

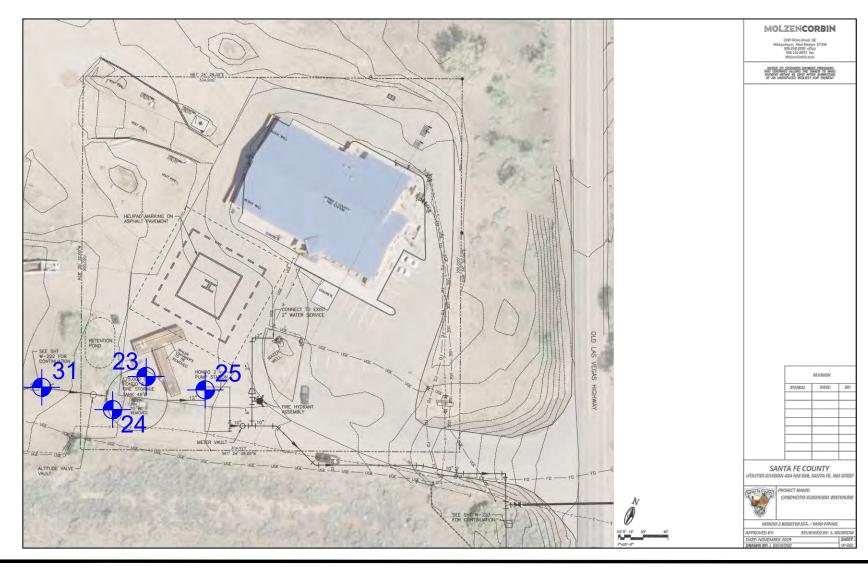
NO: 22 During Drilling: none After 24 Hours:



LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve AMSL - Above Mean Sea Level CS - Continuous Sampler **UD** - Undisturbed

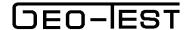
BORING LOCATION MAP



Canoncito-Eldorado Waterline Santa Fe County, New Mexico Job No. 1-30404

Figure 2 Hondo 2 Fire Station





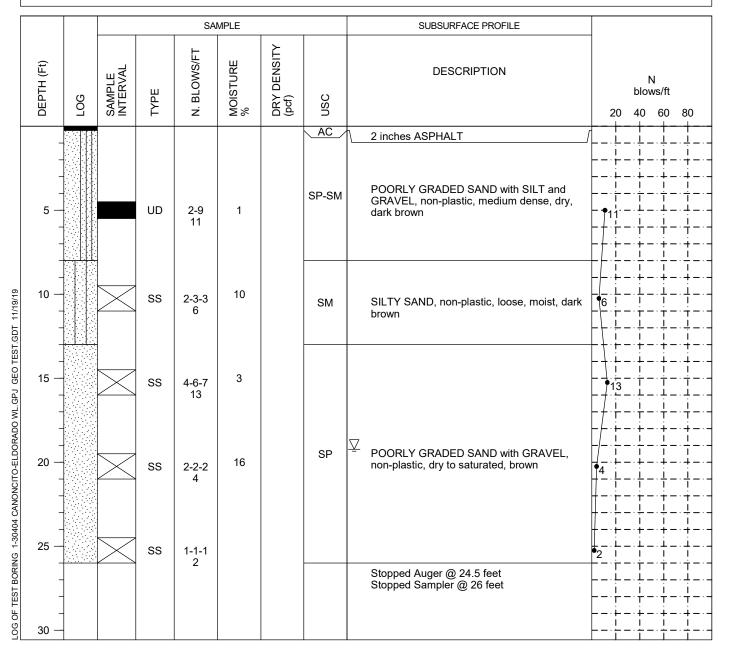
Date: 06/12/2014 Project No: 1-30404

Elevation: Type: 5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

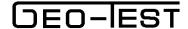
NO: 23 During Drilling: 19.0 After 24 Hours:



LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve AMSL - Above Mean Sea Level CS - Continuous Sampler

UD - Undisturbed



Date: 06/12/2014 Project No: 1-30404

Elevation: Type: 5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 24 During Drilling: 24.0 After 24 Hours:

					SAI	MPLE			SUBSURFACE PROFILE	
	DEPTH (Ft)	907	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	nsc	DESCRIPTION	N blows/ft 20 40 60 80
L.GPJ GEO TEST.GDT 11/19/19	5 —			SS SS SS	2-3-2 5 2-3-4 7 3-5-5 10	4 4 5		SM	SILTY SAND with GRAVEL, non-plastic, loose to medium dense, dry, dark brown	5 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
LOG OF TEST BORING 1-30404 CANONCITO-ELDORADO WL.GPJ GEO TEST.GDT 11/19/19	20 —			SS	12-15-26 41 11-18-30	3 15		SP	POORLY GRADED SAND with GRAVEL, non-plastic, dense, dry to saturated, dark brown ☑	141 i i i i i i i i i i i i i i i i i i
LOG OF TEST BORING 1-	30 —	<u> 1, 12, 12, 12</u> - - -			11-18-30 48	15			Stopped Auger @ 24.5 feet Stopped Sampler @ 26 feet	140

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve AMSL - Above Mean Sea Level CS - Continuous Sampler

UD - Undisturbed



06/12/2014 Date: Project No: 1-30404

Elevation: Type: 5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

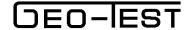
NO: 25 During Drilling: 24.0 After 24 Hours:

					MPLE			SUBSURFACE PROFILE				
DEPTH (Ft)	106	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION	20	N blow 40	vs/ft	80
-					4		FILL	FINE GRAINED SAND, non-plastic, moist, black		- · <u> </u> -		· ‡ - · -
_			SS	3-4-5 9	4		SP-SM	POORLY GRADED SAND with SILT and	9	- · -	- - -	
5 — - -			SS	3-5-5 10	3		SW	WELL GRADED SAND, non-plastic, loose, dry, brown	10	- · - - · -	· · -	· ‡ - · - · ‡ - · -
10 —	31 8	SPT	3-4-4 8	7		SM	SILTY SAND, non-plastic, loose to medium	8!	- · - · · · · · · · · · · · · · · · · · ·	··+-		
- 15 — -		4			dense, slightly moist to dry, brown	- 1 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -	- · ‡ - - · ‡ - - · ‡ -	·· ‡ – ·· ‡ – ·· ‡ –	· + - · - · + - · - · + - · -			
20 —			SS	10-12-14 26	18		SP	POORLY GRADED SAND with GRAVEL, non-plastic, medium dense to dense, saturated, dark brown		26	··+- ··+- ··+- ··+-	· + - · - · + - · - · + - · - · + - · -
25 —		SS 15-23-26 14			∑		- +	49	·			
- - 30 -				49				Stopped Auger @ 24.5 feet Stopped Sampler @ 26 feet		- · - - · -	·· ‡ =	
	5 —	10 —	10 - 20 - 25 -	ss	SS 3-4-5 9 SS 3-5-5 10 10 SPT 3-4-4 8 20 SS 10-12-14 26 25 SS 15-23-26 49	SS 3-4-5 4 9 SS 3-5-5 3 10 10 SPT 3-4-4 7 8 20 SS 10-12-14 18 26 SS 15-23-26 14 49	SS 3-4-5 4 9 SS 3-5-5 3 10 SPT 3-4-4 7 8 SS 4-5-6 4 11 SS 10-12-14 18 26 SS 15-23-26 14 49 SS 15-23-26 14	SS 3-4-5 4 SP-SM SS 3-5-5 3 SW 10 SPT 3-4-4 7 SM SS 4-5-6 4 SP-SM SS 10-12-14 18 SP-SM SS 15-23-26 14 49	SS 3.4-5 4 9 POORLY GRADED SAND with SILT and GRAVEL, non-plastic, loose, dry, brown SP-SM POORLY GRADED SAND with SILT and GRAVEL, non-plastic, loose, dry, brown WELL GRADED SAND, non-plastic, loose, dry, brown SM SILTY SAND, non-plastic, loose to medium dense, slightly moist to dry, brown SS 4-5-6 4 11 SP POORLY GRADED SAND with GRAVEL, non-plastic, medium dense to dense, saturated, dark brown SP POORLY GRADED SAND with GRAVEL, non-plastic, medium dense to dense, saturated, dark brown SP Stopped Auger @ 24.5 feet Stopped Sampler @ 26 feet	SS 3-4-5 4 SP-SM POORLY GRADED SAND, non-plastic, moist, black SP-SM POORLY GRADED SAND, non-plastic, loose, dry, brown SW SILTY SAND, non-plastic, loose to medium dense, slightly moist to dry, brown SR SS 4-5-6 4 SP-SM SILTY SAND, non-plastic, loose to medium dense, slightly moist to dry, brown SR SILTY SAND, non-plastic, loose to medium dense, slightly moist to dry, brown SR SR SR SR SR SR SR S	SS 3-4-5 4	SS 3-4-5 4 FILL FINE GRAINED SAND, non-plastic, moist, black SP-SM POORLY GRADED SAND with SILT and GRAVEL, non-plastic, loose, dry, brown SW WELL GRADED SAND, non-plastic, loose, dry, brown SW SILTY SAND, non-plastic, loose to medium dense, slightly moist to dry, brown SM SILTY SAND, non-plastic, loose to medium dense, slightly moist to dry, brown ST ST ST ST ST ST ST S

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve AMSL - Above Mean Sea Level CS - Continuous Sampler **UD** - Undisturbed





11/01/2019 Date:

Project No: 1-30404

Elevation: Type: 5.5" OD HSA

LOG OF TEST BORINGS

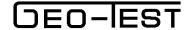
GROUNDWATER DEPTH

NO: 26 During Drilling: none After 24 Hours:

					SAI	MPLE			SUBSURFACE PROFILE	
	DEPTH (Ft)	907	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pdf)	usc	DESCRIPTION	N blows/ft 20 40 60 80
	- - - 5 —			SS SS SS	12-15-13 28 9-5-3 8 7-4-25 29	7 4 6		SC-SM	SILTY, CLAYEY SAND, low plasticity, medium dense to loose, slightly moist to dry, dark brown/black	
3DT 11/19/19	- - 10 — -								Auger REFUSAL @ 6.5 feet Stopped Sampler @ 5.5	
DO WL.GPJ GEO TEST.G	- 15 — - -									
4 CANONCITO-ELDORAI	20 — - - -									
LOG OF TEST BORING 1-30404 CANONCITO-ELDORADO WL.GPJ GEO TEST.GDT 11/19/19	25 — - - - - 30 —									

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve AMSL - Above Mean Sea Level CS - Continuous Sampler **UD** - Undisturbed



11/01/2019 Date: Project No: 1-30404

Elevation: Type: 5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 27 During Drilling: none After 24 Hours:

					SAI	MPLE			SUBSURFACE PROFILE	
	DEPTH (Ft)	907	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pdf)	nsc	DESCRIPTION	N blows/ft 20 40 60 80
	- - - 5 —			SS SS SS	7-4-9 13 8-8-8 16 4-5-6 11	4 4 3		SM	SILTY SAND with GRAVEL, non-plastic, medium dense, dry, dark brown/black	- 13 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1
	- -	<i>7777</i> 7						SP	POORLY GRADED SAND with SILT, non-plastic, slightly moist, brown/gray	
19/19	10 —			SS	3-6-8 14			sc	CLAYEY SAND, low plasticity, medium dense, slightly moist, dark brown/black	
TEST.GDT 11/1	- - -								Stopped Auger @ 9 feet Stopped Sampler @ 10.5 feet	
O WL.GPJ GEC	15 — - -	_								
INCITO-ELDORADO	20 —									
LOG OF TEST BORING 1-30404 CANONCITO-ELDORADO WL.GPJ GEO TEST.GDT 11/19/19	- 25 — -									
LOG OF TEST B	30 —	-								

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve AMSL - Above Mean Sea Level CS - Continuous Sampler **UD** - Undisturbed



11/01/2019 Date: Project No: 1-30404

Elevation: Type: 5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 28 During Drilling: none After 24 Hours:

					SAM	MPLE			SUBSURFACE PROFILE	
	DEPTH (Ft)	907	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pdf)	usc	DESCRIPTION	N blows/ft 20 40 60 80
	-			SS	11-12-15 27	2				27!!
	-	-	\geq	SS	9-14-12 26	3		SM	SILTY SAND with GRAVEL, non-plastic, medium dense, dry, dark brown/black	26
	5 —		\times	SS	11-9-10 19	2				19
	-									
9/19	10 —			SS	5-2-3 5	9		CL-ML	SANDY, SILTY CLAY, low plasticity, soft, slightly moist, brown/gray	5· · · · · · · · · · · · · · · · · · ·
3DT 11/1	-									
LOG OF TEST BORING 1-30404 CANONCITO-ELDORADO WL.GPJ GEO TEST.GDT 11/19/19	-			SS	4-5-6			sc	CLAYEY SAND, medium plasticity, moderately firm, slightly moist, dark brown/black	
L.GPJ GE	15 — -	<i>[]]]]]</i>		55	11	9			Stopped Auger @ 14 feet Stopped Sampler @ 15.5 feet	<u> 11 + + +</u>
RADO W	- -								Copper Campion & Total Soci	
TO-ELDO	20 —									
CANONCI	_									
1-30404 (- 25 —									
SORING	-									
F TEST E	-									
0000	30 —									

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve AMSL - Above Mean Sea Level CS - Continuous Sampler **UD** - Undisturbed



11/01/2019 Date:

Project No: 1-30404

5.5" OD HSA

Elevation: Type:

LOG OF TEST BORINGS

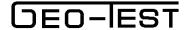
GROUNDWATER DEPTH

NO: 29 During Drilling: none After 24 Hours:

ſ					SAM	MPLE			SUBSURFACE PROFILE	
	DEPTH (Ft)	P00	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pdf)	USC	DESCRIPTION	N blows/ft 20 40 60 80
	-			SS	18-23-26 49	6		SM	SILTY SAND with GRAVEL, non-plastic, dense, slightly moist, brown	
	-		\times	SS	14-18-25 43	2				43 + - +
	5 — -			SS AC	21-24-14 38	2		GP-GC	POORLY GRADED GRAVEL with SILTY CLAY and SAND, low plasticity, dense, dry, gray	38 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
r.GDT 11/19/19	- - 10 — - -			SS	6-6-4 10	4		SM	SILTY SAND, non-plastic, loose, dry, brown	- ½ - ½ - ½ - ½ - ½ - ½ - ½ - ½ - ½ - ½
O WL.GPJ GEO TES	- 15 — - -			SS	18-50/6"	4		GW-GM	WELL GRADED GRAVEL with SILT and SAND, non-plastic, very dense, dry, brown with pink gravel Stopped Auger @ 14 feet Sampler REFUSAL @ 15 feet	
ANONCITO-ELDORAD	20 — 									
LOG OF TEST BORING 1-30404 CANONCITO-ELDORADO WL.GPJ GEO TEST.GDT 11/19/19	25 — 									

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve AMSL - Above Mean Sea Level CS - Continuous Sampler **UD** - Undisturbed



11/01/2019 Date: Project No: 1-30404

Elevation: Type: 5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 30 During Drilling: none After 24 Hours:

					SAI	MPLE			SUBSURFACE PROFILE	
	DЕРТН (Ft)	907	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	usc	DESCRIPTION	N blows/ft 20 40 60 80
	- -			SS SS	11-12-13 25 8-8-8 16	2		SM	SILTY SAND, non-plastic, medium dense, dry, dark brown/black	
	5 — - -			SS	6-7-7 14	1		SW-SM WELL GRADED SAND with SILT,		14 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -
DT 11/19/19	10 — - -			SS	10-7-8 15	1		SW-SM	non-plastic, medium dense, dry, light brown/gray	
GEO TEST.G	- 15 —			SS	10-10-9 19			SC	CLAYEY SAND, medium plasticity, medium dense, dry, brown	19.
ACITO-ELDORADO WL.GP.	20 —								Stopped Auger @ 14 feet Stopped Sampler @ 15.5 feet	
LOG OF TEST BORING 1-30404 CANONCITO-ELDORADO WL.GPJ GEO TEST.GDT 11/19/19	25 —									
LOG OF TEST	30 —									

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve AMSL - Above Mean Sea Level CS - Continuous Sampler **UD** - Undisturbed



11/01/2019 Date: Project No: 1-30404

Elevation: Type: 5.5" OD HSA

LOG OF TEST BORINGS

GROUNDWATER DEPTH

NO: 31 During Drilling: none After 24 Hours:

					SAI	MPLE			SUBSURFACE PROFILE	
	DEPTH (Ft)	907	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pdf)	nsc	DESCRIPTION	N blows/ft 20 40 60 80
	- - - 5 —			SS SS	4-3-3 6 3-4-6 10	4		SM	SILTY SAND, non-plastic, loose, dry, dark brown/black	
/19/19	10 —			SS	3-3-7 10	2		SP-SM	POORLY GRADED SAND with SILT, non-plastic, loose, dry, brown	
WL.GPJ GEO TEST.GDT 11	- - 15 — -								Stopped Auger @ 9 feet Stopped Sampler @ 10.5 feet	
CANONCITO-ELDORADO V	20 —									
LOG OF TEST BORING 1-30404 CANONCITO-ELDORADO WL.GPJ GEO TEST.GDT 11/19/19	25 — - - -									
100 C	30 —									<u> </u>

LEGEND

SS - Split Spoon AC - Auger Cuttings UD/SL - Undisturbed Sleeve AMSL - Above Mean Sea Level CS - Continuous Sampler **UD** - Undisturbed

											SIE PER	EVE ANAI	LYSIS ASSING				
TEST HOLE	DEPTH (FEET)	UNIFIED CLASS	(%) MOIST	LL	PI	NO 200	NO 100	NO 40	NO 10	NO 4	3/8"	1/2"	3/4"	1"	1 1/2"	2"	4"
01	3.0		7.9														
01	5.0	SC-SM	10.3	23	7	39	48	63	83	93	99	100					
01	10.0		24.2														
02	3.0	SC-SM	9.4	22	6	37	48	62	86	95	98	100					
02	5.0		5.8														
02	9.5		6.0														
03	3.0		8.9														
03	5.0	SC	7.2	27	9	27	34	47	78	92	96	96	100				
03	10.0		6.8														
04	3.0		5.7														
04	5.0	SC	4.4	26	8	19	25	36	56	69	74	79	82	84	100		
04	10.0		13.5														
05	3.0		4.2														
03 04 04 04 05 05 06 06 06 07	5.0		4.0														
05	10.0		8.0														
06	3.0		1.7														
06	5.0		1.9														
06	7.5		2.1														
07	3.0		8.3														

DEO-IEST

LL = LIQUID LIMIT
PI = PLASTICITY INDEX
NP = NON PLASTIC or NO VALUE

Project: Cañoncito-Eldorado Waterline

Location: Santa Fe County, New Mexico

											SIE PER	EVE ANAI	LYSIS ASSING				
TEST HOLE	DEPTH (FEET)	UNIFIED CLASS	(%) MOIST	LL	PI	NO 200	NO 100	NO 40	NO 10	NO 4	3/8"	1/2"	3/4"	1"	1 1/2"	2"	4"
07	5.0	SW-SM	4.0	NP	NP	10	16	30	60	77	88	93	97	100			
07	10.0		2.9														
08	3.0		5.1														
08	5.0	SC	7.9	25	9	33	43	61	82	90	94	95	100				
08	9.5		7.6														
09	3.0		7.3														
09	5.0	SC-SM	8.0	22	5	26	34	50	80	91	95	96	100				
09	9.5		2.0														
10	3.0		3.3														
10	5.0		4.1														
10	10.0		2.3														
11	3.0		1.1														
11	5.0		0.7														
12	3.0		3.3														
10 10 10 11 11 11 12 12 12 13 13	5.0	GW-GM	2.3	NP	NP	7	10	18	35	47	61	65	85	91	100		
12	10.0		2.1														
13	3.0		6.8														
13	5.0		6.4														
13	10.0		3.5														
				·											· · · · · · · · · · · · · · · · · · ·		

DEO-IEST

LL = LIQUID LIMIT
PI = PLASTICITY INDEX
NP = NON PLASTIC or NO VALUE

Project: Cañoncito-Eldorado Waterline

Location: Santa Fe County, New Mexico

											SIE PER	EVE ANA CENT PA	LYSIS ASSING				
TEST HOLE	DEPTH (FEET)	UNIFIED CLASS	(%) MOIST	LL	PI	NO 200	NO 100	NO 40	NO 10	NO 4	3/8"	1/2"	3/4"	1"	1 1/2"	2"	4"
14	3.0		13.0														
14	5.0	CL	16.3	33	12	65	73	83	95	98	100						
14	10.0		14.4														
15	3.0		10.5														
15	5.0	CL	16.3	30	14	57	63	72	90	97	100						
15	10.0		18.1														
16	3.0		8.2														
16	5.0		1.7														
16	10.0		14.1														
17	3.0		8.9														
17	5.0	SC	10.2	31	15	41	49	61	80	89	100						
17	10.0		10.9														
18	3.0	CL	9.1	32	16	56	64	83	99	100							
18	5.0		5.7														
18	10.0		5.9														
19	3.0		9.6														
19	5.0		9.6														
16 17 17 17 18 18 18 19 19 19	10.0		8.1														
20	3.0	SC	8.1	33	15	40	47	62	89	94	95	97	100				

DEO-IEST

LL = LIQUID LIMIT
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Project: Cañoncito-Eldorado Waterline

Location: Santa Fe County, New Mexico

											SIE PER	EVE ANAI CENT PA	_YSIS \SSING				
TEST HOLE	DEPTH (FEET)	UNIFIED CLASS	(%) MOIST	LL	PI	NO 200	NO 100	NO 40	NO 10	NO 4	3/8"	1/2"	3/4"	1"	1 1/2"	2"	4"
20	5.0		9.1														
20	10.0		10.5														
21	3.0		3.4														
21	5.0	SM	3.6	22	2	15	22	37	62	75	82	88	88	88	100		
21	10.0		16.7														
22	3.0		1.8														
23	5.0	SP-SM	1.3	NP	NP	5	8	23	53	75	89	95	97	100			
23	10.0	SM	9.5	NP	NP	32	46	71	93	97	99	100					
23	15.0		2.8														
23	20.0		15.5														
24	3.0	SM	4.4	NP	NP	14	23	40	65	77	86	88	91	100			
24	5.0	SM	3.5	NP	NP	16	24	44	73	84	90	91	93	100			
24	10.0		4.7														
24	15.0		3.5														
23 23 24 24 24 24 24 24 25 25 25	20.0		2.5														
24	25.0		14.6														
25	3.0	SP-SM	4.3	NP	NP	12	19	38	63	69	77	81	84	89	100		
25	5.0	SW	2.5	NP	NP	4	7	28	78	88	95	97	100				
25	10.0	SM	7.0	NP	NP	35	48	66	86	94	97	97	100				

DEO-IEST

LL = LIQUID LIMIT
PI = PLASTICITY INDEX
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Project: Cañoncito-Eldorado Waterline

Location: Santa Fe County, New Mexico

											SIE	EVE ANA	LYSIS				
TEST HOLE	DEPTH (FEET)	UNIFIED CLASS	(%) MOIST	LL	PI	NO 200	NO 100	NO 40	NO 10	NO 4	3/8"	1/2"	3/4"	1"	1 1/2"	2"	4"
25	15.0		4.2	NP	NP												
25	20.0		18.1														
25	25.0		14.1														
26	1.0		6.8														
26	3.0		3.7														
26	5.0	SC-SM	6.3	26	6	31	50	65	84	92	97	100					
27	1.0	SM	4.4	27	4	14	22	34	62	77	90	97	100				
27	3.0		4.4														
27	5.0		2.5														
27	10.0	SC		34	16	43	59	70	85	91	95	95	100				
28	1.0		2.5														
28	3.0		3.0														
28	5.0		2.5														
28	10.0	CL-ML	9.5	29	7	51	66	74	90	97	100						
28	15.0		9.0														
29	1.0		6.2														
29	3.0		2.2														
27 27 28 28 28 28 28 28 29 29 29	5.0		1.5														
29	6.5	GP-GC	1.8	24	7	12	15	20	29	38	51	60	71	77	100		

DEO-IEST

LL = LIQUID LIMIT
PI = PLASTICITY INDEX
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Project: Cañoncito-Eldorado Waterline

Location: Santa Fe County, New Mexico

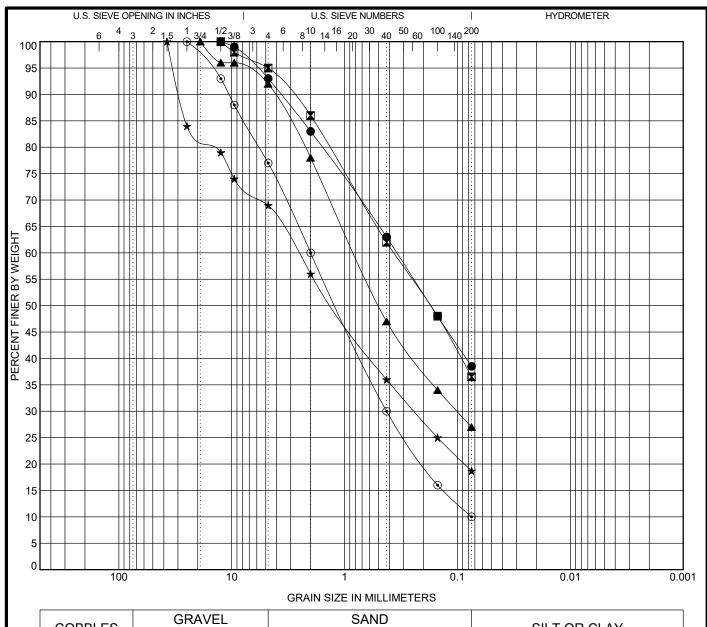
												EVE ANAI					
TEST HOLE	DEPTH (FEET)	UNIFIED CLASS	(%) MOIST	LL	PI	NO 200	NO 100	NO 40	NO 10	NO 4	3/8"	1/2"	3/4"	1"	1 1/2"	2"	4"
29	10.0		3.9														
29	15.0		4.1														
30	1.0		1.8														
30	3.0		1.3														
30	5.0	SW-SM	1.1	NP	NP	8	16	34	78	95	99	100					
30	10.0		1.4														
31	3.0	SM	3.7	23	1	23	40	60	83	92	98	100					
31	5.0		3.0														
31	10.0		1.7														

DEO-IEST

LL = LIQUID LIMIT
PI = PLASTICITY INDEX
NP = NON PLASTIC or NO VALUE

Project: Cañoncito-Eldorado Waterline

Location: Santa Fe County, New Mexico



CORRIES	GRA	VEL		SAND)	SULT OR CLAY
COBBLES	coarse	fine	coarse	medium	fine	SILT OR CLAT

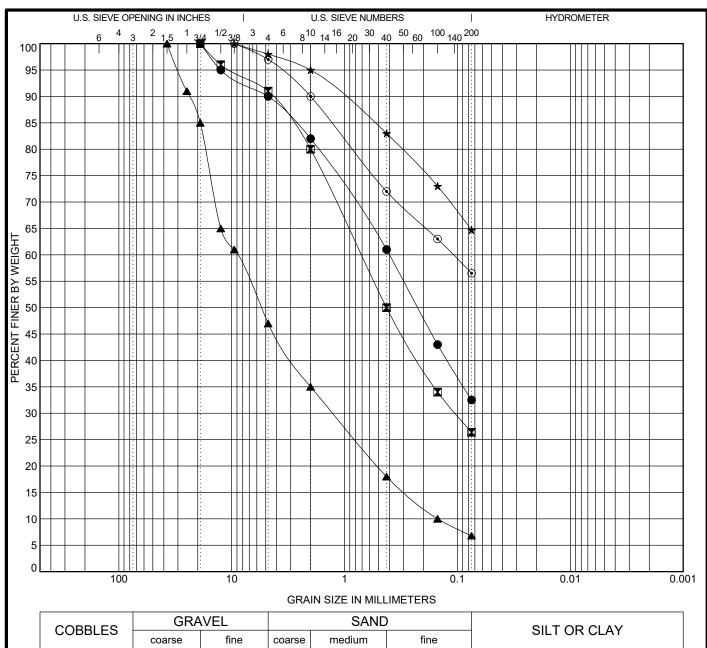
11/19/19	S	Specimen Identification		Cla	ssification			LL	PL	PI	Сс	Cu
11/1	•	01 5.0		SILTY, CLA	YEY SAND(S	C-SM)		23	16	7		
GDT	X	02 3.0		SILTY, CLA	YEY SAND(S	C-SM)		22	16	6		
GEO TEST.GDT	▲	03 5.0		CLAY	EY SAND(SC)		27	18	9		
EO 1	*	04 5.0	C	LAYEY SAN	D with GRA\	/EL(SC)		26	18	8		
PJ O	⊚	07 5.0	WELL-GRA	DED SAND w	vith SILT and	GRAVEL(S)	N-SM)	NP	NP	NP	1.20	26.67
WL.G	S	Specimen Identification	D100	D60	D30	D10	%Grav	el %	Sand	%Si	lt %	Clay
ADO	•	01 5.0	12.5	0.345			7.0		54.5		38.5	
DOR	X	02 3.0	12.5	0.366			5.0		58.5		36.5	
0-EL	•	03 5.0	19	0.814	0.101		8.0		65.0		27.0	
CANONCITO-ELDORADO WL.GPJ	*	04 5.0	37.5	2.61	0.241		31.0		50.3		18.7	
ANC	•	07 5.0	25	2	0.425	0.075	23.0		67.0		10.0	



Project: Cañoncito-Eldorado Waterline Location: Santa Fe County, New Mexico

Number: 1-30404

IIS GRAIN SIZE 1-30404 CL

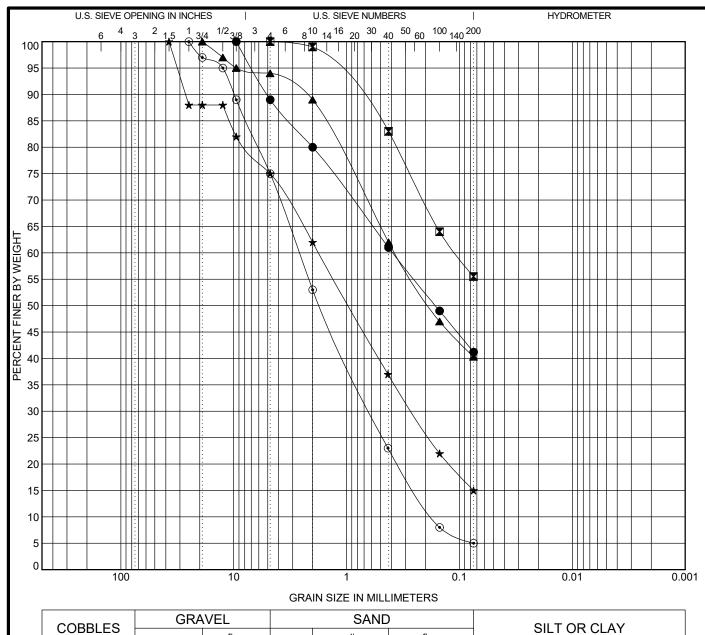


CORRIES	GRA	VEL		SAND)	SUITORCLAY
COBBLES	coarse	fine	coarse	medium	fine	SILT OR CLAT

11/19/19	S	Specimen Identification		Cla	ssification			LL	PL	PI	Сс	Cu
11/1	•	08 5.0		CLAY	EY SAND(SC)		25	16	9		
GDT		09 5.0		SILTY, CLA	YEY SAND(S	C-SM)		22	17	5		
EST.	A	12 5.0	WELL-GRAD	DED GRAVE	L with SILT a	nd SAND(GV	N-GM)	NP	NP	NP	1.19	60.27
EO 1	*	14 5.0		SANDY L	EAN CLAY(CL)		33	21	12		
PJ O	⊚	15 5.0		SANDY L	EAN CLAY(CL)		30	16	14		
WL.G	S	Specimen Identification	D100	D60	D30	D10	%Grav	∕el %	6Sand	%Si	lt %	6Clay
ADO	•	08 5.0	19	0.401			10.0		57.5		32.5	
DOR		09 5.0	19	0.712	0.104		9.0		64.6		26.4	
인틴	A	12 5.0	37.5	9.041	1.268	0.15	53.0		40.2		6.8	
NCI	*	14 5.0	9.5				2.0		33.3	·	64.7	
CANONCITO-ELDORADO WL.GPJ GEO TEST.GDT	•	15 5.0	9.5	0.109			3.0		40.5		56.5	



Project: Cañoncito-Eldorado Waterline Location: Santa Fe County, New Mexico



SAND		

fine

9/19	S	Specimen Identification		Cla	ssification			LL	PL	PI	Сс	Cu
11/19/19	•	17 5.0		CLAY	EY SAND(SC	;)		31	16	15		
GDT	×	18 3.0		SANDY L	EAN CLAY	CL)		32	16	16		
EST.	•	20 3.0		CLAY	EY SAND(SC	;)		33	18	15		
EO J	*	21 5.0		SILTY SAND	with GRAVI	EL(SM)		22	20	2		
J. O	•	23 5.0	POORLY GR	ADED SAND	with SILT a	nd GRAVEL(SP-SM)	NP	NP	NP	0.83	15.26
WL.G	S	Specimen Identification	D100	D60	D30	D10	%Grav	∕el %	Sand	%Si	It %	Clay
ADO	•	17 5.0	9.5	0.39			11.0		47.8		41.2	
DOR	×	18 3.0	4.75	0.108			0.0		44.5		55.5	
O-FI	A	20 3.0	19	0.37			6.0		53.7		40.3	
SANONCITO-ELDORADO WL.GPJ GEO TEST.GDT	*	21 5.0	37.5	1.769	0.263		25.0		60.0		15.0	
ANC	•	23 5.0	25	2.634	0.616	0.173	25.0		70.0		5.0	

medium



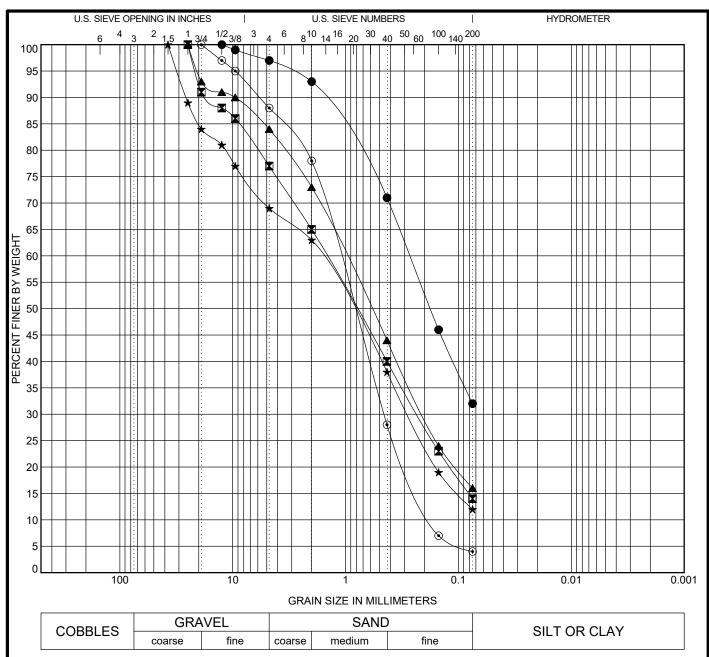
coarse

fine

coarse

GRAIN SIZE DISTRIBUTION

Project: Cañoncito-Eldorado Waterline Location: Santa Fe County, New Mexico



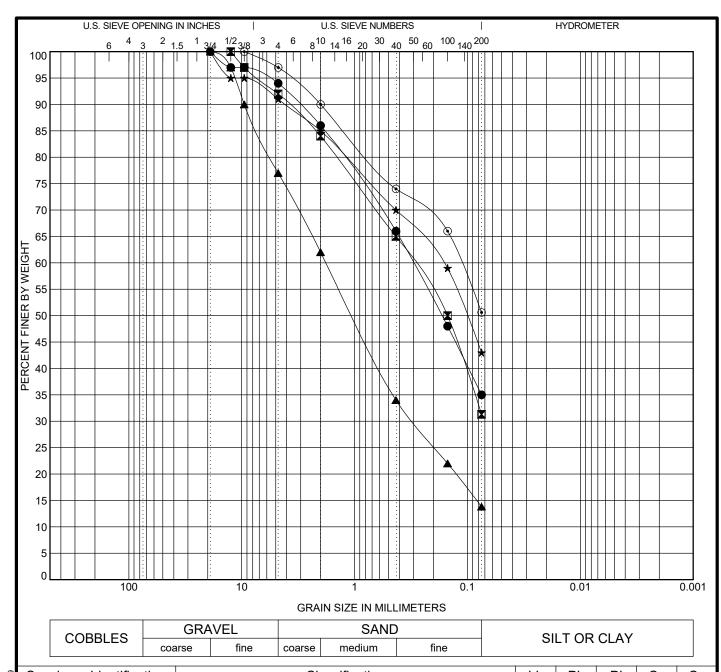
11/19/19	S	Specimen Identification		Cla	ssification			LL	PL	PI	Сс	Cu
11/1	•	23 10.0		SILT	Y SAND(SM)			NP	NP	NP		
GDT	\blacksquare	24 3.0		SILTY SAND	with GRAVE	EL(SM)		NP	NP	NP		
EST.	•	24 5.0		SILTY SAND	with GRAVE	EL(SM)		NP	NP	NP		
EO 1	*	25 3.0 F	POORLY GR	ADED SAND	with SILT ar	nd GRAVEL(SP-SM)	NP	NP	NP	0.74	27.03
J. O	\odot	25 5.0		WELL-GR	ADED SAND	(SW)		NP	NP	NP	1.04	6.60
WL.G	S	Specimen Identification	D100	D60	D30	D10	%Grav	el %	Sand	%Si	It %	Clay
ADO	•	23 10.0	12.5	0.271			3.0		65.0		32.0	
DOR	X	24 3.0	25	1.471	0.231		23.0		63.0		14.0	
0-EL	•	24 5.0	25	1.004	0.206		16.0		68.0		16.0	
NCI	*	25 3.0	37.5	1.663	0.276		31.0		57.0	·	12.0	
CANONCITO-ELDORADO WL.GPJ GEO TEST.GDT	•	25 5.0	19	1.15	0.457	0.174	12.0		84.0		4.0	



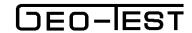
Project: Cañoncito-Eldorado Waterline Location: Santa Fe County, New Mexico

Number: 1-30404

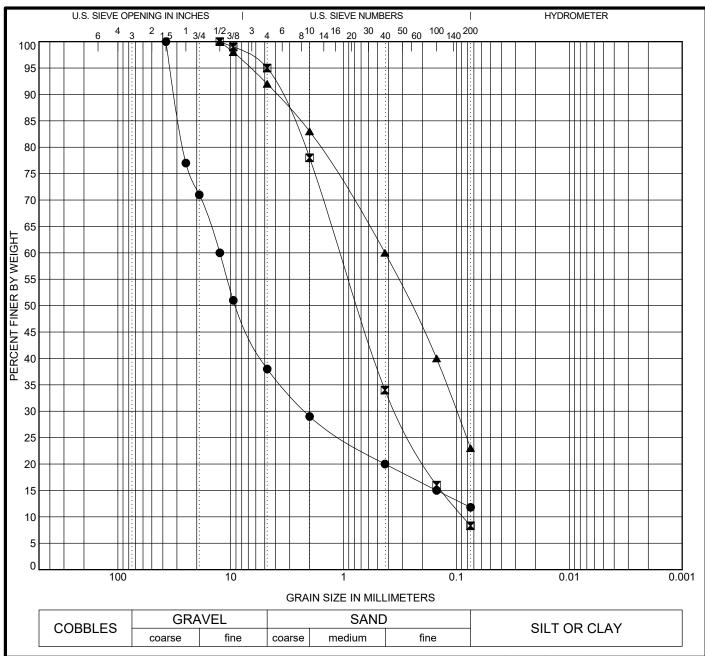
IIS GRAIN SIZE 1-304



6	Sp	pecimen Identification		Cla	assification			LL	PL	PI	Сс	Cu
=		25 10.0		SILT	Y SAND(SM)			NP	NP	NP		
וַקּאַ		26 5.0		SILTY, CLA	YEY SAND(S	SC-SM)		26	20	6		
2	\	27 1.0		SILTY SAND	with GRAV	EL(SM)		27	23	4		
- -	k	27 10.0		CLAY	EY SAND(SC	;)		34	18	16		
בר ה	•	28 10.0		SANDY SIL	LTY CLAY(C	L-ML)		29	22	7		
N L	Sp	pecimen Identification	D100	D60	D30	D10	%Grav	el 9	6Sand	%Si	It 9	6Clay
3		25 10.0	19	0.303			6.0		59.0		35.0	
		26 5.0	12.5	0.303			8.0		60.7		31.3	
5	A	27 1.0	19	1.792	0.303		23.0		63.2		13.8	
	k	27 10.0	19	0.165			9.0		48.0		43.0	
	•	28 10.0	9.5	0.115			3.0		46.4		50.6	



Project: Cañoncito-Eldorado Waterline Location: Santa Fe County, New Mexico



8	Spe	ecimen Identification	Classification	LL	PL	PI	Сс	Cu
<u> </u>	• 2	.9 6.6 0	RLY GRADED GRAVEL with SILTY CLAY and SAND(GF	9-G 2 4	17	7	7.64	246.14
200	X	5.0	WELL-GRADED SAND with SILT(SW-SM)	NP	NP	NP	1.24	12.20
	▲ 3	3.0	SILTY SAND(SM)	23	22	1		
2								

S	Specimen Ide	entification		Cla	assificati	on			LL	PL	PI	Сс	Cu
•	29	6 .60	RLY GRADE	D GRAVEL	with SIL	TY CL	AY and SA	AND(GP	-G 2 4	17	7	7.64	246.14
X	30	5.0	WEL	L-GRADED	SAND w	ith SIL	_T(SW-SM))	NP	NP	NP	1.24	12.20
▲	31	3.0		SILT	Y SAND	(SM)			23	22	1		
S	∟ Specimen Ide	entification	D100	D60	D30)	D10	%Gra	vel 9	%Sand	%Sil	It 9	⊥ 6Clay
•	29	6.5	37.5	12.5	2.20	2		62.0)	26.2		11.8	
X	30	5.0	12.5	1.066	0.34	4	0.087	5.0		86.7		8.3	
A	31	3.0	12.5	0.43	0.1			8.0		69.0		23.0	
							GRAI	N SIZ	E DI	STRII	BUTIO	ON	
					Γ	Droio	ot: Coñon	oito Eldo	rada	Motorlin			

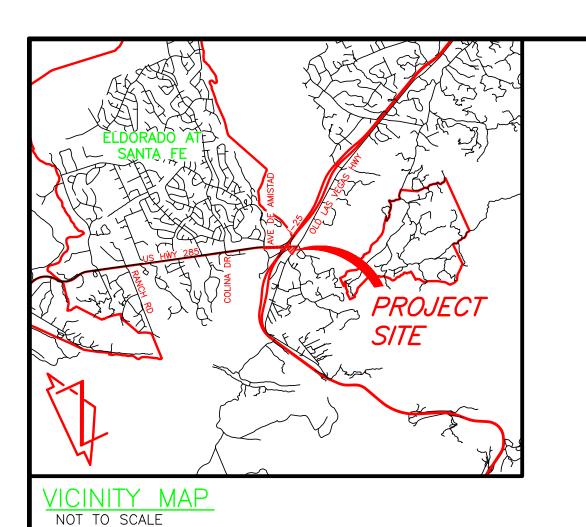


Project: Cañoncito-Eldorado Waterline Location: Santa Fe County, New Mexico

Appendix C

US HWY 285 CAÑONCITO-ELDORADO WATERLINE UTILITY SURVEY (POTHOLES)

October 28, 2019



GENERAL NOTES

- 1. AN UNCLASSIFIED SURVEY FOR UTILITY POTHOLE LOCATIONS WAS PERFORMED IN AUGUST, 2019 AND OCTOBER, 2019. THIS IS NOT A BOUNDARY SURVEY OR A RIGHT-OF-WAY SURVEY.
- 2. ALL DISTANCES ARE GROUND DISTANCES
- 3. SITE LOCATED WITHIN PROJECTED SECTION 4 AND 9, TOWNSHIP 15N, RANGE 10E OF CANADA DE LOS ALAMOS LAND GRANT.
- 4. THE PURPOSE OF THIS SURVEY IS TO DEPICT THE UTILITY SUBSURFACE MATERIAL TYPE AND DEPTH INFORMATION AND IS BASED UPON FIELD REPORTS PREPARED BY THIS FIRM, DATED OCTOBER 28, 2019, FIELD DATA GATHERED BY THIS FIRM ON OCTOBER 24, 2019 AND PRESENTED IN THE SUBSURFACE UTILITY LOCATION TABLES.
- 5. THE ORTHOGRAPHIC MOSAIC SHOWN ON THIS SURVEY IS BASED UPON IMAGERY CAPTURED BY AN UNMANNED AERIAL VEHICLE (UAV) OPERATED BY HIGH MESA CONSULTING GROUP. UAV IMAGERY WAS CAPTURED ON AUGUST 30. 2019. SUPPLEMENTAL IMAGÉS DEPICTED ON THIS SURVEY WERE IMPORTED FROM BING MAPS. THIS PHOTOBASE IMAGERY IS SHOWN TO PROVIDE A GENERAL SITE ORIENTATION AND MAY NOT REFLECT THE CURRENT SITE CONDITIONS.
- 6. UTILITY INFORMATION SHOWN HEREON IS BASED UPON ONSITE SURFACE EVIDENCE, REVIEW OF AVAILABLE RECORD DRAWINGS AND DISTRIBUTION MAPS, UTILITY LINE-SPOTS PROVIDED BY HIGH MESA CONSULTING GROUP (2019.1037.1) AND UTILITY POTHOLES CONDUCTED BY HIGH MESA CONSULTING GROUP ON OCTOBER 24, 2019. IN ADDITION, UTILITY LINÉ-SPOTS WERE REQUESTED VIA THE NEW MEXICO ONE CALL SERVICE (TICKET NO. 19AG280292). UTILITY LINES SHOWN ON THIS DRAWING ARE SHOWN IN AN APPROXIMATE MANNER ONLY AND SUCH LINES MAY EXIST WHERE NONE ARE SHOWN. IF ANY SUCH EXISTING LINES ARE SHOWN, THE LOCATION IS BASED UPON INFORMATION PROVIDED BY THE OWNER OF SAID UTILITY, AND THE INFORMATION MAT BE INCOMPLETE, OR MAY BE OBSOLETE BY THE TIME CONSTRUCTION COMMENCES. THE SURVEYOR HAS CONDUCTED ONLY PRELIMINARY INVESTIGATION OF THE LOCATION, DEPTH, SIZE, OR TYPE OF EXISTING UTILITY LINES, PIPELINES, OR UNDERGROUND UTILITY LINES. THIS INVESTIGATION IS NOT CONCLUSIVE, AND MAY NOT BE COMPLETE, THEREFORÉ, MAKES NO REPRESENTATION PERTAINING THERETO, AND ASSUMES NO RESPONSIBILITY OR LIABILITY THEREFOR. THE PROPERTY OWNER. DEVELOPER, OR CONTRACTOR SHALL INFORM ITSELF OF THE LOCATION OF ANY UTILITY LINE, PIPELINE, OR UNDERGROUND UTILITY LINE IN OR NEAR THE AREA OF THE WORK IN ADVANCE OF AND DURING EXCAVATION WORK. THE PROPERTY OWNER, DEVELOPER, OR CONTRACTOR IS FULLY RESPONSIBLE FOR ANY AND ALL DAMAGE CAUSED BY ITS FAILURE TO LOCATE. IDENTIFY AND PRESERVE ANY AND ALL EXISTING UTILITIES, PIPELINES, AND UNDERGROUND UTILITY LINES. IN PLANNING AND CONDUCTING EXCAVATION, THE CONTRACTOR SHALL COMPLY WITH STATE STATUTES, MUNICIPAL AND LOCAL

CONTROL SURVEY NOTE

A CONTROL SURVEY WAS CONDUCTED AT THE SITE ON AUGUST 30, 2019. CONTROL WAS PROJECTED ONTO THE SUBJECT SITE UTILIZING RTK GPS OBSERVATIONS COMBINED WITH GEOID MODEL 12B TO ESTABLISH HORIZONTAL AND VERTICAL POSITIONS BASED UPON NAD 83/NAVD 88 DATUM. THE RTK OBSERVATIONS WERE USED TO ESTABLISH THE TEMPORARY BENCHMARKS AT THE PROJECT SITE.

THE POINTS OBSERVED HAVE BEEN QUALITY CONTROLLED FOR RELATIVE ACCURACY. AN NGS BENCHMARK "BANK" IN THE VICINITY OF THE PROJECT WERE OBSERVED IN ORDER TO PROVIDE REFERENCE TIES TO THE SITE. ALL HORIZONTAL COORDINATES ARE MODIFIED NAD 83 GRID VALUES AND HAVE BEEN ADJUSTED TO THE GROUND AT THE PROJECTION POINT (THE SCALE FACTOR USED IS 1/CF=1.0004284380). THE CONTROL STATION USED TO PROJECT FROM GRID TO GROUND FOR THIS PROJECT IS THE PROJECT BENCHMARK "BANK" WITH OBSERVED NAD GRID COORDINATES OF:

NORTHING= 1,654,994.53 FEET EASTING= 1,754,005.03 FEET ELEVATION = 7234.19 FEET

THE ELEVATIONS ARE BASED UPON THE NAVD DATUM AND REQUIRE NO FURTHER ADJUSTMENT.

PROJECT BENCHMARK (BANK 1953)

AN NGS BRASS DISK STAMPED "BANK 1953", SET IN 10" CONCRETE MONUMENT, 50 FEET SOUTHWEST OF CENTERLINE OF OLD LAS VEGAS HIGHWAY. ELEVATION = 7234.19 FEET (NAVD 1988)

TEMPORARY BENCHMARK #201 (T.B.M.)

A #5 REBAR W/CAP STAMPED "CONTROL PT. PS 15075", SET IN DIRT TURNING LANE MEDIAN NÉAR THE NORTH END OF THE PROJECT SITE AT THE INTERSECTION OF US HWY 285 AND OLD LAS VEGAS HWY, AND BEING 34 FEET SOUTH OF THE CENTERLINE OF OLD LAS VEGAS HWY AS SHOWN ON SHEET 1 AND SHEET 3. ELEVATION = 7175.75 FEET (NAVD 1988)

TEMPORARY BENCHMARK #202 (T.B.M.)

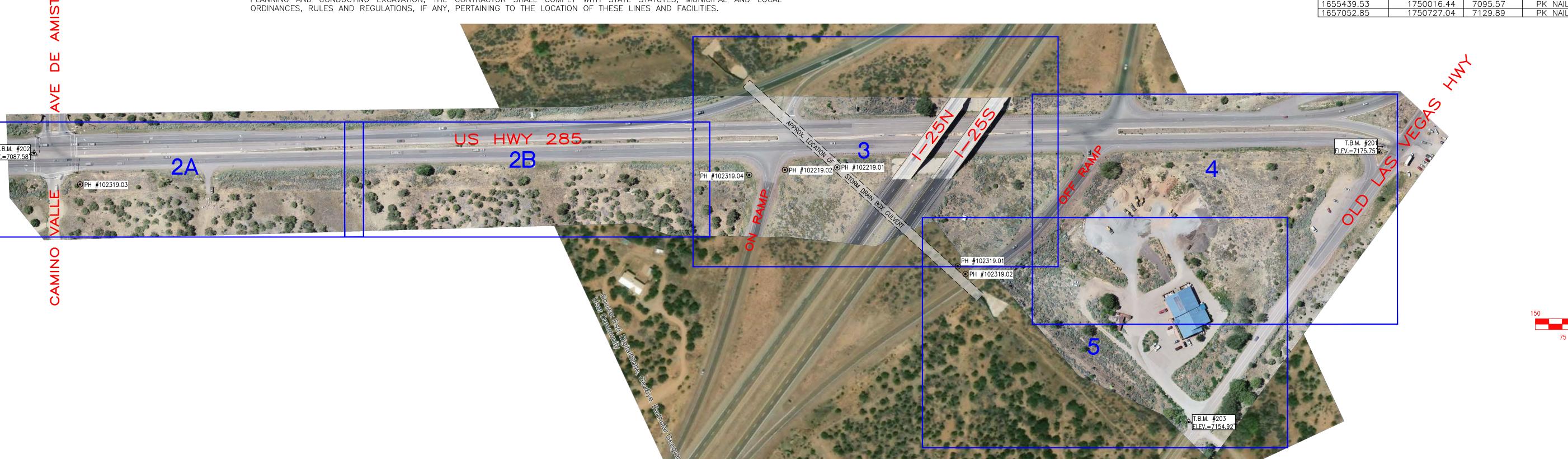
A MAG NAIL SET IN THE SOUTHERN CONCRETE MEDIAN NEAR THE SOUTH END OF THE PROJECT SITE AT THE INTERSECTION OF US HWY 285 AND AVENUE DE AMISTAD, AS SHOWN ON SHEET 1 AND SHEET 2. ELEVATION = 7087.58 FEET (NAVD 1988)

TEMPORARY BENCHMARK #203 (T.B.M.)

A MAG NAIL SET IN ASPHALT PAVEMENT NEAR THE NORTHEAST CORNER OF THE PROJECT SITE, AND BEING 24 FEET SOUTH OF THE CENTERLINE OF OLD LAS VEGAS HWY, AS SHOWN ON SHEET 1 AND SHEET 4. ELEVATION = 7154.92 FEET (NAVD 1988)

OBSERVED MOLZEN CORBIN SITE CONTROL

NORTHING	EASTING	ELEVATION	DESCRIPTION
1655439.53	1750016.44	7095.57	PK NAIL
1057050 05	4750707.04	7400 00	DIZ NIAU



SCALE: 1" = 150'

SUBSURFACE UTILITY NOTES

- THIS UTILITY SURVEY IS A REPRESENTATION OF ASCERTAINABLE UTILITY LINES IDENTIFIED AND/OR SURVEYED BY HIGH MESA CONSULTING GROUP USING DISCUSSED EQUIPMENT AND METHODOLOGIES THIS UTILITY DESIGNATION EFFORT HAS BEEN BASED UPON COORDINATED EFFORTS WITH PUBLIC UTILITY OWNERS THROUGH THE NM811 SERVICE, RECORD DRAWINGS (THAT WERE AVAILABLE AT THE ONSET OF OUR SERVICES), AND CURRENT SITE CONDITIONS INCLUDING SURFACE FEATURES FOUND WITHIN PROJECT LIMITS THAT INDICATE THE PRESENCE OF SUBSURFACE UTILITIES. PUBLICLY-OWNED UTILITIES REPRESENTED ON THIS SURVEY HAVE BEEN BASED UPON LINE-SPOTS PROVIDED BY THE UTILITY OWNER, SUPPLEMENTAL DESIGNATION PROVIDED BY HMCG AND/OR UTILITY INFORMATION THAT WAS OBTAINED OR PROVIDED BY THE UTILITY OWNER AT THE ONSET OF THESE SERVICES ANY UNRESOLVED DISCREPANCIES RELATED TO THE RECORD DRAWINGS, UTILITY CONNECTIVITY AND/OR PUBLIC UTILITY RESPONSE HAVE BEEN SUMMARIZED ON THIS SURVEY. REFER TO KEYED SUBSURFACE UTILITY NOTES.
- UNLESS NOTED OTHERWISE, PUBLIC UTILITY INFORMATION REPRESENTED ON THIS SURVEY HAS BEEN OBTAINED THROUGH NM811 DESIGN LOCATE REQUEST (NM811 TICKET 19AG280292 08/28/2019 9:28AM) AND PUBLIC UTILITY OWNERS PREVIOUSLY IDENTIFIED FROM NM811 DESIGN CONFERENCE REQUEST (NM811 TICKET 19JU260262 07/26/2019 9:25AM). UTILITY OWNERS/OPERATORS THAT ARE NOT REGISTERED WITH NM811 MAY NOT BE REPRESENTED ON THIS
- THE EXACT PIPE/CABLE SIZE, DEPTH OR MATERIAL OF THE UTILITIES DESIGNATED BY THIS EFFORT IS UNKNOWN.
- THIS UTILITY SURVEY AND UTILITY DESIGNATION EFFORT IS NOT ALL-INCLUSIVE AND MAY NOT REPRESENT UTILITIES/INFRASTRUCTURE THAT HAS BEEN ABANDONED IN PLACE.

COVER SHEET, NOTES, VICINITY MAP, KEYED NOTES, SHEETS 2-5 UTILITY SURVEY WITH ORTHOPHOTOGRAPHY

SHEETS 6 UTILITY POTHOLE LOCATION SURVEY

INDEX OF DRAWINGS

KEYED SUBSURFACE UTILITY NOTES

- $\langle 1.
 angle$ location of water line based upon eldorado area water sanitation district (easwsd) GIS FACILITY MAPS. LOCATION OF WATER LINE WAS NOT ASCERTAINABLE WITH ELECTROMAGNETIC (CONDUCTIVE) METHODS.
- 2. PUBLICLY-OWNED COMMUNICATION FIBER OPTIC VAULT WAS NOT ACCESSIBLE. LINES WERE LOCATED FROM VAULTS NORTH AND SOUTH OF THIS VAULT TO THIS POINT. CONTENTS OF THIS VAULT ARE UNKNOWN.
- (3.) ELECTRIC LINE WAS NOT DETECTABLE BEYOND THIS POINT. SIGNAL APPLIED TO CONDUCTOR ABRUPTLY STOPS AT THIS POINT.
- (4.) LOCATION OF CENTURY LINK FIBER OPTIC CABLE DESIGNATED BY HMCG. LOCATION DIFFERS FROM FACILITY MAPS OBTAINED FROM CENTURY LINK.

APWA UTILITY COLOR CODE

RED - ELECTRIC POWER LINES, CABLES, CONDUIT -E---E----E----AND LIGHTING CABLES

BLACK - TRAFFIC SIGNAL LINES

CABLES OR CONDUIT AND TRAFFIC LOOPS

ORANGE — COMMUNICATION, ALARM OR SIGNAL LINES, CABLES OR CONDUIT AND TRAFFIC LOOPS

GREEN - STORM DRAIN BLACK - APPROXIMATE LOCATION OF PROPOSED WATERLINE PER MOLZEN-CORBIN EXHIBIT BLACK - CONCRETE STORM DRAIN BOX CULVERT

-TS----TS----TS----BLUE - POTABLE WATER

LEGEND

- COMM CONDUIT © COMM PULLBOX COMM RISER
- COMM MANHOLE CMV COMMUNICATIONS VAULT ECB ELECTRIC TRANSFORMER CABINET
- ELEC CONDUIT © ELEC PULLBOX

■ TRAF PULL BOX

ELEC JUNCTION BOX OMLP METAL LIGHT POLE OAL AREA LIGHT ₩ATER VALVE BOX

SURVEYORS CERTIFICATION

I, JOSEPH M. SOLOMON, JR., NEW MEXICO PROFESSIONAL SURVEYOR NO. 15075, DO HEREBY CERTIFY; THAT THIS UNCLASSIFIED SURVEY AND THE ACTUAL SURVEY ON THE GROUND UPON WHICH IT IS BASED WERE PERFORMED BY ME OR UNDER MY DIRECT SUPERVISION; THAT THIS SURVEY MEETS THE MINIMUM STANDARDS FOR SURVEYING IN NEW MEXICO, AND THAT IT IS TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.





November 5, 2019



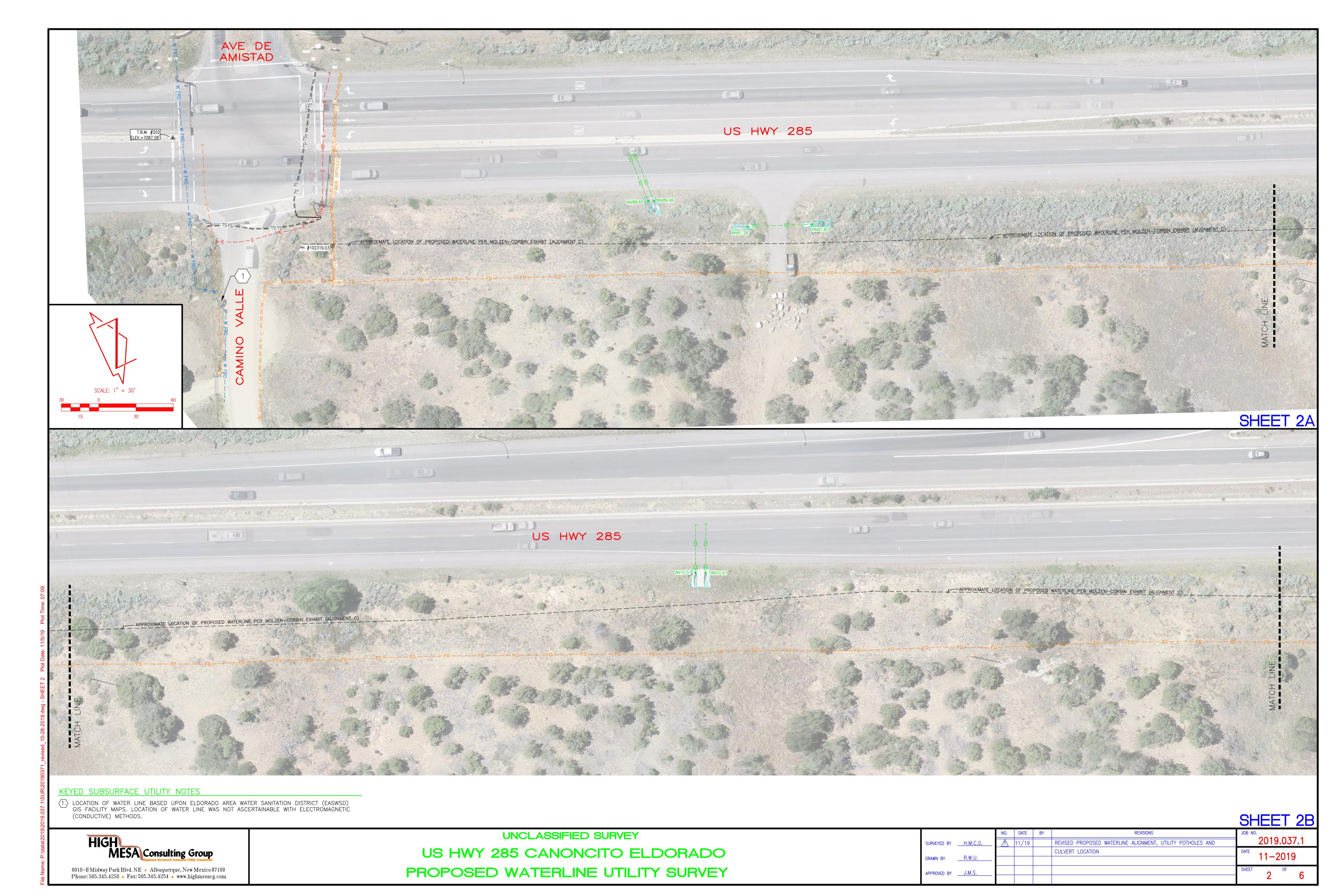
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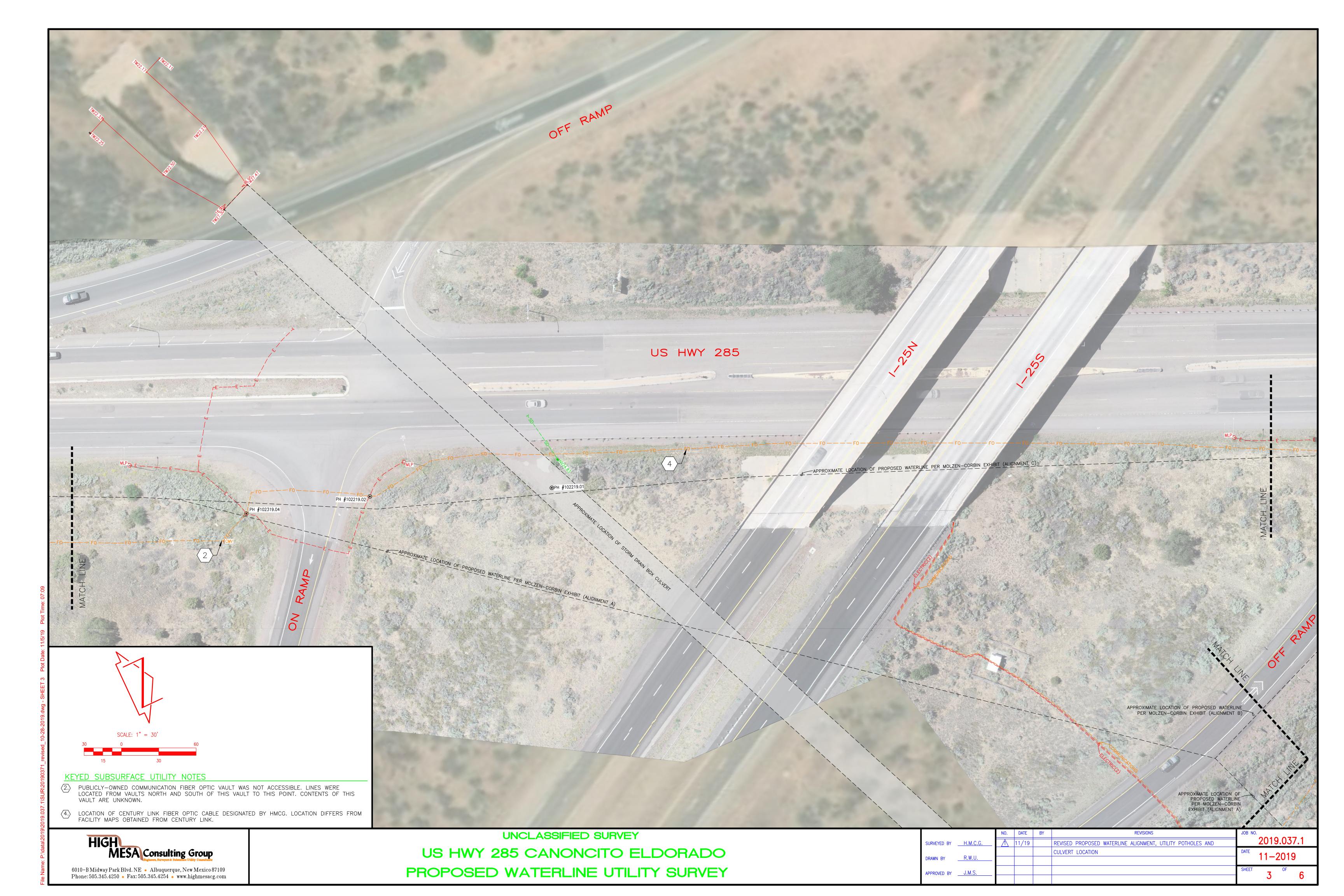
Phone: 505.345.4250 • Fax: 505.345.4254 • www.highmesacg.com

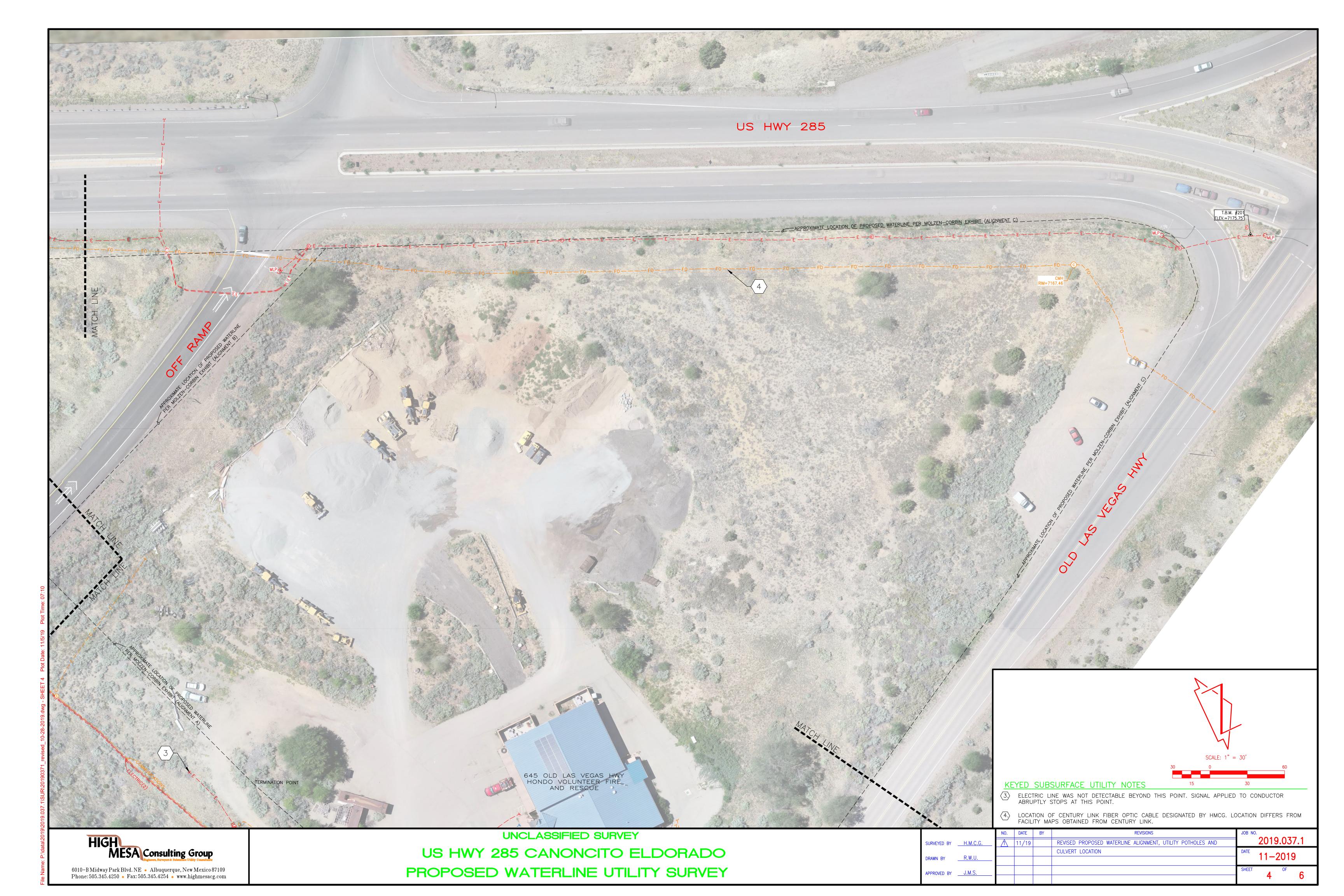
UNCLASSIFIED SURVEY

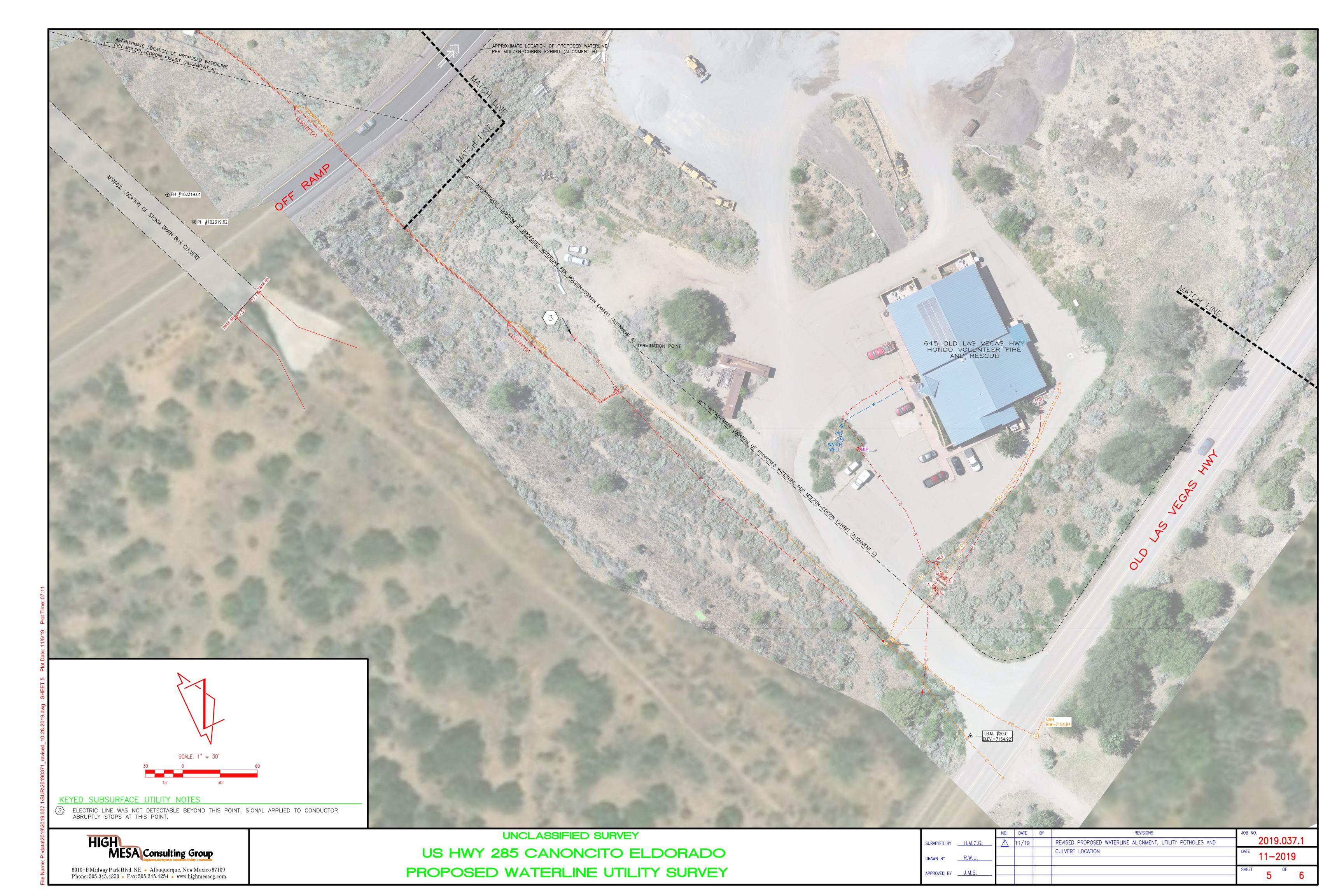
US HWY 285 CANONCITO ELDORADO PROPOSED WATERLINE UTILITY SURVEY

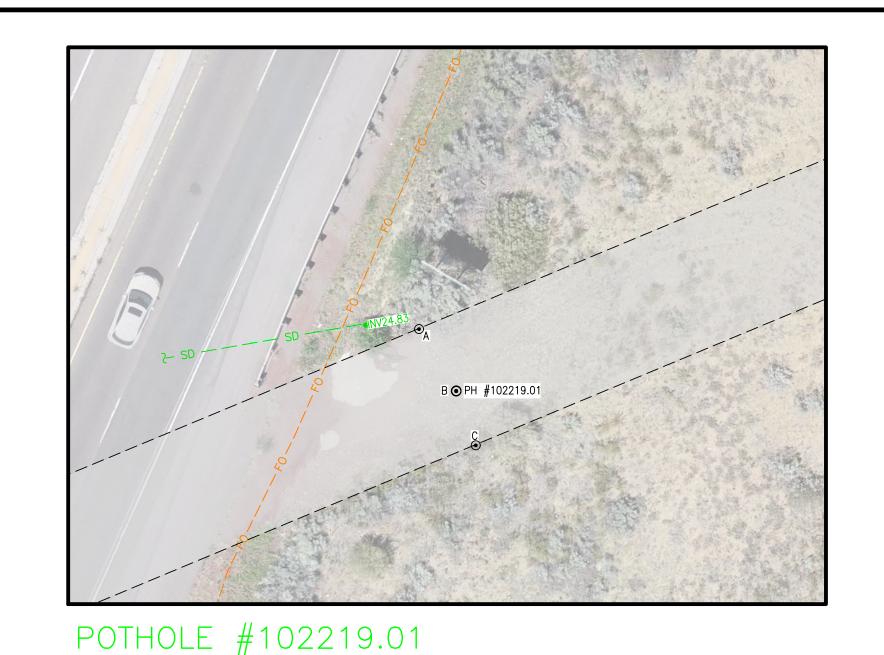
2019.037. REVISED PROPOSED WATERLINE ALIGNMENT, UTILITY POTHOLES AND URVEYED BY <u>H.M.C.G</u>. CULVERT LOCATION 11-2019 RAWN BY R.W.U.PPROVED BY J.M.S.





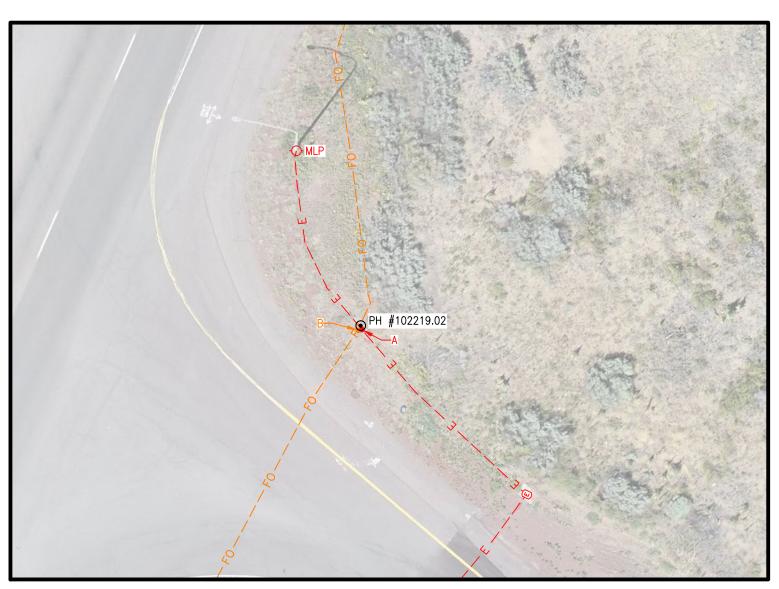






SUBSURFACE UTILITY LOCATION TABLE

POTHOLE	SURFACE	PAVEMENT		UTILITY		DEPTH	TOP OF UTILITY	DEPTH	BOT OF UTILITY
#	ELEVATION	THICKNESS	TYPE	MATERIAL	DIAMETER	TO TOP OF LINE	LINE ELEVATION	TO BOT OF LINE	LINE ELEVATION
A1	7129.58'	DIRT	STORM	CONCRETE	27'	0"	7129.58		
A2	7129.58'	DIRT	STORM	CONCRETE	27'			114"	7120.08'
В	7130.69'	DIRT	STORM	CONCRETE	27'	12"	7129.65	NA	NA
C1	7130.69	DIRT	STORM	CONCRETE	27'	12"	7129.69'		
C2	7130.69	DIRT	STORM	CONCRETE	27'			126"	7120.19'

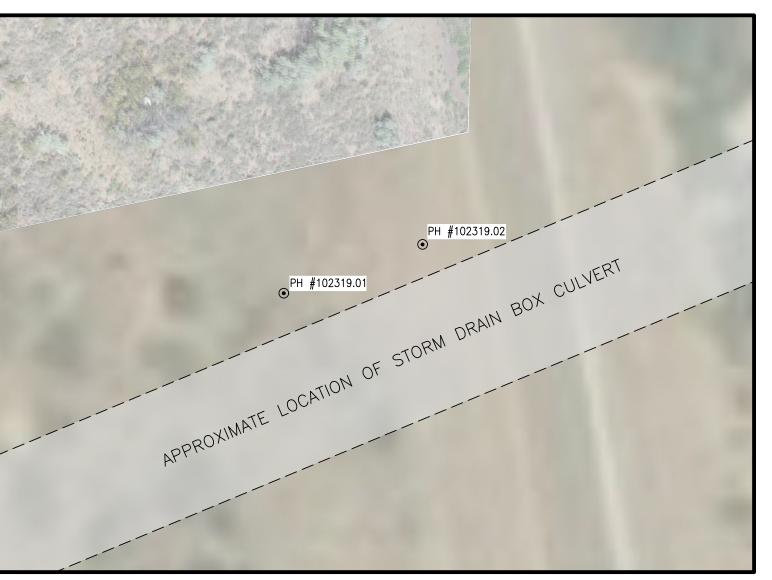


POTHOLE #102219.02

PUTHULE	#102219.02				
SCALE: 1" = 20'		20	0	20	40

SUBSURFACE UTILITY LOCATION TABLE

POTHOLE	SURFACE	PAVEMENT		UTILITY		DEPTH	TOP OF UTILITY
#	ELEVATION	THICKNESS	TYPE	MATERIAL	DIAMETER	TO TOP OF LINE	LINE ELEVATION
А	7127.57	DIRT	ELECTRIC	PVC	2"	24"	7125.57
В	7127.57	DIRT	F.O.	CI	5"	45"	7123.82'

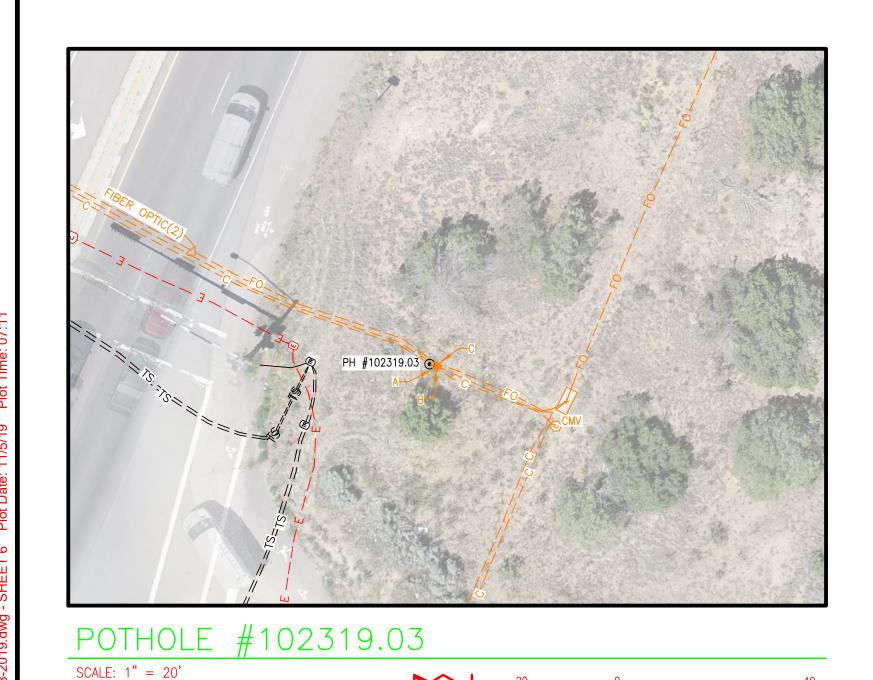


POTHOLE #102319.01 AND #102319.02

• •				
LE: 1" = 20'	20	0		40
	10		20	

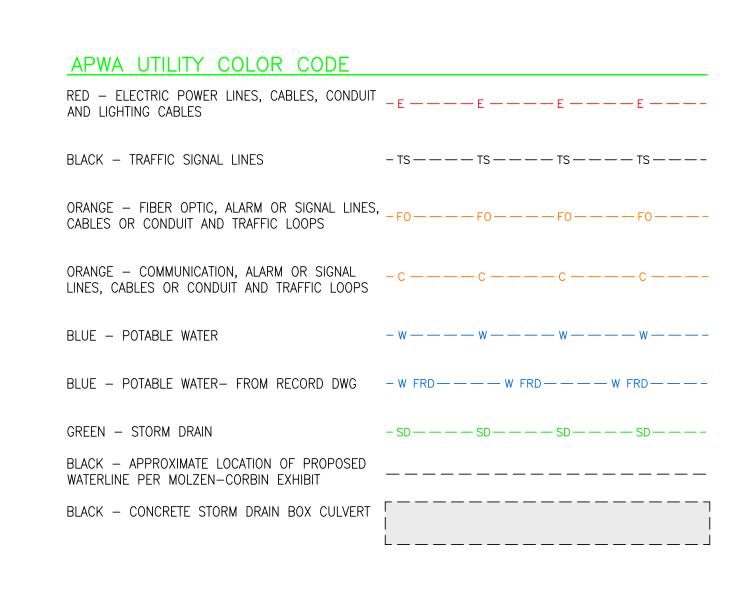
SUBSURFACE UTILITY LOCATION TABLE

F	POTHOLE	SURFACE	PAVEMENT		UTILITY		DEPTH	TOP OF UTILITY
	#	ELEVATION	THICKNESS	TYPE	MATERIAL	DIAMETER	TO TOP OF LINE	LINE ELEVATION
1(02319.01	7144.73	DIRT	STORM	CONCRETE	27'	NA	NA
10	02319.02	7145.54	DIRT	STORM	CONCRETE	27'	NA	NA



SUBSURFACE UTILITY LOCATION TABLE

POTHOLE	SURFACE	PAVEMENT		UTILITY		DEPTH	TOP OF UTILITY
#	ELEVATION	THICKNESS	TYPE	MATERIAL	DIAMETER	TO TOP OF LINE	LINE ELEVATION
Α	7088.04	DIRT	F.O.	PVC	2"	44"	7084.37
В	7088.04	DIRT	F.O.	PVC	2"	44"	7084.37
С	7088 04'	DIRT	FΟ	CARLE	1/2"	43"	7084 29'





COMM CONDUIT
 COMM PULLBOX
 COMM RISER

© COMM MANHOLE
CMV COMMUNICATIONS VAULT
ECB ELECTRIC TRANSFORMER CABINET
• ELEC CONDUIT

ELEC METER

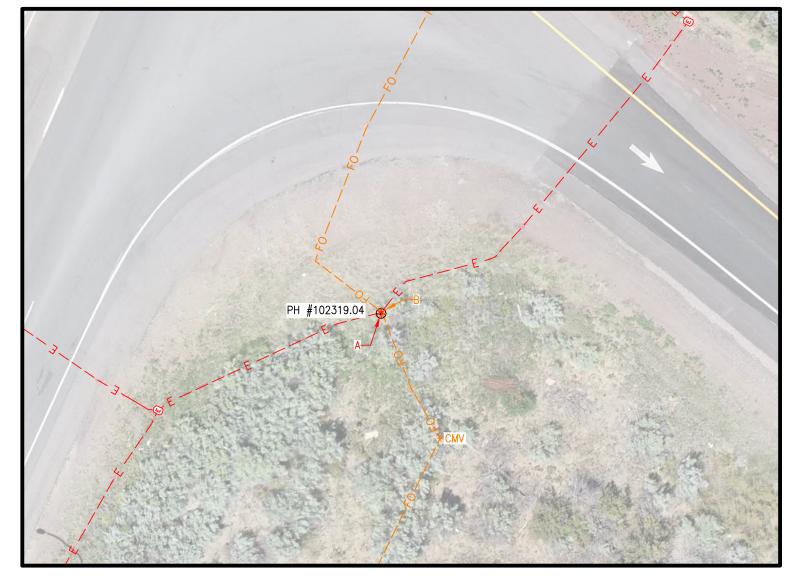
© ELEC METER
© ELEC PULLBOX

□ ELEC JUNCTION BOX

○ MLP METAL LIGHT POLE

○ AL AREA LIGHT

WATER VALVE BOX
© TRAF PULL BOX



POTHOLE #102319.04



SUBSURFACE UTILITY LOCATION TABLE

POTHOLE	SURFACE	PAVEMENT		UTILITY		DEPTH	TOP OF UTILITY
#	ELEVATION	THICKNESS	TYPE	MATERIAL	DIAMETER	TO TOP OF LINE	LINE ELEVATION
Α	7124.97'	DIRT	ELECTRIC	PVC	1-1/2"	48"	7120.97
В	7124.97'	DIRT	F.O.	CI	2"	22"	7123.14

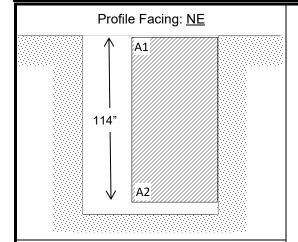


SCALE: 1" = 20'

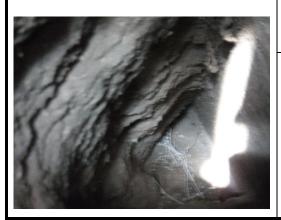


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Subsurfa	ce U	tility	/ Potl	hole R	ерс	ort			Potl	nole N	lo.:	102219.0	1	
		ate:	10/22/	/19				Р	othole T	otal/Pro	ject:	10		
F	Project	No.:	2019.0	037.2					SUE	Superv	isor:	Erik White		
	CI	ient:	Molze	n Corbin					S	Surveyed	d By:	David Reines	3	
Projec	ct Loca	tion:	US H\	NY 285 (Cano	ncito Eldo	orado			eviewed		Joe Gonzale	S	
Uti	ility Ow	ner:	NMDO	DT						Wea	ther:	Sunny		
	Pothole Summary								Swi	ng Tie	e De	scription/	Measur	ement
Surface D	Descrip	tion:	Dirt			Thicknes	ss of Surface:	NA	A.					
Descript	tion of	Soil:	NA		Sur	face/Marl	ker Elevation:	NA		B.				
Total Excava	ted De	pth:	120"			Descripti	on of Marker:	Hub			C.			
			Uti	lity Su	ımr	nary						Survey	Elev	ation
#	ID	T	уре	Materi	al	Size/ Width	Condition	Depth	Α	В	С	Point #	Top of Utility	Bottom of Utility
102219.01	A1	St	orm	Concre	ete	27'	Good	0"				2504	7129.6	
102219.01	A2	St	orm	Concre	ete	27'	Good	114"				2500		7120.1



Top View



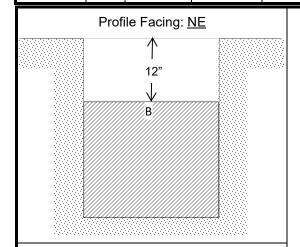


Remarks: Pothole on Storm Drain Box Culvert as directed. Pothole 102219.01 (A2) is northern (bottom) edge of culvert. Top of culvert (A1) is exposed on the surface at grade.



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Subsurfa	ace U	tility	/ Poti	hole R	ерс	ort			Potl	nole N	lo.:	102219.0	1	
		Date:	10/22	/19				Р	othole T	otal/Pro	ject:	10		
	Project	No.:	2019.	037.2					SUE	Superv	isor:	Erik White		
	С	lient:	Molze	n Corbin					S	urveyed	d By:	David Reines	3	
Proje	ct Loca	tion:	US H	NY 285 (Canc	ncito Eldo	orado		R	eviewed	By:	Joe Gonzale	S	
U	tility Ov	vner:	NMDO	OT.						Wea	ther:	Sunny		
			Pot	hole S	um	mary			Swi	ng Tie	e De	scription/	Measur	ement
Surface	Descrip	tion:	Dirt			Thicknes	ss of Surface:	NA	A.					
Descrip	otion of	Soil:	NA		Sur	rface/Marl	ker Elevation:	NA		B.				
Total Excava	ated De	pth:	12"			Descripti	on of Marker:	Hub			C.			
			Uti	ility Su	ımr	nary						Survey	Elev	ation
#	ID	Т	уре	Mater	ial	Size/ Width	Condition	Depth	Α	В	С	Point #	Top of Utility	Bottom of Utility
102219.01	В	St	orm	Concre	ete	27'	Good	12"				2503	7129.7	
		l							1				1	



Top View



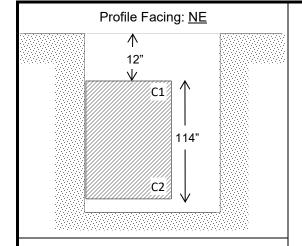


Remarks: Pothole on Storm Drain Box Culvert as directed. Pothole 102219.01 B is top of the box culvert.



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Subsurfa	ace U	tility	/ Poti	hole R	ерс	ort			Potl	hole N	lo.:	102219.0	1	
		Date:	10/22	/19				Р	othole T	otal/Pro	ject:	10		
F	Project	No.:	2019.	037.2					SUE	Superv	isor:	Erik White		
	C	lient:	Molze	n Corbin					S	Surveyed	d By:	David Reines	3	
Projec	ct Loca	ition:	US H\	NY 285 (Cano	ncito Eldo	orado			eviewed		Joe Gonzale	s	
	tility Ov		NMDO	OT .						Wea	ther:	Sunny		
	•		Pot	hole S	um	mary			Swi	ng Ti	e De	scription/	Measur	ement
Surface [Descrip	tion:	Dirt			Thicknes	ss of Surface:	NA	A.					
Descrip	tion of	Soil:	NA		Sur	face/Marl	ker Elevation:	NA		B.				
Total Excava	ated De	pth:	136"			Descripti	on of Marker:	Hub			C.			
			Uti	ility Su	ımr	nary						Survey	Elev	ation
#	ID	T	уре	Materi	al	Size/ Width	Condition	Depth	Α	В	С	Point #	Top of Utility	Bottom of Utility
102219.01	C1	St	orm	Concre	ete	27'	Good	12"				2502	7129.7	
102219.01	C2	St	orm	Concre	ete	27'	Good	126"				2501		7120.2



Top View



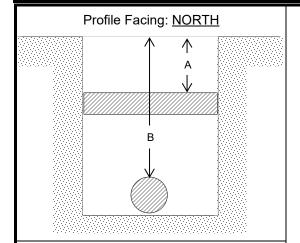


Remarks: Pothole on Storm Drain Box Culvert as directed. Pothole 102219.01 (C2) is the southern (bottom) edge of the culvert. Top of edge of culvert (C1) is 12" below grade.



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Subsurfac	e U	tility	/ Poti	hole R	ерс	ort			Po	othole	No.:	102219	.02	
	D	ate:	10/22	/19					Pothol	e Total/l	Project:	10		
Pro	oject	No.:	2019.	037.2					S	UE Sup	ervisor:	Erik White	;	
	Cli	ent:	Molze	n Corbin						Surve	yed By:	David Rei	nes	
Project	Locat	tion:	US H	NY 285 (Cano	ncito Eldo	orado			Review	ved By:	Joe Gonz	ales	
Utilit	ty Ow	ner:	NMDO	DT(Electr	ic)/ (Conterra(F	Fiber Optic)			W	eather:	Sunny		
			Pot	hole S	um	mary			Swi	ng Tie	e Desc	cription/	Measur	ement
Surface De	scrip	tion:	Dirt			Thicknes	ss of Surface:	NA	A.					
Description	n of S	Soil:	Rocky	'	Sur	rface/Marl	ker Elevation:	NA		B.				
Total Excavate	d De	pth:	50"			Descripti	on of Marker:	HUB			C.			
			Uti	lity Su	ımr	nary						Survey	Elev	ation
#	ID	Ţ	уре	Materi	ial	Size/ Width	Condition	Depth	Α	В	С	Point #	Top of Utility	Bottom of Utility
102219.02	Α	Ele	ectric	PVC	;	2"	Good	24"				2508	7125.6	
102219.02	В	F	.O.	CI		5"	Good	45"				2507	7123.8	



Top View



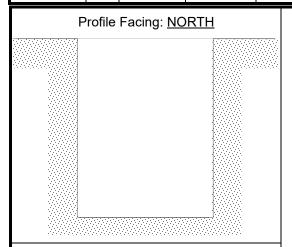


Remarks: Pothole on Electric line for the lighting circuit and Communication Fiber Optic line as dirtected.



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Subsurfac	e U	tility	/ Poti	hole R	ерс	ort			Po	othole	No.:	102319	.01	
		ate:	10/23	/19					Pothol	e Total/l	Project:	10		
Pr	oject	No.:	2019.	037.2					S	UE Sup	ervisor:	Erik White	;	
	CI	ient:	Molze	n Corbin						Surve	yed By:	David Rei	nes	
Project	Loca	tion:	US H\	WY 285 (Cano	ncito Eldo	orado				ved By:	Joe Gonza	ales	
Utili	ty Ow	ner:	NMDO	OT						W	eather:	Sunny		
			Pot	hole S	um	mary			Swi	ng Tie	Desc	cription/	Measur	ement
Surface De	escrip	tion:	Dirt			Thicknes	ss of Surface:	NA	A.					
Description	on of	Soil:	Rocky	/	Sur	rface/Marl	ker Elevation:	NA		B.				
Total Excavate	ed De	pth:	84"			Descripti	on of Marker:	HUB			C.			
			Uti	ility Su	ımr	nary						Survey	Elev	ation
#	ID	T	уре	Materi	ial	Size/ Width	Condition	Depth	Α	В	С	Point #	Top of Utility	Bottom of Utility
102319.01		St	orm	Concre	ete							3073	_	-



Top View



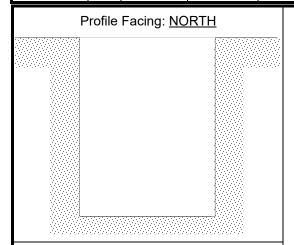


Remarks: Pothole on Storm Drain Box Culvert as directed. Cleared pothole to 84".



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Subsurfa	ce U	tility	/ Poti	hole R	ерс	ort			Po	othole	No.:	102319	.02	
		Date:	10/23	/19					Pothol	e Total/l	Project:	10		
F	roject	No.:	2019.	037.2					S	UE Sup	ervisor:	Erik White		
	CI	lient:	Molze	n Corbin						Surve	yed By:	David Rei	nes	
Projec	t Loca	tion:	US H	WY 285 (Canc	ncito Eldo	orado			Reviev	ved By:	Joe Gonza	ales	
Uti	lity Ov	vner:	NMDO	OT(Electr	ic)/ (Conterra(F	Fiber Optic)			W	eather:	Sunny		
	Pothole Summary								Swi	ng Tie	Desc	cription/	Measur	ement
Surface D	escrip	tion:	Dirt			Thicknes	ss of Surface:	NA	A.					
Descript	ion of	Soil:	Rocky	/	Sur	rface/Marl	ker Elevation:	NA		B.				
Total Excava	ted De	pth:	36"			Descripti	on of Marker:	HUB			C.			
			Uti	ility Su	ımr	nary						Survey	Elev	ation
#	ID	Т	уре	Mater	ial	Size/ Width	Condition	Depth	Α	В	С	Point #	Top of Utility	Bottom of Utility
102319.02		St	orm	Concre	ete							3072	_	



Top View



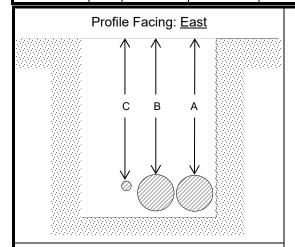


Remarks: Pothole on Storm Drain Box Culvert as directed. Second attempt at relocated location north of the original location (PH 102319.01). Cleared pothole to 36".



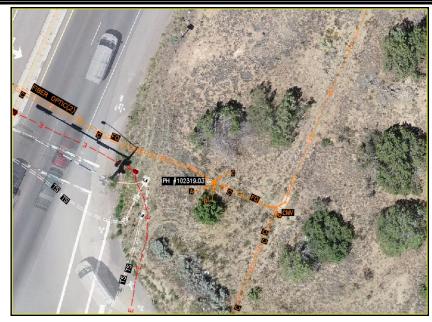
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Subsurfa	ce U	tility	/ Poti	hole R	ерс	ort			Po	othole	No.:	102319	.03	
		ate:	10/23	/19					Pothol	e Total/	Project:	10		
Р	roject	No.:	2019.	037.2					S	UE Sup	ervisor:	Erik White	;	
	CI	ient:	Molze	n Corbin						Surve	yed By:	David Rei	nes	
Projec	t Loca	tion:	US H	NY 285 (Cano	ncito Eldo	orado			Review	ved By:	Joe Gonz	ales	
Util	ity Ov	/ner:	Conte	rra Broad	dban	ıd				W	eather:	Sunny		
	Pothole Summary								Swi	ng Tie	e Desc	cription/	Measur	ement
Surface D	escrip	tion:	Dirt			Thicknes	ss of Surface:	NA	A.					
Descript	ion of	Soil:	Rocky	/	Sui	rface/Marl	ker Elevation:	NA		B.				
Total Excavat	ed De	pth:	46"			Descripti	on of Marker:	HUB			C.			
			Uti	ility Su	ımr	mary						Survey	Elev	ation
#	ID	T	уре	Materi	ial	Size/ Width	Condition	Depth	Α	В	С	Point #	Top of Utility	Bottom of Utility
102319.03	Α	F	.O.	PVC	;	2"	Good	44"				3144	7084.4	
102319.03	В	F	.O.	PVC	;	2"	Good	44"				3143	7084.4	
102319.03	102319.03 C F.O. Cable					1/2"	Good	43"				3142	7084.3	



Top View



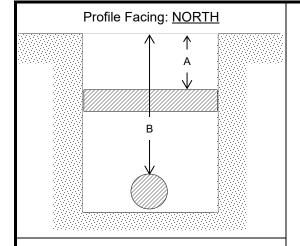


Remarks: Pothole on Communication Fiber Optic line as dirtected. Two PVC inner ducts and one direct buried cable were found buried in joint trench. Utility lines discovered were consistent with the lines found in the communication fiber optic vault east of the pothole location.



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Subsurfac	ce U	tility	/ Poti	hole R	ерс	ort			Po	othole	No.:	102319	.04	
	С	ate:	10/22	/19					Pothol	e Total/l	Project:	10		
Р	roject	No.:	2019.	037.2					S	UE Sup	ervisor:	Erik White	;	
	CI	ient:	Molze	n Corbin						Surve	yed By:	David Rei	nes	
Projec	t Loca	tion:	US H	WY 285 (Cano	ncito Eldo	orado			Review	ved By:	Joe Gonza	ales	
Util	ity Ow	ner:	NMDO	OT(Electr	ic)/	Conterra	(Fiber Optic)			W	eather:	Sunny		
			Pot	hole S	um	mary			Swi	ng Tie	Desc	cription/	Measur	ement
Surface D	escrip	tion:	Dirt			Thicknes	ss of Surface:	NA	A.					
Descripti	ion of	Soil:	Rocky	/	Sur	rface/Marl	ker Elevation:	NA		B.				
Total Excavat	ed De	pth:	50"			Descripti	on of Marker:	HUB			C.			
			Uti	ility Su	ımr	nary						Survey	Elev	ation
#	ID	T	уре	Materi	ial	Size/ Width	Condition	Depth	Α	В	С	Point #	Top of Utility	Bottom of Utility
102219.04	В	F	.0.	PVC	;	2"	Good	22"				3001	7123.1	



Top View



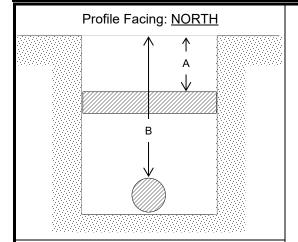


Remarks: Pothole on Electric line for the lighting circuit and Communication Fiber Optic line as dirtected.



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Subsurface Utility Pothole Report						P	othole	No.:	102319	.04				
	Date: 10/22/19								Pothole Total/Project: 10					
Р	roject	No.:	2019.0	037.2				SUE Supervisor: Erik White						
	CI	ient:	Molze	n Corbin					Surveyed By: David Reines					
Project	t Loca	tion:	US H\	NY 285 (Cano	oncito Eldo	orado			Revie	wed By:	Joe Gonza	ales	
Util	ity Ow	ner:	NMDC	DT(Electr	ic)/ (Conterra(F	iber Optic)			V	/eather:	Sunny		
Pothole Summary				Swing Tie Description/Measurement										
Surface D	escrip	tion:	Dirt			Thicknes	s of Surface:	NA	A.					
Descripti	ion of	Soil:	Rocky	,	Surface/Marker Elevation:		NA		B.	В.				
Total Excavat	ed De	pth:	50"	Description of Mark		on of Marker:	HUB			C.				
			Uti	ility Su	ımr	mary						Survey	Elev	ation
#	ID	T	ype	Materi	al	Size/ Width	Condition	Depth	Α	В	С	Point #	Top of Utility	Bottom of Utility
102219.04	Α	Ele	ectric	PVC	;	1 1/2"	Good	48"				3002	7121.0	
		•												
	·	•												



Top View





Remarks: Pothole on Electric line for the lighting circuit and Communication Fiber Optic line as dirtected.

Appendix D

SANTA FE COUNTY 2014 DESIGN GUIDE CHAPTER D, SECTION C – APPROVED MATERIALS LIST

SECTION C APPROVED MATERIALS LIST

C.1

General: All materials used in the construction of water lines shall be approved for use in drinking water systems. Materials shall be approved for use in drinking water systems by recognized organizations or governmental authority.

All underground service line valves and fittings shall conform to the requirements of ANSI/AWWA C800, latest revision. All underground valves and fittings shall be equipped with compression connections. The compression connection shall provide conductance and have a stainless steel or bronze internal split grip ring that grips the service tubing when tightened by the nut on the outlet threads. No clamps with screw type connections are acceptable. All service line valves, fittings and tubing shall be suitable for use with 150 psi pressure. Soldered joints for buried applications are not allowed.

All materials used in water mains and services shall be rated for a minimum of 150 psi working pressure.

The latest revision of standards shall apply with regard to standards listed in AWWA and American Society of Testing and Materials, (ASTM) Standards as well as any other referenced national or industry standards.

The type of pipe, size, joints, gaskets, coating, linings, wall thickness, installation, and testing shall conform to the latest revision of the specifications as set forth below.

C.2

Ductile Iron Pipe: Pipe shall conform to ANSI/AWWA C150/A21.5, latest revision, and ANSI/AWWA C151/A21.51, latest revision.

Mechanical joints, push on joints, or flanged joints shall be used as shown on all drawings and/or Standard Details. Joints shall conform to all requirements of ANSI/AWWA C115/A21.15, latest revision, and/or ANSI/AWWA C153/A21.53, latest revision, and or ANSI/AWWA C115/A21.15, latest revision. Rubber gaskets shall be bituminous coated on the outside.

Pipe thickness shown in AWWA C151.A21.51, latest revision, Table 51.2 for a rated working pressure, minimum of 150 psi shall be used, unless otherwise noted, or required for flanged pipe.

Installation and hydrostatic testing of the main shall be in strict accordance with ANSI/AWWA C600, latest revision. Disinfection of the main shall conform to C651, latest revision, requirements.

C.3

PVC Pipe: Pipe shall be manufactured and tested in strict accordance with ANSI/AWWA C900, latest revision, for 4-inch through 12-inch pipe or ANSI/AWWA C905, latest revision, for 14-inch through 36-inch pipe.

The thickness class shall be DR-18, unless otherwise noted. Pipe shall have the approval of NSF and shall be imprinted with the seal and approval of NSF.

PVC pipe shall be installed according to all applicable AWWA standards, and in strict accordance with the pipe manufacture's recommendations.



Santa Fe County Water Utilities Water and Sewer Construction Standards and Specifications

C.4

Iron Fittings: Ductile or grey iron fittings shall conform to ANSI/AWWA C110/21/10, latest revision, or C153/A21.53, latest revision. Grey iron fittings shall be rated for 250 psi working pressure for sizes up to 3 inch. Ductile iron fittings shall be rated for a 350 psi working pressure in sizes 3-24 inch and ductile iron flanged fittings shall be rated for a 250 psi working pressure in sizes 3-24 inch.

Fittings shall be outside coated with a petroleum asphaltic coating, approximately 1 mil thick. Fittings shall be lined with cement mortar lining in accordance with ANSI/AWWA C104/A21.4, latest revision. Rubber gaskets shall be in accordance with ANSI/AWWA C111/A21.11, latest revision.

Installation of iron fittings be in strict accordance to AWWA/C600, latest revision, requirements.

C.5

Mechanical Joint Retainers: Shall be the Mega lug as manufactured by EBAA Iron, Inc., Eastland, Texas or the Uni-Flange as manufactured by the Ford Meter Box Company, Inc., Wabash, Indiana.

For EBAA Iron, Inc. products the following shall be used: The series 2000 PV Mega lug shall be used for 4"-12" AWWA C900 PVC DR 18 pipe. The series 1100 PV Mega lug shall be used for and for 14"-30" AWWA C905 PVC pipe. The series 1100 Mega lug shall be used for Ductile Iron Pipe. Push on pipe joint harness devices shall be the series 1500 HV for AWWA C900 PVC, the series 1100 HV for AWWA C905 PVC, and series 1700 for Ductile Iron pipe.

For Ford Uni-Flang products shall be as follows: Series UFR1500-E-x-U shall be used for 4"-12" AWWA C900 PVC DR18 pipe. Series UFR1500-E-C shall be used for AWWA C905 14"-24" PVC pipe. Series UFR1400-D-x-U shall be used for Ductile Iron Pipe. Push on pipe joint harness devices shall be the series EFR1390-C-x-U for Ductile Iron pipe and AWWA C900 PVC.

C.6

Tapping Sleeves: Tapping sleeves (for taps other than size-on-size) shall have an epoxy lined and coated carbon steel A-36 body or an all stainless steel body; type 304 stainless steel bolts, hex nuts and plug; gasket suitable for water use; ANSI Class 150 flange. Tapping sleeves shall be manufactured by Romac Industries (Model 420 fabricated steel tapping sleeve), JCM (Model 412 fabricated steel tapping sleeve), Power seal (Model 3490 MJ stainless steel tapping sleeve with MJ outlet or AS stainless steel tapping sleeve with flange outlet), Ford (Model FTSC steel tapping sleeve or Model FTSS stainless steel tapping sleeve with stainless steel flange), or approved equal.

For size-on-size taps, a full wrap-around gasket and stainless steel full wrap-around tapping sleeve is required. The acceptable manufacturers are: Romac Industries (Model SST or Model SST-III stainless steel tapping sleeve), Power Seal (Model 3480 stainless steel tapping sleeve or Model 3490 MJ stainless steel tapping sleeve with MJ outlet or AS Stainless steel tapping sleeve with flange outlet), Ford (Model FTSS stainless steel tapping sleeve with stainless steel flange), or approved equal.

C.7

Gate Valves: Resilient seated gate valves shall be used wherever valves are called for on the drawings, unless otherwise noted. Resilient seated gate valves shall conform to AWWA C-509, latest edition, requirements; and shall be for 4" through 12" diameter N.R.S. (Non Rising Stem) A certified drawing shall be supplied by the manufacturer: The Manufacturer shall supply an affidavit of compliance to the above referenced AWWA



Santa Fe County Water Utilities Water and Sewer Construction Standards and Specifications

specification. Records shall be provided showing that tests specified in Section 6 have been performed. Bolts and nuts shall conform to section 2.2.3 of AWWA C-509, latest edition.

Valve ends can be either flanged or mechanical and will be as specified at time of purchase. Valve shall come equipped with O ring seals. Valves shall open left (counter clockwise) as viewed from the top and valve markings shall be made as outlined in Paragraph 7.1 AWWA C-509, latest edition. Valves shall be furnished with interior coating in accordance with AWWA C550-90. 14" and 16" valves shall be of same specification or better and designed for 200 psi working pressure.

C.8

Butterfly Valves: Butterfly valves shall conform to AWWA C-504, latest edition. Valves furnished shall be equipped with a body style as specified on the drawings. Maximum non shock shutoff pressure shall be 150 psi and class 150B as defined in section 3.5 of C-504, latest edition. All affidavits of testing shall be furnished. CONTRACTOR shall verify the compatibility of the valve with pipe connecting pieces. Butterfly valves are to be used only in sizes 14" and larger or where specifically called for in the drawings.

Valve shaft seals shall be on the type utilizing a stuffing box and pull down pack gland. Valve body shall be ductile iron. Valve discs shall be of a noncorrosive alloy metal.

Valves furnished for buried service shall come equipped with a heavy duty valve operator.

Valves furnished for plant service shall be equipped with a geared actuator assembly with a hand wheel.

Valve Boxes: Valve boxes shall be five and one quarter inch (5 1/4") diameter shafts in 36 to 48 inch extension length to 69 inch extension lengths are required. Boxes shall have the screw-type length adjustment. Valve boxes shall be constructed of cast or ductile iron.

C.10 Fire Hydrants: Fire Hydrants shall be one of the following models:

Model	Manufacturer	Mfg Location	
Kennedy Guardian	ITT Kennedy Valve	Elmira, New York	
Mueller Super Centurion	Mueller Company	Decatur, Illinois	
Mueller Super Centurion 250/HS	Mueller Company	Decatur, Illinois	

C.11

Casing Spacers: Fabricated casing spacers for use on carrier pipe installation through casing conduits shall provide dielectric with polymer runners. Casing spacers with steel bands shall be coated with fusion bonded epoxy or PVC coatings for corrosion protection. Casing spacers shall be of the following models:

Model	Manufacturer	Mfg. Location	
RACI Casing Spacers	Public Works Marketing Inc.,	Plano, TX	



C.12

Casing End Seals: Casing end seals shall be made of synthetic runner and be either a pull or style or wrap around style. Stainless steel band clamps with 100% non metallic worm gear shall be furnished for clamping the seal to spacing and carrier pipes. A mastic seal strip shall be factory furnished along the edge of the wrap around style seal. Refer to Section E for the list of approved casing end seals.

Model	Manufacturer	Mfg. Location	
Model Ac	Advance Products & Systems	Lafayette, Louisiana	

C.13

Copper Service Pipe: Copper service pipe shall confirm to ADTM B 88 and shall be Type K.

C.14

Water Service Materials: Water service materials manufacturers used in this section and referenced below:

Model	Manufacturer	Mfg. Location	
Ford	The Ford Meter Box Co. Inc.,	Wabash, Indiana	
Jones	James Jones Company	El Monte, California	
DFW	DFW Plastics, Inc.	Bedford, Texas	
Mueller	Mueller Company	Decatur, Illinois	

C.15

Meter Boxes: Meter boxes shall be DFW Round Meter Pit as manufactured by DFW Plastics Inc., Mid-States Round Meter Pit, or SFC Utilities approved equivalent. The diameter and length shall be specified as set forth in the SFC Utilities Detail.

C.16

Meter Box Lids and Covers: Meter lids shall be made of plastic with the standard size pentagon bolt for the locking lid and shall be furnished with aluminum inner frost lids. Meter box covers shall be the following model and manufacturer for each size service as listed:

Meter Size Cover Manufacturer & Model		
	³ / ₄ " – 1"	Ford Meter Box Co. (FW3 Wabash Double Lid Cover with EXT-2 Extension Ring)
	1-1/2 " - 2"	Ford Meter Box Co. (MC-36-MB Monitor Cover – includes Inner Frost Lid)

Meter Box lids shall be the following model and manufacturer for each size service as listed:

Meter Size	Lid Manufacturer & Model		
3/4" - 1"	Nicor Inc. (Read Rite Lid Type "A"- H20 Load Rating)		
3/4" - 1"	Ford Meter Box Co. (WA3LP Locking Plastic Lid)		
1-1/2" – 2"	Armorcast Products Co. (21-¼" Dia. Polymer Concrete Cover w. Worm Lock & Iron Recess)		

Inner frost lids shall be the following model and manufacturer for each size service as listed:

Meter Size	Lid Manufacturer & Model
3/4" - 1"	Ford Meter Box Co. (W3BA 11-½" Inner Aluminum Lid)
1-1/2" - 2"	Ford Meter Box Co. (MB 20" Inner Metal Lid)



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Santa Fe County Water Utilities Water and Sewer Construction Standards and Specifications

C.17

Meter Yokes: Yokes shall be constructed of cast iron. The meter yoke bar shall be painted. A 5/8" meter shall use 5/8" x 3/4" yoke; a 3/4" meter shall use 1" yokes, two (2) 1" x 3/4" meter adapters, and one (1) expansion connector, a 1" meter shall use 1" yoke and one (1) expansion connector. Yokes shall be the model and manufacturer as listed:

Manufacturer	Model for 5/8"	Model for 3/4"	Model for 1"
AY McDonald	14-2	14-4	14-4
Ford	Y 502	Y 504	Y 504
Jones	J 6201	J 6202	J 6202
Mueller	H-5020	H-5040	H-5040

C.18

Angle Valves: Angle valves shall be ball type compression connection for CTS tubing x locknut. (Locknut for yoke bar shall be used instead of a meter swivel.) Angle valves shall be the model and manufacturer as listed:

Manufacturer	Ball Style Model for 5/8"	Ball Style Model for ¾" or 1"	
AY McDonald	4602BYQ	4602BYQ	
Jones	J-6417WSG	J-6417WSG	
Ford	BA94-323 W-Q	BA94-444W-Q	
Mueller	B-24273	B-24273	

Include the following information for residential double meter services:

- 1. 5/8" Double Service Branch Piece
 - Acceptable Manufacturers: Jones (j-2613SG w/ dimensions of 1" x 7-1/2" x 3/4" MIP),
 Mueller (H-15363 1"x7-1/2" x 3/4" MIP) and Ford (U48-43-Q 1" x7- 1/2" x 3/4" MIP)
- 2. 5/8" Double Service Angle Valve
 - Acceptable Manufacturer: Mueller Co. Angle Ball Valve (B-24278 w/dimensions of 5/8" x 3/4" x 3/4" FIP) and Ford Angle Ball Yoke Valve (BA91-323W w/dimensions of 5/8" x 3/4" & 3/4" FIP).

C.19

Angle Cartridge with Dual Check Valve: Angle Cartridges shall be Dual Check Valve type. Angle Cartridges shall be the model and manufacturer listed:

Manufacturer	Model for 3/4"	Model for 1"	Model for 2"
Ford	HHCA92-323	HHCA92-444	HHFA31-777

C.20

Expansion Connectors: Expansion connectors shall be of the three piece design with composition gaskets. Plastic or rubber gaskets will not be accepted. Expansion connectors shall be the model and manufacturer as listed:

Manufacturer	Model for 5/8"	Model for 3/4"	Model for 1"
AY McDonald	14-2EHG		14-4 EHG
Ford	EC23	EC4*	EC4
Mueller	H-14234		H-14234



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*Two (2) Meter Adapters (Ford A24) also required.

C.21

Meter Settings, 1 -1/2" & 2": Prefabricated meter settings for 1 -1/2" & 2" meters shall be equipped with balltype angle valves on the meter inlet and outlet sides and shall have a 24" rise and shall have FIP inlet and outlets and shall have a MIP by copper tubing compression adapter. Meter setter shall not have a bypass. Risers shall be positioned at least 2" away from the inner wall of the meter pit. Meter setting shall be the model and manufacturer as listed:

Manufacturer	Model for 1 ½" (Plug Valves)	Model for 2" (Plug Valves)
Ford	VV76-24-1166	VV77-24-1177
Jones	J02EFIPFIPBVBV24	J02FFIPFIPBVBV24
Mueller	H-1422-00-150	H-1422-00-200

Manufacturer	Model for 1 ½" (Ball Valves)	Model for 2" (Ball Valves)
AY McDonald	20-624WWFF 660	20-724WWFF 770

The adapter shall be the model and manufacturer as listed:

Manufacturer	Model for 1-1/2"	Model for 2"
Ford	C84-66	C84-77
Jones	J2605SG	J2605SG
Mueller	H-15428-150	H-15428-200

C.22

Corporation Stops: Corporation stops must be ball type with CC thread (AWWA tapered thread) inlet and compression connection on outlet (CTS - copper tube size). Iron pipe thread not acceptable. Corporation stops shall be the model and manufacturer as listed:

Manufacturer	Model Number
AY McDonald	4701BQ
Mueller	B-25008
Ford	FB1000-x-Q-K

C.23

Service Tapping Saddle: For PVC (C-900) installations: bronze parts are not acceptable. Service tapping saddle shall be stainless steel, double strap with iron body. The iron body shall have either epoxy coating (10-12 mills minimum) or nylon coating (10-12 mills minimum). Acceptable manufacturers are Smith-Blair, Ford and Mueller Co. Double band brass saddles with stainless steel bolts and band, style 202BS, as manufactured by Ford are also accepted.

For DIP/CIP installations: Direct tap with CC threads (AWWA tapered threads) is preferred. Iron pipe thread is not acceptable. Alternate exception is installation of stainless steel full circle tapped clamp with CC threads (AWWA tapered threads). All stainless steel to be: one section, two bolt minimum. Romac and JCM are acceptable manufacturers. Double band brass saddles with stainless steel bolts and band, style 202BSD, as manufactured by Ford are also accepted. When multiple taps are required the following spacing is approved: Minimum 12" horizontal spacing and vertical spacing shall alternate 75° and 85° from vertical.



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C.24

Service Tapped Couplings: Service tapped couplings shall have AWWA threads and shall be either cast iron, ductile iron or PVC and shall meet all requirements for fittings specified in Section C.

C.25

Prefabricated Meter Vault: Prefabricated meter vault shall consist of a vault body with open bottom, a double opening cover with a torsion lift and support mechanism. The vault body shall be manufactured of fiberglass-reinforced plastic. The covers shall be manufactured of polymer concrete. The torsion frame assembly shall be manufactured of hot-dipped galvanized steel. The cover shall be torsion assist polymer concrete consisting of two torsion assisted sides and a stationary center cover. The torsion assisted covers shall have the capability of opening 90 degrees and shall be secured in the closed position with hex-head bolt downs. The stationary center cover shall be secured with stainless steel hex-head bolts.

Polymer concrete covers shall be skid resistant with a 0.5 minimum coefficient of friction. Covers shall have lifting slots with stainless steel lifting pins. Vault body and cover assembly shall be designed to withstand 10,400 pound vertical load when installed at grade level. Vaults shall be manufactured by Armorcast Products Company, North Hollywood, California.

C.26

Air Release Valves: Air release valves shall be combination valves capable of releasing large quantities of air during filling of an empty pipe, and breaking vacuum during pipe draining by allowing the re-entry of large quantities of air, and releasing air accumulations under pipe operating pressure. The air release valves shall be Crispin Combination Air Valve (1" valve shall be Model 201C and 2" valve shall be Model 202C): or approved equal.

C.27

Utility Marking Posts: Utility marking post material shall be manufactured of fiberglass. The marking post shall be blue and have white labels on both sides with black lettering stating "CAUTION WATER PIPELINE/BEFORE DIGGING CLL NM ONE CALL 811 FOR LOCATES". Marking posts shall be constructed of resilient materials and shall not deteriorate with exposure to temperature extremes. Marking post colors shall not fade with exposure to sun, water, etc. Marking posts shall be 72″ long by 4″ wide. Acceptable manufacturers are Carsonite International. − Curv-Flex® (Early Branch, South Carolina) or Rhino-FiberCurve™ (Waseca, Minnesota).

C.28

All water mains and other pressure pipelines shall be buried with a continuous electrical tracing wire to enable future location of pipe. The tracing wire shall be an insulated #12 AWG solid conductor. Tracing wires shall be taped to the top of the pipe at 10-Foot intervals to prevent dislocation of the wire during backfilling. There shall be a Test Station for every 300 ft. run without a service or a hydrant.

The tracing wire shall be spliced and extended to an above or at grade Test Station near the base of fire hydrants, at valve boxes, and meter cans as directed by SFC Utilities representatives.

The Test Station shall be a 2-inch monitoring station as manufactured by Hadley Industries, Jackson, Michigan. The Test Station shall be furnished complete with a cast iron lid and a magnet for easy location with a line locator. A 12" by 12" by 4" deep concrete pad around the test box shall be provided for security.

The tracing wire shall be spliced using a 3-way low voltage tap connector, 3M-562 or equivalent. The splice shall be coated for corrosion protection using a general purpose tape sealant similar to Ray-Chem products, 1.5-inch



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wise, 0.012-inch thick spirally wrapping with 1-inch overlap at connector and wire. The tape sealant shall be covered with a layer of electrical tape as an outer wrap.

Bonding Wire for Line Tracing:

When the electrical continuity of two lengths of metal pipe is broken by a section of plastic pipe, the metal pipes at either end shall be bonded across the plastic pipe to restore the electrical continuity.

Bonding of the metal pipe shall be by means of cadwelds (exothermic) connectors and #4 AWG insulated copper wire. The wire ends and cadwelds shall be capped and sealed to prevent corrosion per Standard Details.

C.28.1

Electronic Marking System Devices (EMD's) Ball Markers are required on all sewer service (green) stub-out locations, casing bore ends or as required by SFCU, on all water line casing bore ends (blue), critical vertical offsets or as required by SFCU. Marker Balls shall be installed directly above the line being identified and in no circumstances shall the balls be buried deeper than 5-feet maximum. Acceptable materials are: 3M EMS Ball Markers; 1403-XR for water, 1404-XR for wastewater, and 1408-XR for reclaimed water systems.



Appendix E

NEW MEXICO DEPARTMENT OF TRANSPORTATION PERMITS

PENDING PERMITS

Appendix F

PNM EASEMENT ENCROACHMENT AGREEMENT



A personal commitment to New Mexico

Alvarado Square, Albuquerque, New Mexico 87158-2101

EASEMENT ENCROACHMENT AGREEMENT

	EASEMENT ENCROACHMENT AGREEMENT
l	This Easement Encroachment Agreement made this day of, 2020,
	by and between (BUYER/BORROWER/OWNER)Santa Fe County
	whose address is Santa Fe, New Mexico
(h	nereinafter called "First Party"), (his) (her) (their) (its) heirs, successors and assigns, and PUBLIC SERVICE COMPANY OF NEW MEXICO, ew Mexico Corporation (hereinafter called "PNM"), and all collectively hereinafter called "Parties."
W	ITNESSETH:
W	HEREAS, PNM is the Grantee of a certain Easement within the hereinafter described property;
٧	VHEREAS, First Party desires to encroach upon the Easement as more particularly specified hereinafter; and
١	WHEREAS, PNM has agreed to said encroachment;
No to	OW THEREFORE, for and in valuable consideration, the receipt of which is hereby acknowledged, PNM does hereby grant First Party the encroach upon the Easement only to the extent of, and for the purposes set forth below:
	MT006345 - (SL115kV Line PNM file: 503.3)
1	An encroachment of a 12-inch PVC waterline extending approximately 3 miles within the easterly twenty feet of a 100 foot wide Public Service Company of New Mexico easement, situate within Sections 22, 27 35 T.16N., R. 9E., N.M.P.M., and Section 2, T.15N., R.9E., N.M.P.M. Santa Fe County, New Mexico, easement was filed for record in the office of the County Clerk of Santa Fe, County on January 26, 195 Book 96, Page 440.
1	aid area of this encroachment is shown on the drawing attached hereto and made a part hereof as Ex A". In addition to the 20-foot encroachment area herein, it is understood that First Party is also acquiri 0' foot strip adjoining PNM's 100-foot easement, to complete First Party's 30-foot waterline easement. letail is shown on "Easement Sketch" and attached hereto as Exhibit "B".
	ENCROACHMENT GUIDELINES FOR ELECTRIC FACILITIES 1. All personnel and equipment must maintain fifteen (15) feet vertical and horizontal clearance from all wires and structures. In addition, all personnel and equipment must comply with Occupational Safety and Health Administration (OSHA) clearances for workers prescribed lines.
-	near energized lines. 2. No permanent structures or landscaping at mature growth can be more than fourteen (14) feet in height within the Easement. 3. First Party will provide a complete set of development plans to PNM for review and approval. If changes are made as a result or review process, a final development plan will be provided by First Party to PNM before final approval is granted. 4. When required, First Party shall install a PNM approved barricade for structures affected and incur all costs associated with the
	barricade installation. 3. Only the waterline encroachment shown on the attached Exhibits "A" and "B" has been approved to be within the easement by PNM, First Party shall not modify or add to said encroachment unless first approved by PNM. 6. No grading within 5 feet of PNM pole structures. 7. No fill over 1 foot within the PNM easement.

By granting the aforesaid right to encroach PNM does not waive or relinquish any rights or benefits that it may have, either expressed or implied, under or by reason of the Easement, including, but not limited to, the right to build, rebuild, construct, reconstruct, locate, relocate, change, remove, replace, modify, renew, operate and maintain its electric lines (including underground electric lines) and other electric equipment, fixtures, appurtenances and structures that are now located, or may in the future be located, on, over, beneath, through and across the Easement. First Party, at its sole cost and expense, agrees to remove or relocate its encroachment upon the written request of PNM within 90 days of such written request. First Party appoints PNM as its agent to accomplish said removal or relocation at First Party's expense if First Party fails to remove or relocate such encroachment within such time period.

7. No fill over 1 foot within the PNM easement.

8. PNM shall have 24/7 vehicle access to facilities,

9. No stockpiling material within the right of way.

10. PNM would like shared use of any access road or trail created for this project.

→1. PNM will need to see copies of all land agreements negotiated by the County with individual property owners for use of a portion of

the PNM easement for a waterline.
12. All construction and maintenance work/equipment will be confined to the 30-foot waterline easement as shown on "Exhibit B".

In consideration of PNM granting First Party the right to encroach upon the Easement, First Party agrees to release from liability PNM, its officers, employees and agents from, and subject to the immunities and limitations of the New Mexico Constitution, Art. IX, Sec. 10 and the New Mexico Tort Claims Act (Section 41-4-1 et seq., NMSA 1978, as amended) and agrees to indemnify and hold harmless, PNM its officers, employees and agents from, any and all claims that directly or indirectly arise out of the existence, construction, maintenance, operation, repair, condition, use or presence of the encroachment that is authorized by PNM in this Agreement, upon the Easement, or are caused by, or arise out of, the actions or omissions of First Party, its officers, employees or agents; provided, however, that notwithstanding anything to the contrary in this paragraph, First Party's obligations to release from liability or indemnify PNM, its employees and agents shall not apply to claims for personal injuries or damages to property to the extent such are caused by or result from the negligent actions or omissions of PNM, its officers, employees or agents.

In consideration of PNM permitting First Party to encroach upon the Easement, First Party agrees that PNM shall not be responsible for any damage caused to facilities, equipment, structures or other property of First Party if damaged by reason of PNM's use of Easement.

First Party shall comply with all applicable laws, ordinances, rules and regulations enacted or promulgated by any federal, state or local governmental body having jurisdiction over First Party's encroachment.

The provisions hereof shall inure to the benefit of and bind the heirs, executors, administrators, personal representatives, mortgagees, lessees, tenants, successors and assigns of the Parties hereto; provided, however, that no such heir, executor, administrator, personal representative, mortgagee, lessee, tenant, successor or assign of First Party shall have the right to use, alter or modify the encroachment in a manner which will increase the burden of the encroachment on the Easement.

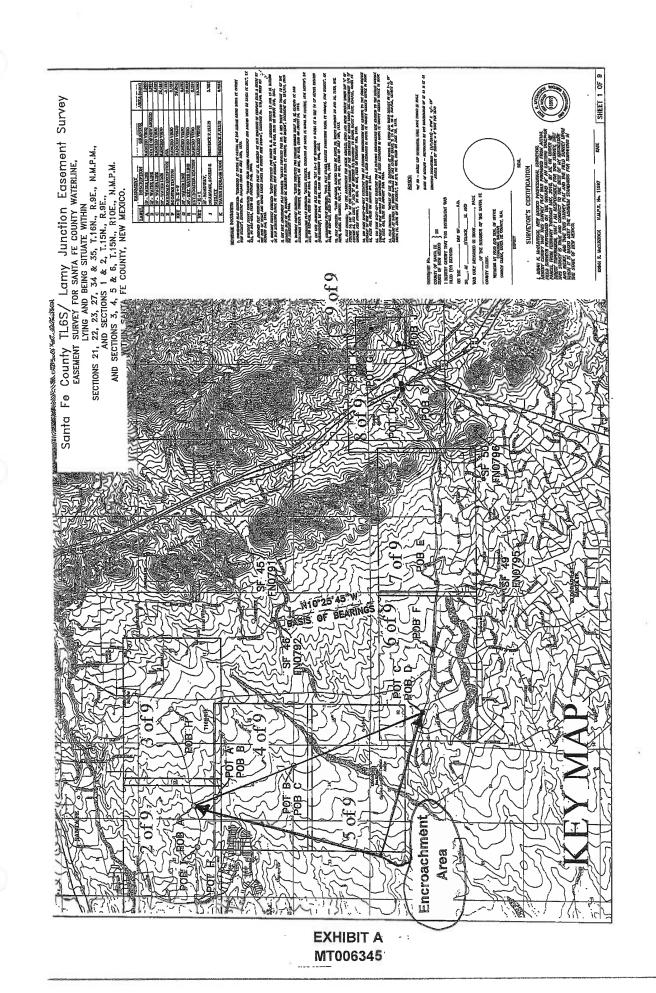
PUBLIC SERVICE COMPANY OF NEW MEXICO

IN WITNESS WHEREOF, the Parties have executed this Agreement on the day and year first written above.

FIRST PARTY

Santa Fe County

Ву: В	y: Fernando Vigil, Manager, Land Management Department
Ву:	
PNM US	E ONLY
STATE OF NEW MEXICO } COUNTY OF BERNALILLO) SS	, 20 20 .
This instrument was acknowledged before me on By Fernando Viqil, <u>Manager</u> , <u>Land Management Department</u> of the corporation, on behalf of said corporation.	Public Service Company of New Mexico, a New Mexico
My commission expires: (Seal)	Notary Public
	,
ACKNOWL	EDGEMENT
STATE OF	
COUNTY OF	
Ву	
My commission expires: (Seal)	Notary Public
ACKNOWLEDGEMENT	FOR CORPORATIONS
STATE OF}	
COUNTY OF} SS This instrument was acknowledged before me on	, 20
Ву	
(Name of Officer)	(Title of Officer)
of(Corporation Ackn	owledgement)
a corporation, on behalf o (State of incorporation) Said officer acknowledges s/he is the duly authorized signatory o	f said corporation.
My commission expires:	
(Seal)	Notary Public



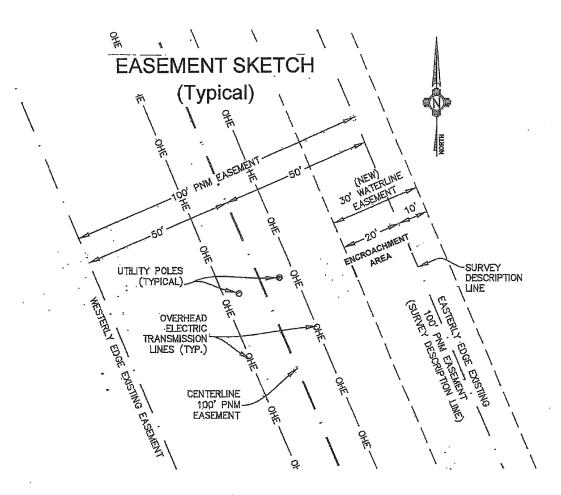


EXHIBIT B MT006345