VOLUME 2 OF 2

SEQUOIA & KINGS CANYON NATIONAL PARKS

PMIS 317446 (formerly 184085, 246176 & 181622)

REHABILITATE ASH MOUNTAIN AND BUCKEYE WASTEWATER TREATMENT PLANTS

PROJECT SPECIFICATIONS
Division 2 – 49

Prepared for:

Sequoia & Kings Canyon National Parks
Tulare County, California

100% CD DRAFT

April 26, 2022

NATIONAL PARK SERVICE
PACIFIC WEST REGION

SEKI Ash Mountain & Buckeye Housing – 100% Draft
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DIVISION 02

EXISTING CONDITIONS

SECTION 02 05 00

COMMON WORK RESULTS FOR EXISTING CONDITIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work of this Section includes the general procedures and requirements for Site Work.

PART 2 - PRODUCTS - NOT USED.

PART 3 - EXECUTION

2.1 EXAMINATION

A. Site Verification of Conditions

1. The contractor shall perform necessary potholing or locating of underground utilities and services. Perform minor, investigative excavations to verify the location of various existing underground facilities at sufficient locations to assure that no conflict with the proposed work exists and sufficient clearance is available to avoid damage to existing facilities.
2. Upon discovery of conflicts or problems with existing facilities or construction documents, notify Contracting Officer within 24 hours.
3. The existing mapping may be used to approximate the locations of existing utilities. The contractor is responsible for determining the actual locations of all utilities.

2.2 PREPARATION

A. Protection

1. Spillage -
   a. Avoid spillage by covering and securing loads when hauling on or adjacent to public streets or highways.
   b. Remove spillage and sweep, wash, or otherwise clean projects, streets, and highways.
2. Dust Control: See Division 01 Section 01 57 23 “Temporary Storm Water Pollution Prevention.”
3. Sediment & Erosion Control: See Division 01 Section 01 57 23 “Temporary Storm Water Pollution Prevention.”
4. Existing Plants and Features: Do not damage the tops, trunks, and roots of existing trees and shrubs on site which are intended to remain. Do not use heavy equipment within branch spread. Interfering branches may be removed only with the permission of the Contracting Officer. Do not damage other plants and features which are to remain.

2.3 REPAIR / RESTORATION - NOT USED.

2.4 FIELD QUALITY CONTROL

A. Notify Contracting Officer 48 hours before performing excavation or fill work.

B. If work has been interrupted by weather, scheduling, or other reason, notify Contracting Officer 24 hours minimum before the intended resumption of grading or compacting.

C. NPS reserves the right to require additional testing to re-affirm the suitability of completed work including compacted soils that have been exposed to adverse weather conditions.

END OF SECTION

SECTION 02 41 00

DEMOLITION & ABANDONMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work of this Section includes all demolition, removal, salvage, and disposal of existing structures, piping, pavement, and other miscellaneous materials.

1.2 SUBMITTALS

A. As specified in Division 01 Section 01 33 23 “Submittal Procedures.”

B. Certifications and testing consistent with Division 01 Section 01 33 23 “Submittal Procedures” and including:

1. Permit for transport and disposal of debris.
2. The proposed method of demolition, proposed schedule, sequence of work, and proposed method and schedule for removing, maintaining, and re-establishing facilities and utilities before scheduling the preconstruction meeting.

1.3 SITE CONDITIONS

A. Protection

1. Erect barriers, fences, guardrails, enclosures, chutes, and shoring around all construction activities to protect personnel, structures, and utilities remaining intact.
2. Protect designated trees and plants from damage.

B. Maintaining Traffic

1. Assure minimum interference with roads, streets, driveways, sidewalks, and adjacent facilities.

C. Utility Lines and Services

1. Keep existing structures to remain and adjacent structures intact and in operation.
2. Obtain permission to disrupt any utilities or services temporarily or permanently.
3. Coordinate with the utility company for disconnecting existing service on structures to be demolished.
4. Coordinate with Park for services to be disconnected and schedule with the utility company. Schedule and coordinate with Park and utility company far enough in advance to not delay work.

D. Before demolishing a utility or facility, notify the Contracting Officer 3 days in advance, and plan the demolition such that the demolition will not create an unsafe condition or interfere with ongoing operations.

E. Where demolition must occur in such a sequence that a portion of this facility must remain operational, coordinate this aspect with the Contracting Officer.

F. Do not burn waste material. All organic material removed from the construction area must be properly chipped and recycled or removed from the Park and properly disposed of.

G. Provide adequate fire protection. Keep the area clear of hazardous substances and debris.

H. Always maintain access to the exit.

I. Separate demolition area from building to remain with temporary dustproof partitions.

J. Provide temporary weather protection to prevent damage to structure and interior area.

K. Explosives are not permitted.

PART 2 - PRODUCTS

2.1 BACKFILL MATERIALS

A. Native soils, stone, gravel, or sand, free from debris, frozen materials, roots, and other organic matter may be used for backfilling demolition areas that are not designated for new construction. Pieces of concrete and masonry smaller than 1 square foot and suitably shaped for compaction may be used in backfill more than 1 foot below finished grade. Restrictions to Backfill:

B. See Section 01 11 00 – Summary of Work; Subsection 1.4.C Preservation of Natural Features Item 4.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that areas to be demolished are unoccupied and discontinued in use.

B. Do not commence work until conditions are acceptable to Contracting Officer

3.2 PREPARATION

A. Arrange for and verify termination of utility services to include capping lines.

B. Remove items scheduled to be salvaged and place them in the designated storage area.

3.3 DEMOLITION/ABANDONMENT

A. All debris from demolition and abandonment shall be removed from the Park and disposed of lawfully. Any material which the Contracting Officer may wish to save or reuse shall be stored per the Contracting Officer's direction.

B. General

1. Dampen debris and use temporary enclosures as necessary to control dust.
2. Do not use water to the extent it causes flooding, contaminated runoff, or icing.
3. Break concrete and masonry into sections less than 3 feet in any dimension and dispose of off-site.
4. Repair damage to adjacent structures.
5. Make neat saw cuts around areas of concrete to be removed, where remaining concrete is to be incorporated into new work.
6. Remove existing exposed piping to the extent shown on the Drawings.
7. Remove buried piping to the extent shown on the Drawings.
8. All equipment to be removed or replaced shall be done so in a safe manner and such that the equipment and any associated piping or wiring is not damaged.
9. All debris from demolition and abandonment shall be removed from the Park and disposed of lawfully. Any material which the Contracting Officer may wish to salvage shall be cleaned and stored per the Contracting Officer’s direction and requirements of this specification.

3.4 HAZARDOUS MATERIALS

A. If suspected hazardous materials are encountered during the demolition of existing facilities, all work is to be stopped immediately and the Contracting Officer is to be immediately notified.

3.5 DISPOSAL

A. Place demolition debris in debris boxes onsite for weekly removal.

B. Dispose of unsuitable and excess material off-site. The contractor shall recycle all recyclable demolished materials. The contractor shall submit names and contact information for proposed recyclers to the Contracting Officer before beginning demolition. Only materials not suitable for recycling shall be disposed of in a landfill.

C. Disposal of demolition material shall be following all EPA, OSHA, and California requirements for materials disposal.

3.6 SALVAGE

A. Carefully remove items to be salvaged and delivered to Contracting Officer’s storage.

1. Store and protect items indicated to be salvaged.

2. Replace any items damaged through carelessness in removal, storage, or handling with new items of the same type.
3. Do not reuse materials or equipment not specifically indicated or specified to be reused.

B. Preparation of Equipment for Storage

1. Identify each component with markings or tags to show its position in the assembly and the assembly to which it belongs.
2. Place small parts in wooden boxes and clearly mark contents on the outside.
3. Thoroughly clean and dry equipment.
4. Coat unpainted surfaces with 2 coats of rust-preventive compound.
5. Attach the unit to suitable crate bottom.
6. Enclose the unit in polyethylene film and seal all seams and the film to the base of the unit with tape.
7. Construct a crate of wooden slats around the top and sides of the unit.
8. Attach a permanent instruction tag to the outside of the crate stating “This unit has been prepared for storage.”

END OF SECTION

SECTION 02 41 16

STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Structure Demolition:

1. Demolition of designated site improvements including paving, curbing, site walls, and utility structures.
2. Demolition of below-grade foundations and site improvements to depth to avoid conflict with new construction or site work.
3. Removal of hollow items or items which could collapse.
4. Salvage designated items.
5. Protection of site work and adjacent structures.
6. Disconnection, capping, and removal of utilities.
7. Pollution control during building demolition, including noise control.
8. Removal and legal disposal of materials.
9. Protection of designated site improvements and adjacent construction,
10. Interruption, capping, or removal of utilities as applicable.

B. Hazardous Materials:

1. Not present.
2. Removed under a separate prior contract.
3. Removed as a part of this contract.

1.2 SUBMITTALS

A. Submit under provisions of Section 01 33 23 - Submittal Procedures.

B. Schedule: Submit for approval demolition schedule, including schedule and methods for capping utilities to be abandoned and maintaining existing utility service.

1.3 QUALITY ASSURANCE

A. Codes and Regulations: Comply with governing codes and regulations. Use experienced workers.

1.4 PRE-INSTALLATION MEETINGS

A. Convene a minimum of two weeks prior to starting the work of this section.

1.5 SEQUENCING

A. Immediate areas of work will not be occupied during demolition. The public, including children, may occupy adjacent areas.

B. No responsibility for buildings and structures to be demolished will be assumed by the Owner.

C. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

PART 2 - PRODUCTS - Not applicable to this Section

PART 3 - EXECUTION

3.1 STRUCTURE DEMOLITION

A. Demolition Operations: Do not damage building elements and improvements are indicated to remain. Items of salvage value, not included on the schedule of salvage items to be returned to the Owner, shall be removed from the structure. Storage or sale of items at the project site is prohibited.

B. Utilities: Locate, identify, disconnect, and seal or cap off utilities in buildings to be demolished.

C. Shoring and Bracing: Provide and maintain interior and exterior shoring and bracing.

D. Occupied Spaces: Do not close or obstruct streets, walks, drives, or other occupied or used spaces or facilities without the written permission of the Owner and the authorities having jurisdiction. Do not interrupt utilities serving occupied or used facilities without the written permission of the Owner and authorities having jurisdiction. If necessary, provide temporary utilities.

E. Operations: Cease operations if public safety or remaining structures are endangered. Perform temporary corrective measures until operations can be continued properly.

F. Security: Provide adequate protection against accidental trespassing. Secure project after work hours.

3.2 SCHEDULE

A. Items for Protection During Demolition: (The following are samples only)
   1. [Designated site improvements, trees, and plantings.]
   2. [Adjacent construction.]

B. Items to be Salvaged for Reinstallation:

   1. [Handrails.]
   2. [Wood trim.]
   3. [Light fixtures.]

C. Items to be Salvaged for Delivery to Owner:

   1. [Doors and hardware.]
   2. [Toilet accessories.]
   3. [Light fixtures.]
   4. [Plumbing fixtures.]
   5. [Radiators]
   6. [Decorative elements.]

D. Utilities Requiring Interruption, Capping, or Removal:

   1. [Chlorination tank]
   2. [Electric.]
   3. [Heat.]
   4. [Water.]
   5. [Gas.]
   6. [Sewerage.]
   7. [Steam.]
   8. [Cable television.]

END OF SECTION

SECTION 02 41 19

SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work of this section consists of removal and disposal of existing, wood fencing, septic tanks, wet well tanks and associated internal mechanical components, abandonment of water lines, valves, sewer lines, sewer cleanouts, and the selective demolition and removal of concrete.

1.2 RELATED WORK

A. Section 01 50 00 – Temporary Facilities & Controls

B. Section 31 23 33 – Utility Excavation & Backfill

1.3 SUBMITTALS

A. As specified in Section 01 33 23

B. Submit a schedule showing sequence of work and methods of demolition and relocation. Include a schedule for isolating, shutting off, and capping utilities, and re-establishing utility services.

1.4 QUALITY ASSURANCE

A. Comply with safety requirements for demolition, ANSI A10 Series.

1.5 PROJECT CONDITIONS

A. Take all necessary measures to control dust during demolition.

B. Ensure the safety of persons in the demolition area. Provide temporary barricades as required.

C. Provide adequate fire protection. Keep the area clear of hazardous substances and debris.

D. Hazardous Materials: Hazardous materials may be present in buildings and structures, such as solvents, oils, and greases. Demolition shall be conducted per the Contracting Officer's direction.

E. Storage or sale of removed items or materials on-site is not permitted.

F. Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1.6 SCHEDULING

A. Complete demolition that might damage new construction before starting new work.

PART 2 – PRODUCTS - NOT USED.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected, isolated, and capped before starting selective demolition operations.

B. Contracting Officer does not guarantee that existing conditions are the same as those indicated in record documents.

C. Survey existing conditions and correlate with requirements indicated to determine the extent of selective demolition required.

3.2 PREPARATION

A. Provide temporary supports and protection for a portion of the structure to remain. Protect fixtures and equipment to remain. Protect nearby structures and vegetation, as necessary.

B. The contractor shall saw-cut the edges of all pavements, walkways, gutters, and concrete curb sections that are to be removed. The saw cut line shall be straight and smooth to allow for a clean line of repair.

C. Water and wastewater lines (including stormwater) abandoned in place shall be capped.

D. Cap or disconnect utilities. Provide bypass connections as necessary to maintain utility service to occupied areas. Abandon utilities in place that are no longer required in areas not disturbed by construction.

E. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

F. Provide protection to ensure the safe passage of people around the selective demolition area and to and from occupied portions of the building.

G. Provide temporary weather protection, during the interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to the structure and interior areas.

H. Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

3.3 DEMOLITION

A. Concrete shall be demolished in small sections. Using a power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at the perimeter of areas being demolished, cut reinforcement, and then remove the remainder of concrete.

3.4 SALVAGE

A. Carefully clean and store items to be salvaged or reused.

B. Storage Area: As directed by the Contracting Officer.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

A. Except for items and materials indicated to be salvaged, remove all demolished materials from the project site.

B. Do not allow demolished materials to accumulate on-site.

C. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

3.6 RESTORATION AND CLEAN-UP

A. Repair and clean adjacent surfaces damaged or soiled by demolition work.

B. Restore utility service to normal operation.

C. Remove equipment, temporary protection and barriers, and debris. Dispose of unsalvageable material as specified in Section 01 50 00.

END OF SECTION

DIVISION 03

CONCRETE

SECTION 03 11 13

CAST-IN-PLACE CONCRETE FORMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work of this Section consists of furnishing and installing required formwork ready for placing of concrete. This includes the design, construction, safety, removal, and disposal of the formwork.

1.2 REFERENCES

A. American Society for Testing and Materials

1. ASTM D 1751-97, 'Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)'

1.3 SUBMITTALS

A. Quality Assurance/Control - Manufacturer's application instructions for a form release agent.

B. Shop Drawings and Engineering Data shall be submitted following the requirements of Division 01 Section 01 33 23 “Submittal Procedures.”

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Forms - wood, metal, or plastic as arranged by Contractor. Forming material shall be compatible with specified form release agents and with finish requirements for concrete to be left exposed or to receive a decorative finish.

B. Expansion / Contraction Joints

1. Asphalt Impregnated Fiber:
   a. Manufactured commercial fiber type meeting requirements of ASTM D 1751 and 1/2 inch thick.
   b. Acceptable Products and Manufacturers:
      1) Conflex by Masonite Building & Industrial Products Group, Chicago, IL
      2) Sealtight by W R Meadows Inc, Elgin, IL
      3) Equal as approved by Contracting Officer before installation. See Division 01 Section 01 33 23 “Submittal Procedures.”

PART 3 - EXECUTION

3.1 INSTALLATION

A. Forms

1. Assemble forms so forms are sufficiently tight to prevent leakage.
2. Properly brace and tie forms.
3. Make proper form adjustments before, during, and after concreting.
4. Use new forms or used forms that have been cleaned of loose concrete and other debris from previous concreting and repaired to proper condition. Provide smooth liner on forms used for concrete to be exposed if necessary to attain specified finish quality.
5. Use metal cold joint forms when unable to place concrete for footings, foundations, and slabs in continuous pours.

B. Accessories

1. Provide for installation of inserts, templates, fastening devices, and other accessories to be set in concrete before placing.
2. Position anchor bolts for hold-down anchors and columns and securely tie them in place before placing concrete.

C. Expansion Joints: Install at joints between the floor slab and foundation wall shown on the Drawings.

D. Form Removal: Removal of forms can usually be accomplished in 12 to 24 hours. If the temperature is below 50 deg F or if concrete (stairs, beams, etc.) depends on forms for structural support, leave forms intact for a sufficient period for concrete to reach adequate strength.

END OF SECTION

SECTION 03 15 10

CONCRETE ACCESSORIES – EPOXY ANCHORS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work covered in this Section includes furnishing and installing a two-part epoxy adhesive anchor for rebar embed placement involving concrete construction and threaded bolt embed placement into cast-in-place or precast concrete as indicated in the Contract Documents.

1.2 REFERENCES

A. American Concrete Institute

1. ACI 318-

B. American Society for Testing and Materials

1. ASTM D 695-96, 'Compressive Strength'
2. ASTM D 638-97, 'Tensile Strength'

C. Concrete Reinforcing Steel Institute

1. CRSI ‘Reinforcing Steel - The Manual of Standard Practice’

1.3 SUBMITTALS

A. As specified in Section – 01 33 23.

B. Manufacturer’s material specifications.

C. Manufacturer’s technical datasheet.

D. Manufacturer’s recommendations for storage and installation.

1.4 DELIVERY, STORAGE, AND HANDLING

A. The epoxy adhesive shall be stored per the manufacturer’s recommendations before and at the time of delivery and placing. Properly protect material on-site after delivery.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Two-Part Epoxy Adhesive Anchor

1. Approved Product: The following material is approved; others shall be approved by the Contracting Officer following Section 01 33 23 “Submittal Procedures.”

Hilti RE 500 Epoxy Adhesive Anchor
Hilti, Inc.
5400 South 122nd East Avenue
Tulsa, OK 74146
(800) 879-8000
http://www.us.hilti.com/holus/

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be per the manufacturer’s recommendations and guidelines.

END OF SECTION

SECTION 03 21 00

CONCRETE REINFORCING STEEL

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work covered in this Section includes furnishing and installing concrete reinforcing steel for concrete construction as indicated in the Contract Documents.

1.2 REFERENCES

A. American Concrete Institute

1. ACI 318

B. American Society for Testing and Materials

1. ASTM A 615-96a, 'Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement'

C. Concrete Reinforcing Steel Institute

1. CRSI ‘Reinforcing Steel-The Manual of Standard Practice.’

1.3 SUBMITTALS

A. As specified in Division 01 Section 01 33 23 “Submittal Procedures.”

B. Certification from steel supplier that meets minimum requirements of the specification.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Reinforcing steel shall be free of heavy rust scales and flakes, or another coating at the time of delivery and placing. Properly protect rebar on-site after delivery.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Reinforcing Steel

1. Rebars shall have grade identification marks and conform to ASTM A 615.
a. Grade 60 minimum.

b. Bars shall be deformed type.
c. Bars shall be epoxy coated for use in the cast-in-place construction where groundwater has been encountered.
d. Bars shall be free of heavy rust scales and flakes, or other bond-reducing coatings.

B. Welded Wire

1. Welded wire fabric shall conform to ASTM 185.

2.2 FABRICATION - NOT USED.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Bend bars cold according to the recommendations of Chapter 7, the current ACI 318.

B. Accurately place and support with chairs, bar supports, spacers, or hangers as recommended by the current edition of CRSI 'Reinforcing Steel-The Manual of Standard Practice.'

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE SITE ELEMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work of this Section consists of furnishing and performing all operations necessary for the placement of cast-in-place concrete site elements as described in the Contract Documents.

1.2 REFERENCES

A. Normal Weight Structural Concrete – Section 03 31 00

B. ACI 301: Specifications for Structural Concrete, American Concrete Institute

C. ACI 117 – 'Specifications for Tolerances for Concrete Construction and Materials."

D. ACI 318 – "Building Code Requirements for Reinforced Concrete."

E. Concrete Reinforcing Steel Institute (CRSI), "Manual of Standard Practice."

1.3 TESTING AGENCY FOR CONCRETE MIX DESIGNS

A. Testing agency for the trial concrete mix design retained and reimbursed by the Contractor and approved by COR.

B. The testing agency shall furnish equipment and qualified technicians to establish the proportions of ingredients for concrete mixes.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's product data with application and installation instructions for proprietary materials and items, including admixtures, patching compounds, epoxies, grouts, waterstops, joint systems, fiber reinforcement, curing compounds, dry-shake finish materials, hardeners, sealers mechanical splices, hooked anchorage systems, dowel bar substitute systems, dowel bar sleeves, joint fillers, and others as requested.

B. Samples: Submit samples of materials specified if requested, including names, sources, and descriptions.

C. Mix Designs: Submit mix designs as specified herein.

D. Material and Mill Certificates: Provide material and mill certificates as specified herein. The Manufacturer and Contractor shall sign the material and mill certificates certifying that each material item complies with specified requirements. Provide certification from admixture manufacturers that chloride ion content complies with specified requirements.

E. Construction Joints: Submit a drawing of proposed construction joint locations in concrete for slab on grade, mat foundations, structural floors, roofs, and walls. Submit any additional or changed reinforcing that is required at construction joints that differs from that shown on the drawings.

F. Pour Sequence for Mat Foundation: Submit the proposed pour sequence for mat foundations.

G. Industrial Slabs: Submit the proposed pour sequence and procedure for protecting concrete during placement, finishing, and curing.

H. Test results – Concrete break tests.

1.5 QUALIFICATIONS

A. The concrete supplier shall have a minimum of five years of experience in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

I. The concrete contractor shall have a minimum of five years of experience with the installation of concrete similar in material, design, and the extent to that indicated for this Project and whose work has resulted in construction with a record of successful –service performance

J. Any testing laboratory retained by the Contractor or Subcontractor to run tests required by this specification but not performed by the Owner's testing laboratory shall meet the basic requirements of ASTM E 329.

1.6 QUALITY CONTROL

A. The Contractor is responsible for the control of quality, including workmanship and materials furnished by his subcontractors and suppliers.

B. Document Conflict and Precedence: In case of conflict among Contract Documents and Contract Specifications, request clarification from the Architect/Engineer through the "Request for Information" (RFI) process before proceeding with the Work. In case of a conflict between and/or among the structural drawings and specifications, the strictest interpretation shall govern, unless specified otherwise in writing.

C. Inspection and Testing of the Work: Materials and installed work may require testing and retesting, as directed by the governing building code, the Architect/Engineer, or the Owner at any time during the progress of work.

1. The Contractor shall provide 48 hours of notification to the Testing Laboratory of construction operations including the project schedule to allow the Testing Laboratory to schedule inspections. Failure to sufficiently notify may result in additional costs incurred by the Testing Laboratory that may be back-charged to the Contractor.

2. The Contractor shall cooperate with laboratory personnel and provide access to the work.
3. The Contractor shall make arrangements with the Testing Laboratory for off-site inspection of material stockpiles, concrete delivery vehicles, concrete material storage facilities, and concrete-batching facilities.
4. If required, the Contractor shall furnish casual labor, equipment, and facilities as required for sampling and testing by the laboratory and otherwise facilitate the required inspections and tests.
5. Inspection or testing by the Owner does not relieve the Contractor of his responsibility to perform the Work following the Contract Documents. Tests not specifically indicated to be done at the Owner's expense, including retesting of rejected materials and installed work, shall be done at the Contractor's expense.

D. Acceptance Criteria for Concrete Strength: A strength test is defined as the average strength of two 6" x 12" cylinder breaks or three 4" x 8" cylinder breaks tested at the strength age indicated on the drawings for that class of concrete. The strength level of an individual class of concrete shall be considered satisfactory when both of the following requirements are met:

1. The average of all sets of three consecutive strength tests equals or exceeds the required f'c.
2. No individual strength test falls below the required f'c by more than 0.1 f'c or 500 psi, whichever is greater.

E. Responsibility for Selection and use of concrete admixtures and chemical treatments: The Contractor shall be responsible for selecting admixtures and surface treatments that are compatible with the intended use of the concrete including all final surface treatments called for within this or other specifications or on the Contract Drawings. The Contractor is responsible for following the manufacturer's instructions for the use of their product including abiding by any limitations placed by the manufacturer on the use of any of its products.

F. Survey for Anchor Rods and Reinforcing Steel Dowels: The Contractor shall use a qualified and experienced field engineer (construction surveyor), having a minimum of three years of experience as a "lead" field engineer on projects of similar type, the layout of the proper location of all embedded anchor rods and tension rods for structural precast before they are encased in concrete.

1.7 PROVISION FOR OTHER WORK

A. Provide for installation of inserts, hangers, metal ties, anchors, bolts, angle guards, dowels, thimbles, slots, nailing strips, blocking, grounds, and other fastening devices required for attachment of work. Properly locate in cooperation with other trades and secure in position before concrete is poured. Do not install sleeves or blackouts in any concrete slabs, beams, or columns except where shown on the drawings or upon written approval

B. Protect adjacent finish materials against damage and spatter during concrete placement.

C. To maintain location accuracy, the General Contractor's field engineer shall furnish building control lines and elevation benchmarks for the use of all trades.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. Refer to the drawings for classes and strengths of concrete required.

B. Normal weight Aggregates: ASTM C 33, and as herein specified. Submit material certificates from an aggregate supplier or test results from an independent testing Laboratory certifying conformance to this specification for each source of aggregate.

C. Use one brand of cement, for each class of concrete, throughout the project, unless approved otherwise. Submit mill certificates certifying conformance to this specification for each brand and type of cement. Documentation of design mix strength history must match the cement brand used.

1. Testing of cement in place of mill certificate submittal will be required if:
   a. The cement has been in storage at the mixing site for over 30 days
   b. It is suspected that the cement has been damaged in storage or transit or is in any way defective.

D. Water: Comply with the requirements of ASTM C 1602

E. Low-alkali cement: Cement that has the additional requirement that equivalent alkalis ($Na_2O + 0.658K_2O$) do not exceed 0.60% according to ASTM C 150-00, Table 2.

F. Cementitious materials, aggregate, and water must be extracted or recovered as well as manufactured within 500 miles of the project site.

G. Air-Entraining Admixture: ASTM C 260. Submit manufacturer's certification that the product conforms to the requirements specified and is compatible with all other admixtures to be used.

H. Water-Reducing Admixture: ASTM C 494, Type A. See maximum permissible chloride ion content in concrete specified below. Submit manufacturer's certification that the product conforms to the requirements specified and is compatible with all other admixtures to be used.

I. High-Range Water-Reducing Admixture (superplasticizer): ASTM C 494, Type F or Type G. See maximum permissible chloride ion content in concrete specified below. Submit manufacturer's certification that the product conforms to the requirements specified and is compatible with all other admixtures to be used.

J. Water-Reducing, Retarding Admixture: ASTM C 494, Type D. See maximum permissible chloride ion content in concrete specified below. Submit manufacturer's certification that the product conforms to the requirements specified and is compatible with all other admixtures to be used.

K. Water-Reducing, Accelerator Admixture (Non-Corrosive, Non-Chloride): ASTM C 494, Type C or E. Submit manufacturer's certification that the product conforms to the requirements specified and is compatible with all other admixtures to be used.

L. Viscosity Modifying Admixture: Used to enhance plastic concrete properties such as workability, pumpability, and stability for “self-consolidating concrete.

M. Shrinkage Reducing Admixture: An admixture that reduces drying shrinkage by reducing the capillary tension of pore water.

N. Corrosion Inhibitor: Provide at dosage rates per manufacturer's recommendation based on design life, application, clear cover, and other products in the concrete mix.

O. Crystalline-forming Waterproofing Admixture: A powder admixture capable of producing concrete that is watertight under hydrostatic pressure up to 7 atmospheres when tested per Corps of Engineers test CRD-C48 and capable of sealing cracks up to 0.4mm.

P. Calcium Chloride and Chloride Ion Content: Calcium chloride or admixtures containing more than 0.5% chloride ions by weight of the admixture are not permitted.

Q. Certification: Written conformance to all the above-mentioned requirements and the chloride ion content of the admixture as tested by an accredited laboratory will be required from the admixture manufacturer at the time of mix design review

2.2 RELATED MATERIALS

A. Waterstops: Provide waterstops at all construction joints and other joints in all foundation walls below grade and where shown on the drawings. Size to suit joints. Provide flat, dumbbell type, or center bulb type where shown on drawings.

1. ADCOR ES waterstops: W.R. Grace & Co.
2. Polyvinyl chloride (PVC) waterstops: Corps of Engineers CRD-C 572.
3. Preformed Plastic Waterstops: Federal Specifications SS-S-210A "Sealing Compound for Expansion Joints".
4. Manufacturers: Synko-Flex Products, Inc.
5. Bentonite Waterstop RX: manufactured by American Volclay Products.

B. Vapor Retarder: Provide vapor retarder cover chosen from products specified below over prepared base material where indicated.

1. Plastic Vapor Retarder Provide a flexible preformed sheet membrane conforming to ASTM E 1745 with the following properties.
   a. Class A material
   b. Minimum of 15 mils thick
   c. Maximum water vapor permeance rating of 0.01 Perms after mandatory conditioning as tested by ASTM E 96
   d. Acceptable products include the following:
      1) Stego Wrap Vapor Barrier (15 mils)", Stego Industries, LLC
      2) Ecoshield-E" (15 mils),
      3) Epro"Monarflex Reflex Super, Monarflex
2. Tape for Plastic Vapor Retarders: High-density polyethylene tape with a pressure-sensitive adhesive having a minimum width of 4 inches having a maximum water vapor transmission rate of 0.3 perms.
3. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.

4. Moisture-Retaining Cover: One of the following, complying with ANSI/ASTM C171:
   a. Waterproof paper.
   b. Polyethylene film.
   c. Polyethylene-coated burlap.
   d. Polyethylene-coated natural cellulose fabric such as “Aquacure” by Greenstreak Group, Inc.

C. Surface Hardener Agents including Slip-resistive Emery Aggregate or Aluminum Granule Finish, Colored, Mineral Aggregate, Dry Shakes, and Metallic Aggregate Hardener Finish

D. Evaporation Control: Monomolecular film-forming compound applied to exposed concrete slab surfaces for temporary protection from rapid moisture loss in hot weather conditions.

E. Liquid membrane-forming Curing and Curing and Sealing Compounds.

F. Evaporation Control: Monomolecular film-forming compound applied to exposed concrete slab surfaces for temporary protection from rapid moisture loss in hot weather conditions.

G. Chemical Curing/Floor Hardener Compounds: Silicate-based compounds that react with concrete constituents to harden the surface, resulting in a surface having a maximum abrasion coefficient of 0.25 cm3/cm2 when tested following ASTM C 418.

H. Water and Chloride Ion Repelling Penetrating Sealer: Clear, solvent-based silane or siloxane penetrating sealer which reacts chemically with the concrete surface to function as a Chloride Ion screen with a minimum 90% factor, or a Clear, solvent-free, silane penetrating sealer that reacts chemically with the concrete surface to function as a Chloride Ion screen with a minimum 83% factor, when either is tested following NCHRP #244, Series II, 100% solids, and applied per the manufacturer's recommendation.

I. Install only anchors identified on the drawings by the named manufacturer and product type. Substitutions using products may be approved by this Specification for permitted use provided complete design calculations, as required by and per the proposed product’s current and valid ICC Evaluation Service Report (ESR) and ACI 318 Appendix D, are signed and sealed by a professional engineer licensed in California, and submitted for formal review. The contractor shall request design criteria for all conditions where a product substitution is considered. Failure to obtain approval for an anchor substitution may result in the request by the Engineer to remove installed anchors and replace them with the product specified on the drawings at the Contractor’s expense.

2.3 PROPORTIONING AND DESIGN OF CONCRETE MIXES

A. The Contractor shall submit concrete mix designs for each class of concrete indicated on the structural drawings and in the Specifications for approval at least 15 working days before the start of construction. If required, the Contractor shall engage the services of an independent Testing Laboratory to assist in preparing the mix design. The Contractor shall not begin work with a particular mix until that mix design has been approved.

B. The Contractor, acting in conjunction with his Concrete Supplier, shall submit in writing the mix designs, the method used to select mix proportions. Either of the following methods, as outlined in ACI 301, may be used.

1. Field Experience Method
2. Laboratory Trial Mixture Method

C. Required types of concrete and compressive strengths shall be as indicated on the Structural Drawings.

1. All mix designs shall state the following information:
2. Mix design number or code designation by which the Contractor shall order the concrete from the Supplier.
3. Structural slab or member for which the concrete is designed (i.e., columns, shear walls, footings, slab on grade, etc.).
4. Wet and dry unit weight.
5. 28-day compressive strength.
6. Aggregate type, source, size, gradation, fineness modulus.
7. Cement type and brand.
8. Fly ash or other pozzolan type and brand (if any).
9. Admixtures including air entrainment, water reducers, high-range water reducers, accelerators, and retarders, if any.
10. Design Slump or Slump/Flow.
11. Proportions of each material used.
12. Water/cementitious ratio and maximum allowable water content.
13. The method by which the concrete is intended to be placed (bucket, chute, or pump).
14. Required average strength qualification calculations per ACI 301 4.2.3.3a and 4.2.3.3b. Submit separate qualification calculations for each production facility that will supply concrete to the project.
15. Documentation of Average strength (trial mix data or field test data) per ACI 301: When field test data is used to qualify average strength, submit separate documentation for each production facility that will supply concrete to the project.
16. Field test data submitted for qualification of average strength under ACI 301 shall include copies of the Concrete Testing Laboratory's reports from which the data was compiled.

D. Admixtures

1. Admixtures to be used in concrete shall be subject to the approval of the Engineer and Owner's Testing Laboratory and shall be used for the purpose intended by the manufacturer to produce concrete to meet the specified requirements.
2. Quantities of admixtures to be used shall be in strict accordance with the manufacturer’s instructions.

E. Adjustments of Concrete Mixes: Mix design adjustments may be requested by the Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant. Such mix design adjustments shall be provided at no additional cost to the Owner. Any adjustments in approved mix designs including changes in admixtures shall be submitted in writing for approval before field use.

F. Chloride Ion Content:

1. Unless noted otherwise, The maximum water-soluble chloride ion concentration in hardened concrete measured at ages from 28 to 42 days contributed from all ingredients including water, aggregates, cementitious materials, and admixtures shall not exceed the limits specified in ACI 318-08 Table 4.3.1 depending on to which Corrosion Exposure Class (CO, C1 or C2) the concrete is subject as noted on the drawings. Water-soluble chloride ion tests shall conform to ASTM C 1218. One test shall be run for each class of concrete before the mix design submittal and each time a change is made to the mix design (such as a change in aggregate type or source).
2. The chloride ion content in all concrete used for prestressed or post-tensioned concrete shall not exceed 0.06 percent by weight of cement.
3. The Concrete Supplier shall certify on the Mix Design Submittal Form that the chloride ion content in all concrete mix designs used on the project does not exceed the limits stated above.

2.4 MATERIALS

A. General: Concrete shall be "Ready Mixed" and comply with ACI 318 and ANSI/ASTM C94, except as specified. Batch mixing at the site is permitted.

B. Granular Base

1. Base type gravel or crushed rock, graded as follows -

Sieve Size	Percent by Weight Passing Sieve
1 inch	100
3/4 inch	85 - 100
No. 4	45 - 60
No. 10	30 - 50
No. 200	5 - 10 (non-plastic)

C. Concrete

1. Meet requirements specified in Division 03 Section 03 31 00 “Normal Weight Structural Concrete” for exterior concrete.

PART 3 - EXECUTION

3.1 SLUMP LIMIT

A. The slump, as measured in the field where concrete cylinders are taken, shall be within plus or minus 1 inch of the design slump noted on the Mix Design Submittal. Self- consolidating concrete shall have a slump/flow of plus or minus 2 inches of the design slump noted on the Mix Design Submittal. Water may be added to the concrete in the field only to the extent that the prescribed water/cementitious ratio noted in the Mix Design Submittal Form is not exceeded.

3.2 JOINTS IN CONCRETE

A. Construction Joints: Locate and install construction joints as indicated on the drawings or if not shown on drawings, located so as not to impair the strength and appearance of the structure.

1. Keyways: Provide continuous keyways with a depth of one-tenth of the member thickness (1 1/2" minimum or as shown on the drawings) in construction joints only where shown on the drawings.
2. Joint Construction: Place construction joints in the center of one-third of suspended spans and grade beams and as shown on the drawings for slabs-on-grade and walls unless shown otherwise. Place joints perpendicular to the main reinforcement. Continue reinforcement across construction joints unless otherwise shown on the drawings. Dowels that cross construction joints shall be supported during concreting operations to remain parallel with the slab or wall surface and at right angles to the joint. Submit all construction joint locations as a shop drawing submittal.
3. Waterstops: Provide waterstops in construction joints as indicated on the Structural Drawings. Install waterstops to form a continuous diaphragm in each joint. Make provisions to support and protect exposed waterstops during the progress of work. Fabricate field joints in waterstops per manufacturer's printed instructions.
4. Isolation Joints in Slabs-on-Ground: Construct isolation joints (without dowels) in slabs-on-ground at points of contact between slabs on ground and vertical surfaces only where specifically detailed on the drawings. Install joint-filler strips at joints where indicated. Extend joint-filler strips full width and depth of joint, terminating flush with the finished concrete surface, unless otherwise indicated on the drawings. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together. Provide construction joints with dowels at all locations unless isolation joints are detailed.
5. Contraction joints in slabs-on-grade and unbonded topping slabs: Maximum joint spacing shall be 36 times the slab thickness or 20 feet, whichever is less and at a minimum, on column lines unless otherwise noted on the drawings. Use one of the two following methods (sawed or formed) to create the joints. Do not use the formed joint in areas subject to vehicular traffic or industrial slabs.
    a. Sawed Joints
        1) Primary Method: Early-Entry, dry-cut method, by Soff-Cut International, Corona, CA (800) 776-3328. The finisher must have documented successful experience in the use of this method before this project. Install cuts within 1 to 4 hours, depending on air temperature, after the final finish as soon as the concrete surface is firm enough to not be torn or damaged by the blade at each saw cut location. Use 1/8 inch thick blade, cutting 1 1/4” inch into the slab.
        2) Optional Method (where Soff-Cut System method equipment is not available, subject to limitations): This method may not be used when there is no dowel passing through the contraction joint. Use a conventional saw to cut joints within 4 to 12 hours after finishing as soon as the concrete has hardened sufficiently to prevent aggregates from being dislodged by the saw. Complete cutting before shrinkage stresses become sufficient to produce cracking. Use 1/8 inch thick blade, cutting to a depth of 1/4 of the slab thickness but not less than 1 inch. Cut to a depth of 1/3 slab thickness for slabs reinforced with steel fibers.

b. Formed Joints: Form contraction joints by inserting pre-molded plastic hardboard or fiberboard strip into fresh concrete until the top surface of the strip is flush with the slab surface. The depth is to be 1/4 the slab thickness, but not less than 1 inch. Tool slab edges round on each side of the insert. After the concrete has cured, remove inserts and clean the groove of loose debris.

c. Joint Filler: Provide in both contraction and saw-cut construction joints when specified.
   1) Remove dirt and debris from the joint by vacuuming immediately before filling the joint. Clean the joint of curing compounds and sealers.
   2) Filler material shall be applied to the joints when the building is under permanent temperature control, but no less than 90 days after slab construction.
   3) Follow the manufacturer's recommended procedure for installing filler material. The joint filler must be flush with the adjacent concrete. A concave profile on the top of the joint filler is unacceptable and will be grounds for removal and replacement.

d. The Contractor shall protect the joints from damage caused by wheeled traffic or other sources during construction until a joint-filler material (if specified) has been installed.

3.3 INSTALLATION OF EMBEDDED ITEMS

A. General: Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached thereto unless directed otherwise by these specifications. Install reglets to receive the top edge of foundation sheet waterproofing where specified, and to receive thru-wall flashings in the outer face of the concrete frame at exterior walls, where flashing is shown at lintels, relieving angles and other conditions.

B. Anchor Rods: Furnish anchor rods and other connectors required for securing structural steel to foundations and other in-place work as shown on the drawings. Furnish 1/8" minimum steel templates for presetting rods and other anchors to accurate locations as shown on the drawings in keeping with the tolerances noted in ACI 117 for embedded anchor rods.

C. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in the finished slab surface. Provide and secure units sufficiently strong to support types of screed strips by use of strike-off templates or accepted compacting type screeds.

D. Do not install sleeves and blockouts in concrete slabs, pier caps, footings, or walls except where shown on the structural drawings or approved by the Engineer.

E. Securely fasten embedded plates, angles, anchor rods, and other items to be built into the concrete to the formwork or hold in place with templates. Insertion of these items into concrete after casting is prohibited.

3.4 VAPOR RETARDER INSTALLATION

A. Install vapor retarder following ASTM E 1643 and manufacturer's instructions.

B. Lap all seams 6" and seal all joints in the field with the specified pressure-sensitive tape. Heat-welded joints done in a shop before delivery is an acceptable method to minimize the number of field joints.

C. Seal all pipe penetrations through the vapor retarder with a boot made from the vapor retarder material and tape.

3.5 CONCRETE PLACEMENT

A. Pre-placement Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work. Moisten wood forms immediately before placing concrete where form coatings are not used.

B. Coordinate the installation of joint materials and vapor retarders with the placement of forms and reinforcing steel.

C. Comply with ACI 301 and as herein specified.

1. Concrete Temperature: The maximum acceptable concrete temperature at the truck discharge point shall be 95 °F.
2. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete that has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation. Spread concrete using short-handled, square-ended shovels, or come-alongs.
3. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 24" and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while the preceding layer is still plastic to avoid cold joints.
4. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use internal vibrators of the largest size and power that can properly be used in the work as described in the table entitled "Range of characteristics, performance, and applications of internal vibrators" found in ACI 301.
5. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than the visible effectiveness of the machine. Place vibrators to rapidly penetrate the placed layer and at least 6-inches into the preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion limit duration of vibration to the time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.

6. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed. Place concrete for beams, girders, brackets, column capitals, haunches, and drop panels at the same time as concrete for slabs. Do not place concrete over columns and walls until concrete in columns and walls is no longer plastic and has been in place for at least one hour.
7. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners of forms, eliminating air and stone pockets that may cause honeycombing, pitting, or planes of weakness.
8. Bring slab surfaces to correct level with straightedge and strike-off. Use highway straightedges, bull floats, or darbies to smooth the surface free of humps or hollows before excess moisture or bleed water appears on the surface. Do not disturb slab surfaces before beginning finishing operations.
9. Maintain reinforcing in proper position during concrete placement operations.
10. Placing Concrete by Pump: If concrete is placed by using a pump, the grout used for pump-priming must not become a part of the completed structure unless an engineered grout design mix and grout location are approved in advance by the Engineer.

3.6 FINISH OF FORMED SURFACES

A. General: Formed surfaces shall have the finishes as described below and as shown on the drawings after formwork is removed and repairs made.

B. Standard Finish: Provide SF-1.0 on all concrete surfaces not exposed to view in the final condition unless otherwise specified.

C. Exposed Finishes: Provide SF-2.0 on all concrete surfaces exposed to view in final condition unless otherwise specified.

D. Definitions and Finish Requirements

1. Surface Finish 1.0 (SF-1.0):
   a. No formwork facing material is specified
   b. Patch voids larger than 1-1/2 in. wide or 1/2 in. deep
   c. Remove projections larger than 1.0 inches.
   d. Provide surface tolerance Class D as specified in ACI 117
   e. Tie holes need not be patched
2. Surface Finish 2.0 (SF-2.0):
   a. Provide specified formwork-facing material
   b. Patch voids larger than 3/4 in. wide or 1/2 in. deep
   c. Patch tie holes
   d. Remove projections larger than 1/4 in.
   e. Provide surface tolerance Class B as specified in ACI 117
   f. Provide mock-up of concrete surface appearance.

E. Rubbed Finishes: Remove forms as early as permitted by these specifications and perform any necessary repairs and patches.

1. Smooth Rubbed Finish: Provide smooth rubbed finish to scheduled or specified concrete surfaces which have received smooth-form finish treatment, not later than one day after form removal. Moisten concrete surfaces and rub with carborundum brick or other abrasive until a uniform color and texture are produced. Do not apply cement grout other than that created by the rubbing process.
2. Grout Cleaned Finish: Provide grout cleaned finish to scheduled or specified concrete surfaces that have received smooth-form finish treatment.
    a. Combine one part of portland cement with 1-1/2 parts sand meeting the requirements of ASTM C144 and C404 by volume, and a 50:50 mixture of acrylic or styrene-butadiene-based bonding admixture and water to the consistency of thick paint. Proprietary additives may be used at the Contractor's option. Blend standard portland cement and white portland cement amount determined by trial patches, so that the final color of dry grout will closely match adjacent surfaces.
    b. Thoroughly wet concrete surfaces and apply the grout to coat surfaces and fill small holes. Remove excess grout by scraping and rubbing with clean burlap. Keep damp with fog spray for at least 36 hours after rubbing.
3. Cork-floated Finish: Provide cork-floated finish to scheduled or specified concrete surfaces that have received smooth-form finish treatment.
    a. Combine one part portland cement with one part sand meeting the requirement of ASTM C144 or C404, by volume and water and mix to a consistency of thick paint. Apply stiff to a wet surface, compressing the grout into all voids.
    b. Produce the final finish with a cork float using a swirling motion.

F. Self-Consolidating Concrete Architectural Finish: Use self-consolidating concrete where shown on the plans to produce a smooth, uniform finish upon form removal with no patching, stoning, rubbing, or another form of repair, except washing, permitted.

G. Related Unformed Surfaces: At the tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.7 MONOLITHIC SLAB FINISHES

A. Place, consolidate, strike off, and level concrete, eliminating high spots and low spots, before proceeding with any other finish operation. Do not add water to the surface of the concrete during the finishing operation.

B. Scratch Finish: Apply scratch finish to monolithic slab surfaces that are to receive concrete floor topping or mortar setting beds for tile, portland cement terrazzo and other bonded applied cementitious finish flooring material, and as otherwise indicated. After placing slabs, the plane surface to the tolerance specified below. Slope surfaces uniformly to drains where required. After leveling, roughen the surface before the final set, with stiff brushes, brooms, or rakes.

C. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified, and slab surfaces which are to be covered with a membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo, and as otherwise indicated. After screeding, consolidating, and leveling concrete slabs, do not work the surface until ready for floating. Begin floating, using a hand float, a bladed power float equipped with float shoes, or a powered disk float, when the bleed water sheen has disappeared and the concrete surface has stiffened sufficiently to permit the operation. Check and level the surface plane to tolerance as specified below. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat the surface to a uniform, smooth, granular texture.

D. Trowel Finish: Apply trowel finish to monolithic slab surfaces to be exposed to view, and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or other thin film finish coating system. After floating, begin the first trowel finish operation by hand or power-driven trowel. Begin final troweling when the surface produces a ringing sound as the trowel is moved over the surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with a level surface to tolerance as specified below. Grind smooth surface defects which would telegraph through the applied floor covering system.

E. Slip-Resistive Broom Finish: Apply slip-resistive broom finish to garage floors and ramps less than 6% slope, exterior concrete platforms, steps and ramps, and elsewhere as indicated. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

F. Chemical-Hardener Finish: Apply chemical-hardener finish to interior concrete floors where indicated. Apply liquid chemical-hardener after complete curing and drying of the concrete surface. Apply proprietary chemical hardeners, in strict accordance with the manufacturer's printed instructions. After the final coat of chemical-hardener solution is applied and dried, remove surplus hardener by scrubbing and mopping with water.

G. Liquid Sealer/Densifier Finish: Apply liquid sealer/densifier finish to exposed interior concrete floors where indicated. Apply liquid sealer/densifier after complete curing and drying of the concrete surface and in strict accordance with the manufacturer’s printed instructions.

H. Finish of Top of Spread Footings and/or Mat Foundations:

1. Top Surface below Finished Slab: The top of the footing or mat shall be screeded level and smooth with a flatness F-number, F_F15 (overall), F_F10 (minimum local), and a levelness F-number, F_L12 (overall), F_L10 (minimum local).
2. Top Surface as Finished Slab: The top surface of a footing or mat that is to serve as the finished slab in the building shall be leveled cured, and surface prepared as specified for the finished floor construction appropriate to the space used as defined in the Architectural Drawings.

3.8 CONCRETE FINISH MEASUREMENT AND TOLERANCES

A. Testing Procedure: ASTM E 1155

B. Tolerance on Floor Elevations: Construction tolerance on absolute floor elevation from the specified elevation as shown on the drawings shall be as specified below, taken from ACI 117:

1. Slab-on-Grade Construction - ± 3/4".
2. Top surfaces of formed slabs measured before removal of supporting shores -± 3/4".
3. Top surfaces of all other slabs - ± 3/4".

C. Random Traffic Floor Finish Tolerances:

1. Specified overall values for flatness (SOFF) and levelness (SOFL) shall conform to the values listed below for the floor surface classification noted for each slab category noted.

Floor Surface Classification	SOFF	SOFL
Conventional	20	15
Moderately Flat	25	20
Flat	35	25
Very Flat	45	35
Super Flat	60	40

2. Minimum local values for flatness (MLFF) and levelness (MLFL) shall equal 3/5 of the SOFF and SOFL values, respectively unless noted otherwise. The MLFF and MLFL values shall apply to the minimum areas bounded by the column lines and half-column lines or the minimum areas bounded by the construction and contraction joints, whichever are the smaller areas.
3. The SOFL and MFLL tolerance values shall apply only to level slabs-on-ground or to level, uncambered suspended slabs that are shored such that they cannot deflect from the time the floor is placed to the time it is measured.
4. Slabs specified to slope shall have a tolerance from the specified slope of 3/8" in 10 feet at any point.

D. Construction Requirements to Achieve Specified Floor Finish Tolerances:

1. Forms shall be properly leveled, in good condition, and securely anchored including special attention to ends and transitions.
2. Bearing surfaces for straightedges such as form edges or previously poured slabs shall be kept clean of laitance, sand, gravel, or other foreign elements.
3. Screeds shall be maintained in good condition with true round rolling wheels and level cutting edges. The use of optical sighting equipment such as lasers is recommended for checking levelness and straightness. The Contractor shall promptly adjust or replace equipment when test results indicate substandard work.
4. Highway straightedges are recommended for use instead of bull floats for all slab placement and finishing operations.

E. Contractor Responsibility for Concrete Floor Finish Requirements: Floor finish requirements shown below (flatness and levelness tolerances) are minimum requirements that apply unless stricter requirements are contained in instructions for installation of applied floor products in which case the Contractor is responsible for attaining the values prescribed by the manufacturer of such products.

F. Concrete Floor Finish Tolerance for Slab-on-Grade Construction:

1. Concrete Placement: Concrete shall be placed and screeded to predetermined marks set to elevations prescribed on the drawings.
2. Finish Tolerances of Random Traffic Floor Surfaces:
   a. Slabs in nonpublic areas, mechanical rooms, surfaces to receive raised computer flooring, surfaces to have thick-set tile or a topping, and parking structures: Conventional
   b. Industrial Slabs: Moderately Flat

G. Concrete Floor Finish Tolerance for Shored, Cast-in-Place Suspended Slab Construction:

1. Concrete Placement: Formwork shall be set and securely braced so that soffits are positioned to allow scheduled concrete member sizes and thicknesses within tolerances specified in ACI 117. Concrete shall be placed and screeded to predetermined marks on the forming surface conforming to elevations prescribed on the drawings.
2. Camber: Formwork camber, as indicated on the drawings, shall be set to provide a uniform, smooth soffit profile in each direction. Minimum slab thickness, as specified on the drawings, shall be maintained throughout the slab surface to tolerance as specified in ACI 117. Tolerance on camber shall be $\pm$ 1/4". Levelness F-Number tolerances specified below do not apply to areas of the floor where camber or intentional slope is shown.
3. Finish Tolerances of Random Traffic Floor Surfaces:
   a. Slabs in nonpublic areas, mechanical rooms, surfaces to receive raised computer flooring, surfaces to have thick-set tile or a topping, and parking structures: Conventional
   b. Exposed slabs in public spaces, slabs to receive thin-set flooring: Flat
4. Extra Concrete: The contractor shall include in his bid any additional concrete required to achieve the specified slab surface finish tolerance.

H. Remedial Measures for Slab Finish Construction Not Meeting Specified Tolerances:

1. Application of Remedial Measures. Remedial measures specified herein are required whenever either or both of the following occur:
   a. The composite overall values of F_F or F_L of the entire floor installation measure less than the specified values.
   b. Any individual test section measures less than the specified absolute minimum F_F or F_L value.
2. Modification of Existing Surface:
   a. If in the opinion of the Architect/Engineer or Owner's Representative, all or any portion of the substandard work can be repaired without sacrifice to the appearance or serviceability of the area, then the Contractor shall immediately undertake the approved repair method.

b. The Contractor shall submit for review and approval a detailed work plan of the proposed repair showing areas to be repaired, method of repair, and time to affect the repair.
c. Repair method(s), at the sole discretion of the Architect/Engineer or Owner's Representative, may include grinding (floor stoning), planing, re-topping with self-leveling underlayment compound, or repair topping, or any combination of the above.
d. The Architect/Engineer or Owner's Representative maintains the right to require a test repair section using the approved method of repair for review and approval to demonstrate a satisfactory end product. If, in the opinion of the Architect/Engineer or Owner's Representative, the repair is not satisfactory an alternate method of repair shall be submitted or the defective area shall be replaced.
e. The judgment of the Architect/Engineer or Owner's Representative on the appropriateness of a repair method and its ability to achieve the desired end product shall be final.
f. All repair work shall be performed at no additional cost to the Owner and with no extension to the construction schedule.

3. Removal and Replacement:
a. If in the opinion of the Architect/Engineer or Owner's Representative, all or any portion of the substandard work cannot be satisfactorily repaired without sacrifice to the appearance or serviceability of the area, then the Contractor shall immediately commence to remove and replace the defective work.
b. Replacement section boundaries shall be made to coincide with the test section boundaries as previously defined.
c. Sections requiring replacement shall be removed by saw cutting along the section boundary lines to provide a neat clean joint between the new replacement floor and the existing floor.
d. The new section shall be reinforced the same as the removed section and dowelled into the existing floor as required by the Engineer. No existing removed reinforcing steel may be used. All reinforcing steel shall be new steel.
e. Replacement sections may be retested for compliance at the discretion of the Architect/Engineer or Owner's Representative.
f. The judgment of the Architect/Engineer or Owner's Representative on the need for replacement shall be final.
g. All replacement work shall be performed at no additional cost to the Owner and with no extension to the construction schedule.

3.9 CONCRETE CURING AND PROTECTION

A. General:

1. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Maintain concrete with minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of concrete. Limit moisture loss to a maximum of 0.05 lb. /sq. ft – hr for concrete containing silica fume and 0.2 lb. /sq. ft. - hr for all other concrete before and during finishing operations. If using an evaporation retarder, apply following the manufacturer's instructions after screeding and bull-floating, but before power floating and troweling.

2. Curing shall commence as soon as free water has disappeared from the concrete surface after placing and finishing. The curing period shall be 7 days for all concrete except high early strength concrete which shall be cured for 3 days minimum.
3. Alternatively, curing times may be reduced if either of the following provisions is complied with:
    a. If tests are made of cylinders kept adjacent to the structure and cured by the same methods, curing measures may be terminated when the average compressive strength has reached 70% of the specified 28-day compressive strength.
    b. If the temperature of the concrete is maintained at a minimum of 50°F for the same length of time required for laboratory cured cylinders of the same concrete to reach 85% of the 28-day compressive strength, then curing may be terminated thereafter.
4. Curing shall be following ACI 301 procedures. Avoid rapid drying at the end of the curing period.

B. Curing Formed Surfaces: Where wooden forms are used, cure formed concrete surfaces, including undersides of beams, supported slabs, and other similar surfaces by moist curing with forms in place for the full curing period or until forms are removed. When forms are removed, continue curing by one or a combination of the methods specified below, as applicable.

1. Columns and shearwalls that are not exposed to view: Moist cure in forms or by one or a combination of methods 1, 2, or 3 specified below. Use a high–solids, liquid membrane-forming curing and sealing compound conforming to ASTM C 1315, type I, Class A, or B for method 3.
2. Columns and shearwalls that are exposed to view: Moist cure in forms or by one or a combination of methods 1, 2, or 3 specified below. Use a high-solids, non-yellowing, liquid membrane-forming curing and sealing compound conforming to ASTM C 1315, type 1, class A for method 3.
3. Sides and Soffits of Beams and Pan-Joist Ribs, Soffits of Slabs: Moist cure in forms or by one or a combination of methods 1, 2, or 3 specified below. Use a liquid membrane-forming dissipating resin curing compound conforming to ASTM C 309, type 1, class A or B for method 3.
4. Basement Walls, Sides of Exterior Retaining Walls: Moist cure in forms or by one or a combination of methods 1, 2, or 3 specified below. Use a liquid membrane-forming dissipating resin curing compound conforming to ASTM C 309, type 1, class A or B for method 3.

C. Curing Unformed Surfaces: Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by one or a combination of the methods specified below, as applicable. The Contractor shall choose a curing method that is compatible with the requirements for subsequent material usage on the concrete surface.

1. Floors Directly Exposed to Vehicular or Foot Traffic, not in Parking Areas and not otherwise receiving a chemical hardener or penetrating sealer finish: Apply two coats of a high-solids, water-based, non-yellowing, liquid membrane-forming curing and sealing compound conforming to ASTM C 1315, type 1, Class A per method 3 as specified below.
2. Floors in Non-Public spaces that are left exposed to view and not receiving sealers or hardeners, floors involved in under-floor air distribution systems: Apply one coat of a high-solids, water-based, non-yellowing, liquid membrane-forming curing and sealing compound conforming to ASTM C 1315, type 1, Class A or B per method 3 as specified below.

3. Industrial Slabs: Cure using methods 1 or 2 as specified below for 7 days. The temperature of applied water shall be 10◦ F of concrete surface temperature.
4. All Other Surfaces: Cure using methods 1, 2, or 3 as specified below. Use a water-based dissipating resin type curing compound conforming to ASTM C 309, type 1, class A or B for method 3.

D. Curing Methods:

1. Method 1 - Moisture Curing: Provide moisture curing by one of the following methods:
   a. Keep the concrete surface continuously wet by covering it with water.
   b. Continuous water-fog spray.
   c. Covering the concrete surface with a specified absorptive cover, thoroughly saturate the cover with water, and keep it continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4" lap over adjacent absorptive covers.
2. Method 2 - Moisture-Retaining Cover Curing: Provide moisture-retaining cover curing as follows:
   a. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3" and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during the curing period using cover material and waterproof tape.
   b. Water may be added to the concrete surface to prevent drying before the cover is installed, but the surface shall not be flooded with water if a non-absorptive cover is used.
3. Method 3 – Curing or Curing and Sealing Compound: Provide curing, curing/hardener, liquid membrane-forming curing, or curing and sealing compound as follows:
   a. Apply specified compound to concrete slabs as soon as final finishing operations are complete (within 2 hours and after surface water sheen has disappeared). Apply uniformly in continuous operation by power spray or roller per manufacturer's directions. Do not allow to puddle. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during the curing period. Apply a second coat for sealing 2 to 3 hours after the first coat was applied.
   b. Do not use membrane-forming curing and sealing compounds on surfaces that are to be covered with coating material applied directly to concrete, liquid floor hardener, waterproofing, dampproofing, membrane roofing, flooring (such as ceramic or quarry tile, glued-down carpet, vinyl composition tile, linoleum, sheet vinyl, rubber, athletic flooring, synthetic turf, or wood), paint or other coatings and finish materials. Dissipating resin-type cures are acceptable in these locations.

3.10 HOT WEATHER CONCRETING

A. Definition:

1. Conditions warranting hot weather concreting practices are defined as any combination of high air temperature, low relative humidity, and wind velocity tending to impair the quality of fresh or hardened concrete or otherwise result in abnormal properties. If conditions cause an evaporation rate of 0.2 lb. /sq. ft. /hr. as calculated by Figure 2.1.5 in ACI 305R-99, then precautions shall be taken to prevent plastic shrinkage cracks from occurring.

B. Specification: Follow hot weather concreting practices specified below when required to limit the concrete temperature at the truck discharge point to the stated maximum acceptable temperature.

C. Records: Under hot weather conditions, the Contractor shall keep records of outside air temperature, the concrete temperature at truck discharge, and general weather conditions.

D. Hot Weather Concreting Requirements: The following items, all or in part as required, shall be followed to limit the concrete temperature to the stated maximum acceptable temperature and to minimize the possibility of plastic shrinkage cracks from developing.

1. Design the concrete mixes specifically for hot weather conditions replacing some cement with fly ash or other pozzolan and using water-reducing retarding admixture (ASTM C 494 Type D).
2. Use the largest size and amount of coarse aggregate compatible with the job.
3. Use sunshades and/or windbreaks.
4. Delay construction of indoor slabs-on-grade until the walls and roof are constructed.
5. Cool and shade aggregate stockpiles.
6. Use ice as part of the mixing water or cool the water with liquid nitrogen.
7. Limit the number of revolutions at mixing speed to 125 maximum.
8. Reduce the time between mixing and placing as much as possible.
9. Do not add water to ready-mixed concrete at the job site unless it is part of the amount required initially for the specified water-cement ratio and the specified slump.
10. Schedule concrete placement for early morning, late afternoon, or night.
11. Have all forms, equipment, and workers ready to receive and handle concrete.
12. Maintain one standby vibrator for every three vibrators used.
13. Keep all equipment and material cool by spraying with water including exteriors of forms, reinforcing steel, subgrade, chutes, conveyors, pump lines, tremies, and buggies.
14. Protect slab concrete at all stages against undue evaporation by applying a fog spray or mist above the surface or applying a monomolecular film. Where high temperatures and/or placing conditions dictate, use water-reducing retarding admixture (Type D) instead of the water-reducing admixture (Type A) as directed by the Testing Laboratory.
15. Provide continuous curing, preferably with water, during the first 24 hours using wet burlap, cotton mats, continuous spray mist, or by applying a curing compound meeting ASTM C 1315. Continue curing for 3 days minimum.
16. Cover reinforcing steel with water-soaked burlap so that steel temperature will not exceed ambient air temperature immediately before placement of concrete.
17. As soon as possible, loosen forms and run water down the inside. When forms are removed, provide a wet cover to newly exposed surfaces.

3.11 COLD WEATHER CONCRETING

A. Definition:

1. Concrete shall not be placed when the outside air temperature is 40°F or less unless cold weather concreting practices are followed as specified below.

2. Cold weather concreting practices should also be followed whenever the average daily air temperature is expected to be less than 40°F for more than three successive days. The average daily air temperature is the average of the highest and lowest temperature occurring during the period from midnight to midnight. The requirement for adhering to these cold-weather concreting practices may be terminated when the air temperature is above 50º F for more than half of any 24-hour duration.
3. Cold-weather concreting practices invoked shall keep the temperature of the concrete immediately after placing within the following temperature ranges:
   a. 55º to 75º F for sections less than 12 in. in the least dimension
   b. 50º to 70º F for sections 12 to 36 in. in the least dimension
   c. 45º to 65º F for sections 36 to 72 in. in the least dimension
   d. 40º to 60º F for sections greater than 72 in. in the least dimension
4. Concrete Protection: Protect the concrete immediately after placing and during the defined protection period such that the concrete does not freeze nor fall below the temperature levels stated in the above paragraph. For concrete not loaded during construction, the protection period shall be for a minimum of three days if cold-weather conditions persist. The time may be reduced to a minimum of two days if Type III cement or an accelerating admixture is used or if an additional 100 pounds of cement per cubic yard is added to the concrete mix. Concrete fully loaded during construction shall be protected during cold weather conditions for whatever time is required to obtain the required strength as determined by non-destructive strength tests (Windsor probe, Swiss Hammer Test) on the in-place concrete. Protect concrete surfaces from freezing for the first 24 hours even if cold-weather conditions do not officially exist due to high volatility in ambient temperatures.
5. Protection Deficiency: If the temperature requirements during any portion of the protection period are not met but the concrete surface did not freeze, the protection period shall be extended until twice the deficiency expressed in degree-hours is made up. Deficiency degree-hours is defined as the average deficiency in temperature below the required value times the number of hours the deficiency persisted. Make-up degree hours are the average increase in temperature above the minimum value times the hours required to make up twice the deficiency degree hours. Contact the Architect/Engineer if the concrete surface was allowed to freeze during the protection period.
6. Protection Removal: As the protection is being removed the decrease in temperature measured at the surface of the concrete in 24 hours shall not exceed the following:
   a. 50º F for sections less than 12 in. in the least dimension
   b. 40º F for sections 12 to 36 in. in the least dimension
   c. 30º F for sections 36 to 72 in. in the least dimension
   d. 20º F for sections greater than 72 in. in the least dimension
7. The maximum concrete temperature heated by artificial means at the point of placement shall not exceed 90°F.

B. Records: Under cold weather conditions, the Contractor shall keep records of outside air temperature, concrete temperature as placed, and general weather conditions. The temperature record shall be taken no less than 2 times per 24-hour duration.

C. Cold Weather Concreting Requirements: The following items, all or in part as required, should be followed to assure acceptable concrete in cold weather conditions:

1. Design the concrete mix to obtain high early strength by using higher cement content, a high early strength cement (Type III), or a specified non-chloride accelerator (ASTM C 494 Type C or E).

2. Protect the concrete during the curing period using insulating blankets, insulated forms, enclosures, and/or heaters.
3. Concrete cured in heated enclosures shall have heaters vented to prevent exposure of concrete and workmen to noxious gases.
4. The frozen subgrade shall be thawed before concrete placement and snow and ice shall be removed from forms.
5. The temperature of embedments in concrete must be heated above 32◦ F before placing concrete.
6. Heat the mixing water and then blend hot and cold water to obtain concrete no more than 10°F above the required temperature.
7. Heat the aggregates by circulating steam in pipes placed in the storage bins for air temperatures consistently below 32°F. When either water or aggregate is heated to over 140°F combine them in the mixer first to obtain a maximum temperature of the mixture not to exceed 140°F to prevent the flash set of the concrete.
8. Uniformly thaw aggregates far in advance of batching to prevent moisture variations in the stockpile.
9. Cover warmed stockpiles with tarps to retain heat.
10. Place air-entraining admixture in the batch after the water temperature has been reduced by mixing with cooler solid materials.
11. Use windscreens to protect concrete from rapid cooling.
12. Place vertical pump lines inside the building, if possible, for concrete being pumped.
13. Maintain artificial heat as low as possible to reduce temperature stresses during cooling.
14. Avoid water curing of concrete except for parking garage structures. Apply the required curing compound to unformed surfaces as soon as possible to prevent the drying of concrete from heated enclosures.
15. Delay form stripping as long as possible to help prevent drying from heated enclosures and to reduce damage to formed surfaces caused by premature stripping.
16. Provide triple thickness of insulating materials at corners and edges vulnerable to freezing.
17. Wrap protruding reinforcing bars with insulation to avoid heat drain from the warm concrete.
18. Gradually reduce the heat at the end of the heating period to reduce the likelihood of thermal shock.

3.12 MISCELLANEOUS CONCRETE ITEMS

A. Filling-In: Fill-in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.

B. Curbs: Provide a monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations, as shown in drawings. Set anchor rods for machines and equipment to the template at correct elevations, complying with certified diagrams or templates of manufacturer furnishing machines and equipment.

D. Grout base plates and foundations as indicated, using specified non-shrink, non-metallic grout. Use high-flow grout where high fluidity and/or increased placing time is required. This grout shall be used for all base plates larger than 10 square feet.

E. Steel Pan Stairs: Provide concrete fill for steel pan stair treads and landings and associated items. Cast-in safety inserts and accessories as shown on drawings. Screed, tamp and finish concrete surfaces as scheduled.

F. Installation of adhesive anchors using injectable epoxy or adhesive: A representative of the adhesive manufacturer shall be present on the first day that adhesive anchors are installed. After drilling the hole to the diameter and depth recommended by the manufacturer, clean the hole with a wire or nylon brush. Blow the dust out of the hole using compressed air with a nozzle that reaches the bottom of the hole. When using adhesive from a new pack, the adhesive that is discharged from the mixing nozzle should be a uniform gray color before any adhesive is installed in the hole. Fill the hole with adhesive starting from the very bottom of the hole until the hole is about 2/3 full. Do not leave an air pocket at the bottom of the hole. Insert the anchor rod or dowel by slowly twisting it into the hole.

3.13 CONCRETE SURFACE REPAIRS

A. Definition - Defective Areas:

1. Formed Surfaces: Concrete surfaces requiring repairs shall include all cracks over 0.01" and any other defects that affect the durability or structural integrity of the concrete. Voids, including honeycombing and rock pockets, and tie holes shall be repaired as required by the specified Surface Finish.
2. Unformed Surfaces: Concrete surfaces requiring repair shall include all surface defects such as crazing, cracks over 0.01" wide, or cracks that penetrate to reinforcement or through the member, popouts, spalling, and honeycombs.

B. Classification:

1. Structural Concrete Repair: Major defective areas in concrete members that are load-carrying (such as shear walls, beams, joists, and slabs), are highly stressed, and are vital to the structural integrity of the structure shall require structural repairs. Structural concrete repairs shall be made using a two-part epoxy bonder, epoxy mortar, or specified polymer repair mortar. The Engineer shall determine the locations of required structural concrete repairs.
2. Cosmetic Concrete Repair: Defective areas in concrete members that are non-load carrying and minor defective areas in load-carrying concrete members shall require cosmetic concrete repair when exposed to view and not covered up by architectural finishes. Cosmetic concrete repairs may be made using a polymer repair mortar and a compatible bonding agent. The Architect/Engineer shall determine the locations of required cosmetic concrete repairs. Stains and other discolorations that cannot be removed by cleaning and are exposed to view will require cosmetic repair. Cosmetic concrete repair in exposed-to-view surfaces will require Architect's approval before patching operation.

3. Slab Repairs: High and low areas in concrete slabs shall be repaired by removing and replacing defective slab areas unless an alternate method, such as grinding and/or filling with self-leveling underlayment compound or repair mortar is approved by the Architect/Engineer. Repair of slab spalls and other surface defects shall be made using epoxy products as specified above and as determined by the Engineer. The high-strength flowing repair mortar may be used for areas greater than 1 inch in depth.

3.14 PREPARATION

A. Sub-Base

1. Compact sub-base as specified in Division 31 Utility Excavation & Backfill – Section 31 23 33.

3.15 INSTALLATION

B. Place 4 inches minimum of the granular base, level, and compact as specified.

C. Joints

C. Scored Control Joints:

1. Spacing, as approved by the Contracting Officer.
   a. Depth of control joints shall be approximately 1/4 of concrete slab thickness, but not less than 1 inch.

D. Finish

1. Slab and Flatwork:
   a. Broom finish as specified by ACI 301 unless noted otherwise in the plans or contract documents.
   b. Round edges including edges formed by expansion joints.
   c. Remove edger marks

3.16 FIELD QUALITY CONTROL

D. Inspection

1. To allow the Contracting Officer's verification of grades and elevations, notify the Contracting Officer three days minimum before placing concrete for specified concrete site elements.

END OF SECTION

SECTION 03 31 00

NORMAL WEIGHT STRUCTURAL CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work in this Section includes furnishing and installing Project concrete work as described in the Contract Documents.

1.2 REFERENCES

A. American Society for Testing and Materials

1. ASTM C 33-99, 'Standard Specification for Concrete Aggregates'
2. ASTM C 94-98c, 'Standard Specification for Ready-Mixed Concrete'
3. ASTM C 150-98, 'Standard Specification for Portland Cement'
4. ASTM C 260-98, 'Standard Specification for Air-Entraining Admixtures for Concrete'
5. ASTM C 494-98a, 'Standard Specification for Chemical Admixtures for Concrete'
6. ASTM C 618-98, 'Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete'
7. ASTM E 1155-96 (2001), ‘Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers’

B. “GREENBOOK” Standard Specifications for Public Works Construction – 2012 Edition

1.3 SYSTEM DESCRIPTION

A. Design Requirements

1. Concrete elements of the Project are designed to meet SSPWC Section 201 – CONCRETE, MORTAR, and RELATED MATERIALS
   a. Compressive strength: 4,500 psi

B. Performance Requirements

1. Conform to requirements of ASTM C 94 unless specified otherwise.
2. For testing purposes, the following concrete strengths are required-
   a. At 7 days: 60 percent minimum of 28-day strengths
   b. At 28 days-
      1) 4,500 psi

1.4 SUBMITTALS

A. As specified in Division 01 Section 01 33 23 “Submittal Procedures.”

B. Quality Assurance/Control

1. Concrete mix design.
2. Delivery Tickets: Require a mixing plant to furnish delivery tickets for each batch of concrete. Keep delivery tickets at the job-site for use by the Owner or his representatives. Tickets shall show the following:
   a. Name of ready-mix batch plant
   b. Serial number of tickets
   c. Date and truck number
   d. Name of Contractor
   e. Name and location of Project
   f. Specific class or designation of concrete in conformance with that employed in Project specification
   g. Amount of concrete
   h. Time loaded
   i. Type, name, and amount of admixtures used
   j. Amount and type of cement
   k. Total water content
   l. Sizes and weights of sand and aggregate

1.5 PROJECT CONDITIONS

A. Project Environmental Requirements

1. Cold Weather Concreting Procedures:
   a. No frozen materials shall be used.
   b. Forms, reinforcement, and fillers shall be free from frost. Place no concrete on frozen ground.
   c. For temperatures below 40 degrees F, maintain concrete at between 60 and 80 degrees F when placing, and 50 degrees F minimum for 5 days if regular concrete or at 50 degrees F for 3 days if high early strength concrete, or longer if determined necessary by the Contracting Officer.
   d. Housing, covering, or other protection shall remain in place for 24 hours after heat is discontinued.
2. Hot Weather Concreting Procedures-
   a. The maximum concrete temperature allowed is 90 degrees F in hot weather.
   b. Cool aggregate and subgrades by sprinkling.
   c. Avoid cement over 140 degrees F
   d. Use cold mixing water or ice.
   e. Use fog spray or evaporation retardant to lessen rapid evaporation from the concrete surface.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Portland Cement: Meet requirements of ASTM C 150, Type II.

B. Aggregates

1. Combined Aggregate Grading- Grading C
   a. Meet requirements of SSPWC Section 201-1.3.2 Combined Aggregate Gradings which by test or actual service produces concrete of required strength and conforms to local governing codes.
   b. Aggregate shall be uniformly graded as follows-
      1) All Work

Sieve Size	Percent Passing
1-1/2 inch	100
1 inch	95 - 100
3/4 inch	77 - 93
3/8 inch	50 - 70
No. 4	39 - 51
No. 8	31 - 41
No. 16	22 - 32
No. 30	12 - 22
No. 50	3 - 15
No. 100	0 - 5
No. 200	0 - 2

C. Water - Clear, clean, and potable.

D. Admixtures And Miscellaneous

1. Mineral-
   a. Fly Ash Pozzolan- Meet requirements of ASTM C 618, Class F or C, and with the loss on ignition (LOI) of 4 and 2 percent maximum, respectively.
2. Chemical-
   a. No admixture shall contain calcium chloride, nor shall calcium chloride be used as an admixture. All chemical admixtures used shall be from the same manufacturer and compatible with each other.
   b. Air Entraining Admixture-
      1) Meet the requirements of ASTM C 260.
      2) Approved Products -
         a) Air Mix 200 or AEA-92 by Euclid
         b) Air plus or Super Air Plus by Fritz-Pak
         c) MB-VR or MB-AE by Master Builders

d) Sika Air by Sika
e) Daravair or Darex II AEA by W R Grace.

c. Water Reducing Admixture -
1) Meet requirements of C 494, Type A, and containing not more than 0.05 percent chloride ions.
2) Approved Products -
a) Eucon WR 75 or Eucon 91 by Euclid
b) FR-2 or FR-3 by Fritz-Pak
c) Pozzolith Normal by Master Builders
d) Plastocrete 160 by Sika
e) Daracem 50/55, WRDA-64, or WRDA-82 by W R Grace.

d. Water Reducing, Retarding Admixture -
1) Meet requirements of ASTM C 494, Type D, and contain no more than 0.05 percent chloride ions.
2) Approved Products -
a) Eucon Retarder 75 by Euclid
b) FR-1 or Modified FR-1 by Fritz-PakPozzolith Retarder by Master Builders
c) Plastiment by Sika
d) Daratard-17 or Daratard-40 by W R Grace.

e. High Range Water Reducing Admixture (Superplasticizer) -
1) Meet requirements of ASTM C 494, Type F or G, and containing not more than 0.05 percent chloride ions.
2) Approved Products -
a) Eucon 37 or Eucon 537 by Euclid
b) Supercizer 1 through 7 by Fritz-Pak
c) Rheobuild 1000 by Master Builders
d) Sikament 300 by Sika
e) Darachem-100 or WRDA-19 by W R Grace.

f. Non-Chloride, Non-Corrosive Accelerating Admixture -
1) Meet requirements of ASTM C 494, Type C, or E and not contain more chloride ions than are present in municipal drinking water.
2) Approved Products -
a) Accelguard 80 by Euclid
b) Daraset or Polarset by W R Grace.

g. Water-Reducing, Accelerator Admixture (Non-Corrosive, Non-Chloride):
1) Meet requirements of ASTM C 494, Type C or E, and containing not more than 0.05 percent chloride ions.
2) Approved Products:
a) Plastocrete 161FL, Sika Chemical Co.
b) Polarset, Gilco, Lubricon NCA, or DCI, W.R. Grace
c) Eucon AcN, Accelguard 80/90; NCA, or AcN, the Euclid Chemical Company

h. Water-Reducing, Retarding Admixture.
1) Meets requirements of ASTM C 494, Type D.
2) Approved Products:
a) Daratard series, W.R. Grace & Co.
b) Pozzolith" series or "DELVO" series; BASF Construction Chemicals
c) Plastiment; Sika Chemical Co.
d) "Eucon Retarder", Series, the Euclid Chemical Company

i. Viscosity Modifying Admixture
   1) Used to enhance plastic concrete properties such as workability, pumpability, and stability for "self-consolidating concrete.
   2) Approved Products:
      a) Rheomac VMA series, BASF Construction Chemicals
      b) Eucon SL or Visctrol, the Euclid Chemical Company
      c) VisoCrete" series, Sika Chemical Co.
      d) VMAR series, W.R. Grace & Co.

j. Shrinkage Reducing Admixture
   1) An admixture that reduces drying shrinkage by reducing the capillary tension of pore water.
   2) Approved Products:
      a) For Air-Entrained Concrete:
         1. Eclipse Plus, Grace Construction Products
         2. Eucon SRA, the Euclid Chemical Company
      b) For Non-Air-Entrained Concrete:
         1. Eclipse Floor; Grace Construction Products
         2. Tetraguard AS20; BASF Construction Chemicals

k. Corrosion Inhibitor.
   1) A 30% Calcium Nitrate at dosage rates per manufacturer's recommendation based on design life, application, clear cover, and other products in the concrete mix.
      a) Approved Products:
         1. Eucon CIA or Eucon BCN, the Euclid Chemical Company
         2. DCI or DCI-S, W.R. Grace & Co.
         3. Rheocrete CNI, BASF Construction Chemicals
         4. Sika CNI, Sika Chemical Co.
   2) Amine-Ester type at dosage rates per manufacturer's recommendation
      a) Approved Products:
         1. Rheocrete 222+, BASF Construction Chemicals

l. Crystalline-forming Waterproofing Admixture
   1) A powder admixture capable of producing concrete that is watertight under hydrostatic pressure up to 7 atmospheres when tested per Corps of Engineers tests CRD-C48 and capable of sealing cracks up to 0.4mm.
      a) Approved Products:
         1. Penetron Admix, ICS/Penetron International/Ltd.
         2. Krystol Internal Membrane, Kryton International, Inc.
         3. Xypex C series, Xypex Chemical Corporation
         4. Rheomac 300D, BASF Construction Chemicals

3. Evaporation Retardant -
   a. Approved Products -
      1) Sure Film J-74 by Dayton Superior
      2) Euco-Bar by Euclid Chemical Co
      3) E-Con by L & M Construction Chemicals
      4) SikaFilm, Sika Chemical Co.
      5) Confilm by Master BuildersFine:
4. Calcium Chloride and Chloride Ion Content: Calcium chloride or admixtures containing more than 0.5% chloride ions by weight of the admixture are not permitted

2.2 MIXES

A. Submit mix designs to meet the following requirements

1. Proportions -
   a. Mix Design -
      1) Minimum weight cement per cubic yard concrete - 565 pounds
      2) Air Entrainment – 4 percent, plus or minus 1 percent
      3) Water / Cement Ratio – 0.45 maximum by weight
2. Admixtures -
   a. Mix design shall show the proposed admixture, amount, usage instructions, and justification for the proposed use. Do not use any admixture without the Contracting Officer's written approval.
   b. Mineral - Fly ash up to 15 percent of the weight of cement can be substituted for cement. Subsititution shall consider fly ash with cement in determining the amount of water necessary to provide a specified water/cement ratio.
   c. Chemical -
      1) 4 inches slump maximum before the addition of high range water reducer.
      2) 6 inches slump maximum with use of high range water reducer (HRWR).
      3) A specified accelerator or retarder may be used if necessary to meet environmental conditions.
   d. Mix Design -
      1) Minimum weight cement per cubic yard concrete 556.5 pounds and fly ash percent by weight -
      2) Air Entrainment – 4 percent, plus or minus 1 percent
      3) Water / Cement Ratio – 0.45 maximum by weight

PART 3 - EXECUTION

3.1 PREPARATION

A. Remove water and debris from the space to be placed.

3.2 INSTALLATION

A. Site Tolerances

1. ACI Standards shall govern concrete work except where specified differently.

B. Placing

1. Place as soon after mixing as possible. Deposit as nearly as possible in the final position. Placing of concrete shall be continuous until a panel or section is complete.
2. Compact concrete in forms by vibrating and other means where required. Thoroughly work in concrete around reinforcing bars.
3. Do not embed aluminum in concrete.
4. Do not use contaminated, deteriorated, or re-tempered concrete.
5. Avoid accumulation of hardened concrete.

C. Finishing

1. Broom Finishes, Exterior Flatwork Not Specified in Cast-In-Place Concrete Site Elements – Section 03 30 00.
   a. Broom finish exterior concrete.
   b. Round edges including edges formed by expansion joints.
   c. Remove edger marks.

D. Curing:

1. Keep concrete moist for seven days minimum for regular concrete and 3 days for high early strength. Do not use concrete curing compounds without the Contracting Officer's written approval. Do not use curing compounds to replace moist curing unless accepted in writing by the Contracting Officer at least 3 days before placement of concrete.
2. Concrete curing blankets are to be used to cover the fresh concrete if nighttime temperatures drop below 40 degrees F.

3.3 FIELD QUALITY CONTROL

A. Test for Portland Cement Concrete

1. The contractor will engage a qualified independent testing agency to perform the concrete testing indicated below. Payment for these services will be made by the Contractor.

3. Take 3 concrete test cylinders for every 100 or fewer cubic yards of each class of concrete placed. Take 1 additional test cylinder during cold weather concreting, cured on the job site under the same conditions as the concrete it represents. At a minimum take 3 concrete test cylinders for the concrete mat foundation supporting the water tanks and take 3 concrete test cylinders for the concrete pipe transition thrust block where the above-ground piping transitions to underground piping.
   a. Curing: Cure and test cylinders at a laboratory approved by the Contracting Officer. Test Timing: Test 1 of each 3 at 7 days and the other 2 at 28 days.
   b. Test Criteria: All testing shall be per "GREENBOOK" Standard Specifications for Public Works Construction – 2012 Edition, Section 201-1.1.5
4. All Portland cement concrete delivered and placed shall be sampled and tested following ASTM C39 testing.

3.4 ADJUSTING - NOT USED.

3.5 PROTECTION

A. Protect concrete that has not received its initial set from precipitation to avoid excess water in the mix and unsatisfactory surface finish.

END OF SECTION

SECTION 03 40 00

PRECAST CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Concrete structures: Manholes, grease interceptor, septic tanks, pump station, wet wells, valve vaults, and siphon dosing tank, as detailed on plans, precast instead of casting in place.

1.2 STANDARDS

A. See standards listed in related sections.

1.3 SUBMITTALS

A. For concrete items detailed in plans:

1. Shop drawings showing all dimensions, all standard views and major cross-section views, and placement of all reinforcement (including ties and stirrups) and embedded items.
2. Placement drawings, showing lifting inserts, weight and center of gravity, and lifting method requirements.
3. Anti-buoyancy measures, where groundwater is present in the zone of placement.
4. Reinforcement schedule, with steel shop instructions, and shape details.
5. For sites with access restrictions by obstacles or property boundaries, approach plan showing positions of transporting truck and lifting implement to effect placement.
6. Manhole lids should be rated for H20 loading for structures located in areas accessible to vehicles.

PART 2 - PRODUCTS

2.1 Products in other sections: concrete mixes and reinforcing steel, subject to:

A. For other precast items, use the “water-containing concrete” mix requirements of Division 03 Section 03 31 00 “Normal Weight Structural Concrete.”

B. Preapproved manufacturer of precast concrete structures: tanks and manholes (or COR approved equal):

1. Jensen Precast®
   5400 Raley Blvd., Sacramento, CA 95838
   Phone: (916) 991-8800
   Toll-Free: (800) 843-9569
   Fax: (916) 991-8810

PART 3 - EXECUTION

3.1 PLACEMENT

A. Bed as required to control subsidence.

B. Install plumb and true, to grade and alignment as required per plans.

3.2 FINISHING AND SEALING

A. Seal points and penetrations of precast, chambers, vaults, and manholes as required using non-shrink grout.

1. A premixed compound consisting of non-metallic aggregate, cement, water-reducing, and plasticizing agents; capable of developing minimum compressive strength of 6000 psi in 28 days.

END OF SECTION

SECTION 03 82 13

CONCRETE CORE DRILLING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Core drilling of concrete

B. Control of drilling water

1.2 RELATED TECHNICAL SPECIFICATIONS SECTIONS

A. Section 02 41 19 - Selective Demolition

1.3 REFERENCES

A. California Division of Occupational Safety and Health Construction Safety Orders Title 8 of the California Code of Regulations.

1.4 SUBMITTALS

A. General: Refer to Technical Specifications Section 01 33 23 - Submittal Procedures for Shop Drawings, Product Data, and Samples, and the following for submittal requirements and procedures.

B. Coring Procedures: Submit a concrete coring procedure, which shall include the following:

1. Proposed coring methods.
2. Equipment to be used includes coring equipment and rebar locating equipment.
3. Methods to control drilling water and spoils.

C. Remedial Procedures when Reinforcement is cut: Coring operations shall terminate immediately when reinforcement is cut. The Contractor shall submit to the Contracting Officer for approval, the procedure proposed to repair the cut reinforcement and to prevent further cutting of reinforcement.

D. Immediately after coring, the concrete cores shall be identified by the Contractor with a description of the core locations and submitted to the Contracting Officer for inspection.

1.5 QUALITY ASSURANCE

A. Codes and Standards: Comply with all applicable Federal, State, and Local Codes and Safety Regulations. Work practices and worker health and safety shall conform to the California Division of Occupational Safety and Health Construction Safety Orders Title 8, of the California Code of Regulations.

B. Construction Tolerances: The deviation in the alignment of cored holes from that shown on the Construction Drawings shall not be more than 1/2 inch per 10 feet of cored hole length with a maximum deviation of not more than 3 inches.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Water for core drilling operations shall be from the local domestic water supply or shall not contain more than 1,000 parts per million of chlorides as Cl^-, nor more than 1,300 parts per million of sulfates as SO_4^{2-}, nor shall the water contain any impurities in a sufficient amount that would cause discoloration of the concrete or produce etching of the surface.

PART 3 - EXECUTION

3.1 CORE DRILLING

A. Coring concrete shall consist of coring holes through reinforced concrete members as shown on the Contract Documents.

B. The holes shall be cored by methods that will not shatter or damage the concrete adjacent to the holes.

C. Water from core drilling operations shall not be permitted to fall on public traffic, flow across shoulders or lanes occupied by public traffic, or flow into gutters or other drainage facilities.

END OF SECTION

DIVISION 05

METALS

SECTION 05 05 23

METAL FASTENING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes but is Not Limited To

1. Quality of structural bolts used on the Project.
2. Requirements and standards for site welded metal-to-metal connections.

B. Related Sections

1. Furnishing and installing of structural bolts specified under Section concerned.
2. Performance of welding specified under Section concerned.

1.2 REFERENCES

A. American National Standards Institute / American Welding Society

1. ANSI / AWS D1.1-92, 'Structural Welding Code - Steel'
2. ANSI / AWS D1.3-89, 'Structural Welding Code - Sheet Steel'

B. American Society for Testing & Materials

1. ASTM A 36-97a, 'Standard Specification for Carbon Structural Steel'
2. ASTM A 307-97, 'Standard Specification for Carbon Steel Bolts and Studs 60,000 psi Tensile Strength'

1.3 QUALITY ASSURANCE

A. Qualifications - Welders shall be certified and bear evidence of certification thirty (30) days before commencing work on Project. If there is doubt as to the proficiency of the welder, The Contracting Officer may require the welder to take another test, at no additional cost to the Government. Certification shall be by Pittsburgh Laboratories or other authority approved by the Contracting Officer before welding activities commence.

B. Certifications - Maintain all welder's certifications on the job site.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Bolts and Threaded Fasteners

1. Anchor Bolts -
   a. All bolts are to be stainless steel type 304 unless otherwise specified.
   b. Bolt to be threaded 2 inches minimum. Anchor hook to project 2 inches minimum including bolt diameter.
2. All Other Bolts - Conform with requirements of ASTM A 307, Grade A.

B. Arc-Welding Electrodes - Type E70XX AWS Iron and Steel Arc-welding electrodes and meeting current AISC Specifications.

PART 3 - EXECUTION

3.1 PERFORMANCE

A. Welding shall meet the requirements of ANSI / AWS D1.1 and D1.3.

B. Minimum weld sizes, unless detailed otherwise.

1. Weld tube columns to base plates and top plates with 1/4 inch fillet weld all around.

END OF SECTION

SECTION 05 05 23.16

STRUCTURAL WELDING

PART 1 - GENERAL

1.1 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 360.....(2016) Specification for Structural Steel Buildings

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ANSI/ASNT CP-189.....(2020) ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4 .....(2012) Standard Symbols for Welding, Brazing and Nondestructive Examination

AWS D1.1/D1.1M.....(2020; Errata 1 2021) Structural Welding Code – Steel

AWS D1.3/D1.3M.....(2018) Structural Welding Code - Sheet Steel

AWS D1.4/D1.4M.....(2011) Structural Welding Code - Reinforcing Steel

AWS D1.8/D1.8M.....(2016) Structural Welding Code—Seismic Supplement

AWS D14.4/D14.4M.....(2012) Specification for Welded Joints for Machinery and Equipment

AWS QC1 .....(2016) Specification for AWS Certification of Welding Inspectors

AWS Z49.1.....(2012) Safety in Welding and Cutting and Allied Processes

ASTM INTERNATIONAL (ASTM)

ASTM E165/E165M .....(2018) Standard Practice for Liquid Penetrant Examination for General Industry

ASTM E709 .....(2021) Standard Guide for Magnetic Particle Testing

1.2 SUBMITTALS

A. Submit the following Section 01 33 23 SUBMITTAL PROCEDURES:

1. Welding Quality Assurance Plan
2. Welder, Welding Operator, and Tacker Qualification
3. Welding Electrodes and Rods
4. Nondestructive Testing Weld Inspection Log

1.3 QUALITY ASSURANCE

A. Except for pre-qualified (following AWS D1.1/D1.1M) and previously qualified procedures, each Contractor performing welding must record in detail and qualify the welding procedure specification for any welding procedure followed in the fabrication of weldments.

B. Conform welding procedure qualifications to AWS D1.1/D1.1M and the specifications in this section.

C. Submit for approval copies of the welding procedure specification and the procedure qualification records for each type of welding being performed.

D. Submission of the welder, welding operator, or tacker qualification test records is also required. Approval of any procedure, however, does not relieve the Contractor of the sole responsibility for producing a finished structure meeting all the specified requirements.

1. Submit this information on the forms in Annex M of AWS D1.1/D1.1M.
2. Individually identify and reference on the detail drawings and erection drawings all welding procedure specifications, or suitably key them to the contract drawings.
3. In case of conflict between this specification and AWS D1.1/D1.1M, this specification governs.

1.4 PREVIOUS QUALIFICATIONS

A. Welding procedures previously qualified by test following AWS D1.1/D1.1M may be accepted for this contract without re-qualification, upon receipt of the test results, if the following conditions are met:

1. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.
2. The qualified welding procedure conforms to the requirements of this specification and applies to welding conditions encountered under this contract.
3. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and apply to welding conditions encountered under this contract.

1.5 PRE-QUALIFIED PROCEDURES

A. Welding procedures that are considered pre-qualified as specified in AWS D1.1/D1.1M will be accepted without further qualification.

B. Submit for approval a listing or an annotated drawing to indicate the joints that are not pre-qualified. Procedure qualification is mandatory for these joints.

1.6 WELDER, WELDING OPERATOR, AND TACKER QUALIFICATION

A. Each welder, welding operator, and tacker assigned to work on this contract must be qualified following the applicable requirements of AWS D1.1/D1.1M and as specified in this section.

B. Welders, welding operators, and tackers who make acceptable procedure qualification test welds will be considered qualified for the welding procedure used within the applicable essential variables for welder qualification.

1.7 PREVIOUS PERSONNEL QUALIFICATION

A. At the discretion of the Contracting Officer, welders, welding operators, and tackers qualified by test within the previous 6 months may be accepted for this contract without re-qualification if all the following conditions are met:

1. Copies of the welding procedure specifications, the procedure qualification test records, and the welder, welding operator, and tacker qualification test records are submitted and approved per the specified requirements for detailed drawings.
2. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.
3. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and apply to welding conditions encountered under this contract.

1.8 CERTIFICATES

A. Before assigning any welder, welding operator, or tacker to work under this contract, submit the names and certification that each individual is qualified as specified.

B. State in the certification the type of welding and positions for which the welder, welding operator, or tacker is qualified, the code and procedure under which the individual is qualified, the date qualified, and the name of the firm and person certifying the qualification tests.

C. Keep the certification current, on file, and furnish 3 copies.

1.9 RENEWAL OF QUALIFICATION

A. Re-qualification of a welder or welding operator is required under any of the following conditions:

1. It has been more than 6 months since the welder or welding operator has used the specific welding process for which he is qualified.
2. There is a specific reason to question the welder or welding operator's ability to make welds that meet the requirements of these specifications.

3. The welder or welding operator was qualified by an employer other than those firms performing work under this contract, and a qualification test has not been taken within the past 12 months.
4. Submit as evidence of conformance all records showing periods of employment, the name of the employer where the welder, or welding operator, was last employed, and the process for which qualified.

B. A tacker who passes the qualification test is considered eligible to perform tack welding indefinitely in the positions and with the processes for which he/she is qualified, unless there is some specific reason to question the tacker's ability or there has been a gap greater than 6 months since he/she last used the process.

1. In such a case, the tacker is required to pass the prescribed tack welding test.

1.10 SYMBOLS AND SAFETY

A. Use symbols following AWS A2.4, unless otherwise indicated.

B. Follow safe welding practices and safety precautions during welding in conformance with AWS Z49.1.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. The design of welded connections should conform to AISC 360 unless otherwise indicated or specified.

B. Material with welds will not be accepted unless the welding is specified or indicated on the drawings or otherwise approved.

C. Perform welding as specified in this section, except where additional requirements are shown on the drawings or are specified in other sections.

D. Do not commence welding until welding procedures, inspectors, nondestructive testing personnel, welders, welding operators, and tackers have been qualified and the submittals approved by the Contracting Officer.

E. Perform all testing at or near the worksite. Maintain records of the test results obtained in welding procedure, welder, welding operator, and tacker performance qualifications.

2.2 PRE-ERECTION CONFERENCE

A. Hold a pre-erection conference before the start of the field welding, to bring all affected parties together and to gain a naturally clear understanding of the project and the Welding Procedure Specifications (WPS).

B. Mandatory attendance is required by all Contractor's welding production and inspection personnel and appropriate.

C. Government personnel. Include as items for discussion:

1. Responsibilities of various parties; welding procedures and processes to be followed; welding sequence; inspection requirements and procedures, both visual and non-destructive testing; welding schedule; and other items deemed necessary by the attendees.

2.3 WELDING EQUIPMENT AND MATERIALS

A. Provide all welding equipment, welding electrodes and rods, welding wire, and fluxes capable of producing satisfactory welds when used by a qualified welder or welding operator.

B. Provide welding equipment and materials that comply with the applicable requirements of AWS D1.1/D1.1M. Submit product data on welding electrodes and rods.

PART 3 - EXECUTION

3.1 WELDING OPERATIONS

A. Requirements

1. Conform workmanship and techniques for welded construction to the requirements of AWS D1.1/D1.1M and AISC 360.
2. When AWS D1.1/D1.1M[, AWS D1.8/D1.8M] and the AISC 360 specification conflict, the requirements of AWS D1.1/D1.1M govern.

B. Identification: Identify all welds in one of the following ways:

1. Submit written records to indicate the location of welds made by each welder, welding operator, or tacker.
2. Identify all work performed by each welder, welding operator, or tacker with an assigned number, letter, or symbol to identify welds made by that individual.
   a. The Contracting Officer may require welders, welding operators, and tackers to apply their symbol next to the weld utilizing a rubber stamp, felt-tipped marker with waterproof ink, or other methods that do not cause an indentation in the metal.
   b. Identification with die stamps or electric etchers is not allowed.

3.2 QUALITY CONTROL

A. Perform testing using an approved inspection or testing laboratory or technical consultant; or if approved, the Contractor's inspection and testing personnel may be used instead of the commercial inspection or testing laboratory or technical consultant.

B. A Certified Welding Inspector must perform a visual inspection on 100 percent of all welds.

1. Document this inspection in the Visual Weld Inspection Log.
2. Verify the welds conform to paragraph STANDARDS OF ACCEPTANCE.
3. Conform procedures and techniques for inspection with applicable requirements of AWS D1.1/D1.1M, ASTM E165/E165M, and ASTM E709.
4. Submit a Welding Quality Assurance Plan and records of tests and inspections.

3.3 STANDARDS OF ACCEPTANCE

A. Conform dimensional tolerances for welded construction, details of welds, and quality of welds with the applicable requirements of AWS D1.1/D1.1M and the contract drawings.

B. Submit all records of nondestructive testing.

C. Nondestructive Testing

1. The welding is subject to inspection and tests in the mill, shop, and field.
2. Inspection and tests in the mill or shop do not relieve the Contractor of the responsibility to furnish weldments of satisfactory quality.
3. When materials or workmanship do not conform to the specification requirements, the Government reserves the right to reject material or workmanship or both at any time before final acceptance of the structure containing the weldment.
4. Any indication of a defect is regarded as a defect unless re-evaluation by nondestructive methods or by surface conditioning shows that no unacceptable defect is present.
5. Submit all records of nondestructive testing per paragraph STANDARDS OF ACCEPTANCE.

D. Destructive Tests

1. Make all repairs when metallographic specimens are removed from any part of a structure.
2. Employ only qualified welders or welding operators, and use the proper joints and welding procedures, including peening or heat treatment if required, to develop the full strength of the members and joints cut and to relieve residual stress.

3.4 GOVERNMENT INSPECTION AND TESTING

A. In addition to the inspection and tests performed by the Contractor for quality control, the Government will perform inspection and testing for acceptance to the extent determined by the Contracting Officer.

B. The work may be performed by the Government's forces or under a separate contract for inspection and testing.

C. The Government reserves the right to perform supplemental nondestructive and destructive tests to determine compliance with paragraph STANDARDS OF ACCEPTANCE.

3.5 CORRECTIONS AND REPAIRS

A. If inspection or testing indicates defects in the weld joints, repair defective welds using a qualified welder or welding operator as applicable.

B. Conduct corrections following the requirements of AWS D1.1/D1.1M and the specifications.

C. Repair all defects per the approved procedures.

D. Repair defects discovered between passes before additional weld material is deposited.

E. Wherever a defect is removed and repaired by welding is not required, blend the affected area into the surrounding surface to eliminate sharp notches, crevices, or corners.

F. After a defect is thought to have been removed, and before re-welding, examine the area by suitable methods to ensure that the defect has been eliminated.

G. Repaired welds must meet the inspection requirements for the original welds.

END OF SECTION

SECTION 05 50 00

METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including Division 1 Specification Sections apply to the work of this Section.

1.2 SECTION INCLUDES

A. Miscellaneous Metal Fabrications

1.3 REFERENCES

A. All references shall be the latest adopted edition.

B. ANSI A14.3 - American National Standard for Ladders - Fixed – Safety Requirements

C. ASTM A36 - Standard Specification for Carbon Structural Steel

D. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

E. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

F. ASTM A153/A 153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

G. ASTM A283/A 283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates

H. ASTM B308 - Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles

I. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

J. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

K. ASTM A1008 - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable

L. AWS A2.4 - Symbols for Welding, Brazing, and Nondestructive Examination; American Welding Society

M. AWS D1.1 - Structural Welding Code - Steel; American Welding Society

N. SSPC (PM2) - Painting Manual, Vol. 2, Systems and Specifications; Steel Structures Painting Council

1.4 SUBMITTALS

A. Refer to Division 1 of the specifications for submittal procedures.

B. Shop Drawings: Submit shop drawings prepared by a professional steel detailer showing each metal fabrication; indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.

1.5 QUALITY ASSURANCE

A. Welders: Qualified within the previous 12 months for the type of welding required for this project in accordance with AWS D-1.1 and AWS D 1.4.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel Sheet: ASTM A1008.

B. Solid Steel Bars, Plates & Shapes: ASTM A36.

C. Steel Tubing: ASTM A500, Grade C.

D. Plates: ASTM A283.

E. Pipe: ASTM A53, Grade B Schedule 40, black finish.

F. Bolts: ASTM F3125 Grade A325

G. Nuts: ASTM A563

H. Washers: ASTM F436 galvanized to ASTM A153 for galvanized components.

I. Welding Materials: AWS D1.1; type required for materials being welded.

J. Shop and Touch-Up Primer: SSPC-Paint 15, Type 1, red oxide.

K. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type I Inorganic zinc-rich.

2.2 FABRICATION

A. Coordinate and confirm field dimensions and conditions prior to fabrication.

B. Fit and shop assemble items in the largest practical sections, for delivery to the site.

C. Fabricate items with joints tightly fitted and secured.

D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to a small uniform radius.

E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with the design of the component, except where specifically noted otherwise.

F. Supply components required for the anchorage of fabrications. Fabricate anchors and related components of the same material and finish as fabrication, except where specifically noted otherwise.

2.3 FABRICATED ITEMS

A. Miscellaneous Embedded Plates, Framing, and Supports: Fabricate from structural steel shapes, plates, and bars, of welded construction to sizes, shapes, and profiles indicated and required, to receive other adjacent construction retained by framing and supports.

1. Use mitered joints for field connection.
2. Cut, drill, and tap units to receive hangers, hardware, and similar items.
3. Hot-dip galvanize items on building exterior, exposed to the exterior atmosphere or so indicated on the Drawings; prime paint other items.

B. Other Miscellaneous Fabricated Steel Items Shown on The Drawings: Fabricate as shown.

2.4 FINISHES - STEEL

A. Prime Paint:

1. Prepare surfaces to be primed in accordance with SSPC-SP-1 and SP 3.
2. Clean surfaces of rust, scale, oil, grease, and foreign matter before finishing.
3. Prime Painting: Shop prime fabricated members with primer specified.
4. Steel with Fireproofing: Do not shop prime, leave steel surfaces bare.

B. Galvanizing: Galvanize after fabrication to ASTM A123. Provide minimum 2.0 oz/sq ft galvanized coating.

1. Hot-dip galvanize fabricated items located on the building exterior, exposed to the exterior atmosphere or so indicated in this Section or on the Drawings.

2.5 FABRICATION TOLERANCES

A. Squareness: 1/8 inch maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: No misalignment allowed, fabricate flush.

C. Maximum Misalignment of Adjacent Members: 1/16 inch.

D. Maximum Bow: 1/8 inch in 48 inches.

E. Maximum Deviation from Plane: 1/16 inch in 48 inches.

PART 3 - EXECUTION

3.1 COORDINATION

A. Review, coordinate and accommodate work of other trades that interface with, affect, or are affected by the work of this Section to facilitate the execution of the overall Work of this project in a coordinated and efficient manner.

3.2 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

B. Beginning installation indicates the installer's acceptance of conditions.

3.3 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.4 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Field weld components are indicated on shop drawings.

D. Perform field welding following AWS D1.1.

E. Obtain approval before site cutting or making adjustments not scheduled.

F. After erection, prime welds, abrasions, and surfaces are not shop-primed or galvanized.

G. Touch up damaged areas of galvanized finish on fabrications with touch-up primer.

3.5 ERECTION TOLERANCES

A. Maximum Variation from Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset from True Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION

SECTION 05 50 16

MISCELLANEOUS METAL FOR UTILITIES

PART 1 – GENERAL

1.1 SUMMARY

A. This section contains specifications for miscellaneous metals not specified in other sections including steel used to support piping.

1.2 RELATED WORK

A. Section 03 30 00 - Cast-in-Place Concrete Site Elements

B. Section 09 90 00 – Paints & Coatings

1.3 REFERENCE

A. Applicable provisions of Division 1 shall govern work under this Section.

B. AISC - Specifications and Code of Standard Practice

C. AISC - Structural Shop Drafting Textbook.

D. ASTM A36 - Structural Steel

E. ASTM A307 - Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength

F. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

G. ASTM A500 - Cold Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes.

H. ASTM A992 - Steel for Structural Shapes for Use in Building Framing.

I. AWS A2.0 - Standard Welding Symbols

J. AWS D1.1 - Structural Welding Code

1.4 FIELD MEASUREMENTS

A. Take measurements in the field as required to verify or supplement dimensions shown on the drawings and assume responsibility for fit of new work to work in place.

1.5 SUBMITTALS

A. Refer to Division 1 of the Specifications for submittal procedures.

B. Product Data: Submit manufacturer's product data for pre-manufactured components.

C. Approval will be for the size and arrangements of the principal and auxiliary members. Errors in dimensions shown on shop drawings shall be the responsibility of the Contractor. Contract drawings shall not be used as erection or shop drawings.

D. Except as shown otherwise, structural steel details shall conform to standard practice as illustrated in the Structural Shop Drafting Textbook of the AISC. Design, fabrication, and erection of all shop and field connections by this Contractor.

E. Submit 3 copies for review.

PART 2 - PRODUCTS

2.1 STRUCTURAL STEEL FOR PIPE, ANCHORS, GUIDES, SUPPORTS, AND STANCHIONS

A. Structural and Miscellaneous Steel: W-shaped members shall conform to ASTM A992 fy = 50 KS1.

B. Structural tubing shall conform to ASTM A500 Grade C.

C. Angle plates and channels shall conform to ASTM A36.

D. Support, guide, and anchor steel for steel piping as shown on drawings.

E. Priming for Steam, Condensate, and Air Pipe: Shop primed painting of structural steel shall be two coats (6 DMils Thickness total) of ethyl silicate inorganic zinc-rich equal to TNEMEC Tneme-zinc 90E-92. Primer shall be suitable for the temperature of at least 500° F. Shop surface prep shall be SSPC-SP6 Commercial Blast Cleaning.

F. All support steel embed plates shall be hot-dipped galvanized.

G. High-strength bolts, nuts, and washers shall be made of heat-treated steel. Provide interference body bearing type where indicated.

H. Headed welded studs shall conform to ASTM A307.

I. Epoxy anchors shall be HIT HY500 as manufactured by Hilti, Inc., or approved equal.

J. All anchor rods, anchor bolts, nuts, and washers shall be 316 stainless steel.

2.2 FRAMES, COVERS, ACCESS HATCHES

A. Furnish manhole entrance covers and frames as shown. Frames shall be installed as shown on the drawings.

B. Cover: 1/4“ thick aluminum diamond plate, 300 psf live load rating, mill finish, lifting mechanism with reinforced composite tubes and electro-coated compression springs, automatic hold-open arm, forged aluminum hinges with stainless steel pins, neoprene gasketed standard slam lock with keyed cylinder lock and underside release knob.

C. Cover and frames shall be Bilco Type J-AL, Halliday Type WIR, or approved equal.

D. Frame: 1/4” thick extruded aluminum channel with continuous concrete anchor, with continuous EPDM debris gasket and 1-1/2” aluminum coupling for the drain.

E. Guarantee: 10-year material.

2.3 DRY PIT/SUMP PUMP GRATE FRAMES

A. Sump pump grate frames shall be hot-dipped galvanized steel.

2.4 MANHOLE LADDERS

A. Construct ladders of 3/8 x 2-1/2" steel bar side rails with 3/4" diameter twisted bar steel rungs, headed into rails, approximately but not over 12" o.c. Ream holes inside rails, plug weld solid, and grind smooth.

B. Anchor ladder at bottom and top and intermediate points not over 5'-0" o.c. with brackets secured to the wall with expansion or toggle bolts. Bolts shall be Red Head stainless steel bolts and washers. Ladders shall have a 2” HDPE block under the floor-mounted anchors.

C. Ladders shall be hot-dip galvanized.

2.5 LADDER “SAFETY POST”

A. Manufacturer: Bilco “Ladder up LU-2”, Halliday, Okeeffe’s or approved equal.

B. Provide galvanized assembly with release rod and pull-up loop.

C. The safety post shall be steel. The safety post shall NOT have a twist-type locking mechanism.

PART 3 - EXECUTION

3.1 FABRICATION

A. The mechanical contractor shall provide steel embedment plates for steel pipe and anchor bolts for pipe supports, anchors, and guides for General Contractor to install.

B. Work shall be made and erected square, plumb, straight, and true, smooth, accurately fitted joints and intersections. Work shall be reinforced and anchored in place.

C. Shearing and punching shall leave clean, true lines and surfaces. Weld permanent connections. Insofar as possible, work shall be fitted and shop assembled, ready for erection. At all materials exposed to skin welds shall be ground smooth.

D. Grind off sharp areas of exposed steel including sheared edges.

E. Do cutting, fitting, drilling, welding, tapping, etc., as may be required to complete this work and to join or accommodate work of other trades.

F. Any steel pipe anchors, guides, and supports shall be shop primed and intermediate coat applied following paint requirements of Section 09 90 90 – Paints & Coatings.

G. Welding shall be following the code of the American Welding Society. Before welding, clean surfaces of loose scale, rust, paint, or other foreign matter and properly align. After welding, the brush welds with wire brushes.

H. Welds shall show uniform section, smoothness of weld metal, weather edges without overlaps, and freedom from porosity and clinkers. Where necessary to achieve smooth connections, joints shall be dressed smooth. All welding shall be done by certified welders.

3.2 GENERAL

A. Include fabrication and erection of all metalwork complete, including all required shapes, clip angles, bolts, hangers, and accessories to complete metals work. Grind off sharp areas of exposed metals including sheared edges.

B. Except as amended herein, materials and workmanship shall be following each applicable and appropriate standard practice issued by the National Association of Architectural Metal Manufacturers.

C. Fabricate structural steel connections, parts, and accessories following the current edition of Specifications and Code of Standard Practice adopted by AISC.

D. Metals shall be made with structural properties to safely sustain and withstand stresses and strains to which normally subjected, true to detail, clean, straight, with sharply defined profiles, lines, and angles, and unless otherwise noted, with smooth finished surfaces.

E. The contractor shall be responsible for the location and levels of work of this Section, except for such parts as may be delivered to others and set by them. In such cases, this Contractor shall assist others in properly locating those parts.

F. Coating of aluminum access hatches frames: Coat aluminum frames that contact concrete with a bitumastic or epoxy coating. Where frame coating has been damaged or is missing recoat before pouring concrete.

END OF SECTION

SECTION 05 51 19

METAL GRATING STAIRS

PART 1 – GENERAL

1.1 SUMMARY

A. Provide industrial grade aluminum stair structural framing, grating treads, and risers as shown on the drawings, as specified herein, and as needed for a complete and proper installation.

B. Related Work:

1. Section 05 50 00- Metal Fabrications
2. Section 05 52 13- Pipe & Tube Railings
3. Section 05 53 00- Aluminum Grating
4. Section 09 90 00- Paints & Coatings

1.2 SUBMITTALS

A. Submit shop drawings, including:

1. The manufacturer's specifications and other data are needed to demonstrate compliance with the specified requirements.
2. Fabrication, layout, installation, anchorage, and interface of the work of this section with the work of adjacent trades.
3. Manufacturer's recommended installation procedures.

1.3 QUALITY ASSURANCE

A. Comply with OSHA and local building codes.

B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with no less than three years of experience.

C. Comply with recommendations of AWS, Structural Welding Code on Aluminum, D1.2 latest edition.

D. Stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform Load: 100 lbf/sq. (4.79kN/Sq. m)
2. Concentrated Load: 300 lbf (1.33kN) applied on an area of 4 sq. in. (2,580 sq. mm.)
3. Uniform and concentrated loads need not be assumed to act concurrently
4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to L/360 or ¼-inch (6.4mm), whichever is less.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver all materials to the job site properly marked to identify the structure for which they are intended and at such intervals to insure uninterrupted progress of the work. Marking shall correspond to markings indicated on the shop drawings.

1. Store all members off the ground using pallets, platforms, or other supports.
2. Do not store materials on the structure in a manner that might cause distortion or damage to the members of the supporting structure.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Aluminum Grate Stair by Grating Pacific Inc. phone: (559) 664-0709, fax number: (559) 664-0730, email: sales@gratingpacific.com Or Approved Equal.

B. Aluminum Grating by Breuer Metal Craftsmen Inc. phone: (920) 885-2828, fax: (920) 885-2822, email: craftsmen@breuermetal.com, Or Approved Equal.

2.2 GENERAL REQUIREMENTS

A. Fit and shop assemble stairs in the largest practical sections for delivery to the job site.

B. Miter the stringers at changes in direction with joints tightly fitted and secured by continuous welds and grind with #3 NOMMA Finish. Make exposed joints butt tight. Ease exposed edges to a small uniform radius.

C. Close and fit the ends of stringers at the floor or landing on the floor surface. On the landings and platforms where they are part of the stair framing, carry the wall stringers around and above the finished level of the platform to form a base of the height as shown.

D. Provide standard prefabricated aluminum grating treads and aluminum nosing with extruded re-enforced profile with non-slip ribs.

1. Mechanically fasten grating treads with an aluminum bearing angle to stringers.
2. Grating bearing bars shall be spaced 1-3/16-inches on center and crossbars shall be spaced at 4-inches on center.
3. Crossbars shall be flush at the top with bearing bars.
4. All Grating edges shall be banded.
5. Unless noted otherwise, all grating at treads and landings will not be welded to supports, provided saddle clips are required for attachment. Limit the weight of each section to no more than 50-pounds.
6. Provide aluminum riser plate welded to grating tread unless drawings indicate otherwise.

2.3 MATERIALS

A. Aluminum

1. Plate: Alloy 6061-T6, Mill Finish, Heat Treatable.
2. Structural Shapes: Alloy 6061-T6, ASTM B 308
3. Sheet Aluminum: ASTM B209 (ASTM B209M), Alloy 5052, H32, or H22 Temper.
4. Round Pipe: Alloy 6061-T6, ASTM B429
5. Square Tubing: Alloy 6063-T52, Extruded
6. Rectangular Tubing: Alloy 6063-T52, Extruded
7. Aluminum- Alloy Bars: ASTM B211 (ASTM B211M), Alloy 6061-T6

B. Grating- Aluminum

1. Material: ASTM B 211, Alloy 6061-T6 or 6063-T6
2. Construction Type: Swage-Locked, Standard Rectangular Bar
3. Surface: Serrated

C. Fasteners- Stainless Steel

1. Interior: Bolts, Nuts, Washers, and Anchors: 304 Stainless Steel
2. Exterior: Bolts, Nuts, Washers, and Anchors: 316 Stainless Steel

2.4 ALUMINUM FINISHES

A. Grind weld joints smooth with adjacent finish surface.

B. Coat aluminum in contact with dissimilar metals, masonry, or lime products with one coat of bituminous paint.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install metal stairs per the manufacturer's recommendations and approved shop drawings.

B. Install components plumb and level, accurately fitted, free from distortion or defects.

C. Securely install bolts or anchors, plates, angles, hangers, and struts required for connecting stairs to the structure.

D. Provide welded field joints where specifically indicated on shop drawings. Perform field welding per the appropriate AWS Specification.

E. Obtain approval from Contracting Officer before site cutting or creating adjustments not shown on schedules.

END OF SECTION

SECTION 05 52 00

METAL RAILINGS

PART 1 – GENERAL

1.1 SUMMARY

A. Provide mechanically connected aluminum handrails and railings as shown on the drawings, as specified herein, and as needed for a complete and proper installation.

B. Related Work:

1. Documents affecting work under this section include, but are not limited to;
   a. Division 01 - General Requirements
   b. Section 05 50 00 - Metal Fabrications
   c. Section 05 51 19 - Metal Grating Stairs
   d. Section 05 52 13 – Pipe & Tube Railings
   e. Section 09 90 00 – Paints & Coatings

1.2 SUBMITTALS

A. Submit shop drawings, including:

1. The manufacturer's specifications and other data are needed to prove compliance with the specified requirements.
2. Fabrication, layout, installation, anchorage, and interface of the work of this section with the work of adjacent trades.
3. Manufacturer's recommended installation procedures.

1.3 QUALITY ASSURANCE

A. Comply with OSHA and local building codes.

B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with no less than 3 years of experience.

C. Railing shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guardrail System:
   a. Uniform load of 50 lb_f./ft. (0.73 kN/m) applied in any direction.
   b. Concentrated load of 200 lb_f. (0.89 kN) applied in any direction.
   c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill Area of Guardrail System:
    a. Concentrated load of 50 lbf. (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
    b. Uniform loaf of 25 lbf. applied horizontally.
    c. Infill load and other loads need not be assumed to act concurrently.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver all materials to the job site properly marked to identify the structure for which they are intended and at such intervals to insure uninterrupted progress of the work. Marking shall correspond to markings indicated on the shop drawings.

B. Pack all-aluminum pipes in individual plastic sleeves to protect the finish.

C. Store all members off the ground using pallets, platforms, or other supports.

D. Do not store materials on the structure in a manner that might cause distortion or damage to the members of the supporting structure.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Aluminum Grate Stair by Grating Pacific Inc. phone: (559) 664-0709, fax number: (559) 664-0730, email: sales@gratingpacific.com Or Approved Equal.

B. BMC Rail by Breuer Metal Craftsmen Inc. phone: (920) 885-2828, fax: (920) 885-2822, email: craftsmen@breuermetal.com, or Approved Equal.

2.2 GENERAL REQUIREMENTS

A. Design, fabricate, and test railing assemblies following the most stringent requirements of ASTM E 985 and applicable local codes.

B. Design railing assembly, wall rails, and attachments to resist lateral force required by applicable code at any point without damage or permanent set. Test following ASTM E 935.

C. Mechanically fastened aluminum railing:

1. Mechanically fastened 1-1/2 Schedule 40 pipe and 1-1/2 Schedule 80 post pipe. Post spacing to be no more than 5'-0" and the top rail shall be smooth and not interrupted along the distance of the guardrail.
2. Use all internal fittings secured with stainless steel rivets.
3. Provide expansion joints for rails at intervals of not more than 20 feet.

D. Provide all railings with 4-inch high kickplate with maximum 3/8-inch clearance to walkway surface fabricated and finished from the same material as the rails and shipped in mill lengths along with stainless steel fasteners.

E. Use an in-line stainless steel base flange assembly with stainless steel anchor bolts for surface mounting posts to concrete.

F. Use an aluminum side mount bracket assembly with stainless steel anchor bolts for side mounting posts.

G. Embed posts 6-inches in the concrete core drilled hole with Styrofoam plug and pre-drilled drain hole.

H. Mount stainless steel base flange to stringers with stainless steel bolts and beveled washers.

I. Handrail: 1-1/2-inch extruded aluminum pipe. Provide where shown on the Drawing.

J. Hinged Swinging Gate

1. Components: Gate frame, stainless steel self-closing device, hinges, gate stops, and durable self-locking type latch. Fabricate components in conformance with OSHA minimum strength requirements.
2. Of same design, material, quality, and workmanship as that of the guardrail system in which they will be installed.

2.3 MATERIALS

A. Aluminum

1. Extruded Bar and Shapes: ASTM B 221, alloy 6063-T6
2. Extruded Pipe and Tube: ASTM B 429, alloy 6005-T5, T

B. Stainless Steel

1. Tubing: ASTM A 554, grade as follows:
   a. Alloy 304
2. Plate: ASTM A 167, grade as follows:
   a. Alloy 304

2.4 FASTENERS

A. Fasteners for Anchoring Railings to Other Construction: Select fasteners of the type, grade, and class required to produce connections that are suitable for anchoring railing to other types of construction indicated and capable of withstanding design loadings.

1. For aluminum railings, provide stainless steel 304.

B. Cast-in-Place and Post-Installed Anchors: Fabricated from corrosion-resistant materials with the capability to sustain, without failure, the loads determined by local code requirements.

2.5 GROUT AND ANCHORING CEMENT

A. Non-shrink, Nonmetallic Grout: Premixed, factory packaged, non-staining, non-corrosive, non-gaseous grout complying with ASTM C 1107. Provide 9 grout specifically recommended by the manufacturer for interior and exterior applications.

B. Interior Anchoring Cement: Factory packaged, non-shrink, non-staining, hydraulic controlled expansion cement formulation for mixing with water at the Project site to create pourable anchoring, patching, and grouting compound. Use for interior applications only.

2.6 ALUMINUM FINISHES

A. Mill Anodized- Aluminum Association Specification M12-C22-A41, finish non-specular as fabricated, chemical finish-medium matte, Architectural Class 1 clear 0.7 mils thick anodic coating.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Posts:

1. Use a single, un-spliced pipe for each post.
2. Do not locate anchor bolts less than 2-inch from concrete surface edges.
3. Materials shall be plumb, square, level, and anchored securely.
4. Bituminous or epoxy paint shall be applied where aluminum is in contact with the dissimilar surface.

B. Rails:

1. Use a continuous pipe length for top rails wherever possible with every single un-spliced length attached to a minimum of three supports.
2. Use a single un-spliced length between supports for lower rails.
3. Attach wall terminal fitting and brackets for rails to the mounting surface with stainless steel anchor bolts.
4. The top horizontal rail should be set 42-inches from the centerline to the adjacent walking surface.
5. Intermediate rail should be set 21-inches from centerline to centerline of the parallel top rail unless indicated on the drawing.

C. Handrails:

1. Set handrails 36-34 inches, measured vertically, above the nosing of the treads or the finished floor of the landing or walking surface.
2. Set lower rails 16-18 inches, measured vertically from centerline to centerline of the parallel top rail.
3. Set handrails with a minimum clear space of 1-1/2-inches between the handrail and adjacent wall or surface.
4. Extend handrails at least 12-inches beyond the top riser and at least one tread depth horizontally beyond the bottom riser at the slope of the stair flight.

END OF SECTION

SECTION 05 52 13

PIPE & TUBE RAILINGS

PART 1 – GENERAL

1.1 SUMMARY

A. Provide mechanically connected aluminum handrails and railings as shown on the drawings, as specified herein, and as needed for a complete and proper installation.

B. Related Work:

1. Documents affecting work under this section include, but are not limited to;
   a. Division 01 - General Requirements
   b. Section 05 50 00 - Metal Fabrication
   c. Section 09 90 00 – Paints & Coatings

1.2 SUBMITTALS

A. Submit shop drawings, including:

1. The manufacturer's specifications and other data are needed to prove compliance with the specified requirements.
2. Fabrication, layout, installation, anchorage, and interface of the work of this section with the work of adjacent trades.
3. Manufacturer's recommended installation procedures.

1.3 QUALITY ASSURANCE

A. Comply with OSHA and local building codes.

B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with no less than 3 years of experience.

C. Railing shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guardrail System:
   a. Uniform load of 50 lb_f./ft. (0.73 kN/m) applied in any direction.
   b. Concentrated load of 200 lb_f. (0.89 kN) applied in any direction.
   c. Uniform and concentrated loads need not be assumed to act concurrently.
2. Infill Area of Guardrail System:
   a. Concentrated load of 50 lbf. (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
   b. Uniform loaf of 25 lbf. applied horizontally.
   c. Infill load and other loads need not be assumed to act concurrently.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver all materials to the job site properly marked to identify the structure for which they are intended and at such intervals to insure uninterrupted progress of the work. Marking shall correspond to markings indicated on the shop drawings.

B. Pack all aluminum pipes in individual plastic sleeves to protect the finish.

C. Store all members off the ground using pallets, platforms, or other supports.

D. Do not store materials on the structure in a manner that might cause distortion or damage to the members of the supporting structure.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Aluminum Grate Stair by Grating Pacific Inc. phone: (559) 664-0709, fax number: (559) 664-0730, email: sales@gratingpacific.com Or Approved Equal.

B. BMC Rail by Breuer Metal Craftsmen Inc. phone: (920) 885-2828, fax: (920) 885-2822, email: craftsmen@breuermetal.com, or Approved Equal.

2.2 GENERAL REQUIREMENTS

A. Design, fabricate, and test railing assemblies following the most stringent requirements of ASTM E 985 and applicable local codes.

B. Design railing assembly, wall rails, and attachments to resist lateral force required by applicable code at any point without damage or permanent set. Test following ASTM E 935.

C. Mechanically fastened aluminum railing:

1. Mechanically fastened 1-1/2 Schedule 40 pipe and 1-1/2 Schedule 80 post pipe. Post spacing to be no more than 4'-0" and the top rail shall be smooth and not interrupted along the distance of the guardrail.
2. Use all internal fittings secured with stainless steel rivets.
3. Provide expansion joints for rails at intervals of not more than twenty (20) feet.

D. Use an in-line stainless steel base flange assembly with stainless steel anchor bolts for surface mounting posts to concrete.

E. Use an aluminum side mount bracket assembly with stainless steel anchor bolts for side mounting posts.

F. Mount stainless steel base flange to stringers with stainless steel bolts and beveled washers.

G. Handrail: 1-1/2-inch extruded aluminum pipe. Provide where shown on the Drawing.

H. Hinged Swinging Gate

1. Components: Gate frame, stainless steel self-closing device, hinges, gate stops, and durable self-locking type latch. Fabricate components in conformance with OSHA minimum strength requirements.
2. Of same design, material, quality, and workmanship as that of the guardrail system in which they will be installed.

2.3 MATERIALS

A. Aluminum

1. Extruded Bar and Shapes: ASTM B 221, alloy 6063-T6
2. Extruded Pipe and Tube: ASTM B 429, alloy 6005-T5, T

B. Stainless Steel

1. Tubing: ASTM A 554, grade as follows:
   a. Alloy 304
2. Plate: ASTM A 167, grade as follows:
   a. Alloy 304

2.4 FASTENERS

A. Fasteners for Anchoring Railings to Other Construction: Select fasteners of the type, grade, and class required to produce connections that are suitable for anchoring railing to other types of construction indicated and capable of withstanding design loadings.

1. For aluminum railings, provide stainless steel 304.

B. Cast-in-Place and Post-Installed Anchors: Fabricated from corrosion-resistant materials with the capability to sustain, without failure, the loads determined by local code requirements.

2.5 GROUT AND ANCHORING CEMENT

A. Non-shrink, Nonmetallic Grout: Premixed, factory packaged, non-staining, non-corrosive, non-gaseous grout complying with ASTM C 1107. Provide 9 grout specifically recommended by the manufacturer for interior and exterior applications.

B. Interior Anchoring Cement: Factory packaged, non-shrink, non-staining, hydraulic controlled expansion cement formulation for mixing with water at the Project site to create pourable anchoring, patching, and grouting compound. Use for interior applications only.

2.6 ALUMINUM FINISHES

A. Mill Anodized- Aluminum Association Specification M12-C22-A41, finish non-specular as fabricated, chemical finish-medium matte, Architectural Class 1 clear 0.7 mils thick anodic coating.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Posts:

1. Use a single, un-spliced pipe for each post.
2. Do not locate anchor bolts less than 2 inches from concrete surface edges.
3. Materials shall be plumb, square, level, and anchored securely.
4. Bituminous or epoxy paint shall be applied where aluminum is in contact with the dissimilar surface.

B. Rails:

1. Use a continuous pipe length for top rails wherever possible with every single un-spliced length attached to a minimum of 3 supports.
2. Use a single un-spliced length between supports for lower rails.
3. Attach wall terminal fitting and brackets for rails to the mounting surface with stainless steel anchor bolts.
4. The top horizontal rail should be set 42 inches from the centerline to the adjacent walking surface.
5. Intermediate rail should be set 21 inches from centerline to centerline of the parallel top rail unless indicated on the drawing.

C. Handrails:

1. Set handrails 36 to 34 inches, measured vertically, above the nosing of the treads or the finished floor of the landing or walking surface.
2. Set lower rails 16 to 18 inches, measured vertically from centerline to centerline of the parallel top rail.
3. Set handrails with a minimum clear space of 1½ inches between the handrail and adjacent wall or surface.
4. Extend handrails at least 12 inches beyond the top riser and at least 1 tread depth horizontally beyond the bottom riser at the slope of the stair flight.

END OF SECTION

SECTION 05 53 00

ALUMINUM GRATING

PART 1 – GENERAL

1.1 SUMMARY

A. Provide aluminum grating as shown on the drawings, as specified herein, and as needed for a complete and proper installation.

B. Related Work:

1. Section 05 50 00- Metal Fabrications
2. Section 05 51 19- Metal Grating Stairs

1.2 SUBMITTALS

A. Submit shop drawings, including:

1. The manufacturer's specifications and other data are needed to prove compliance with the specified requirements.
2. Fabrication, layout, installation, anchorage, and interface of the work of this section with the work of adjacent trades.
3. Manufacturer's recommended installation procedures.

1.3 QUALITY ASSURANCE

A. Comply with OSHA and local building codes.

B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with no less than three years of experience.

C. Perform shop and/or field welding required in connection with the work of this Section in strict accordance with pertinent recommendations of the American Welding Society.

D. Conform to Metal Bar Grating Manual and NAAMM requirements.

E. Do not exceed a maximum clearance of one-half inch between the vertical legs of the bearing angle and the edge of the grating, with the grating centered within the bearing angles.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver all materials to the job site properly marked to identify the structure for which they are intended and at such intervals to insure uninterrupted progress of the work. Marking shall correspond to markings indicated on the shop drawings.

B. Store all members off the ground using pallets, platforms, or other supports.

C. Do not store materials on the structure in a manner that might cause distortion or damage to the members of the supporting structure.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Aluminum Grate Stair by Grating Pacific Inc. phone: (559) 664-0709, fax number: (559) 664-0730, email: sales@gratingpacific.com, Or Approved Equal.

B. Aluminum Grating by Breuer Metal Craftsmen Inc. phone: (920) 885-2828, fax: (920) 885-2822, email: craftsmen@breuermetal.com, Or Approved Equal.

2.2 GENERAL REQUIREMENTS

A. Provide shop fabricated grating and accessories such as frames, support angles, fasteners, and treads.

B. Grating shall be designed and fabricated to meet the live load conditions of 100 lbs/sq. ft. with a maximum deflection of 1/4” for the clear spans shown on drawings.

C. Provide trim banding or load carrying banding on edges and cutouts welded to the grating.

1. Bearing bars not resting on supports shall have load carrying banding sized to span opening.
2. Minimum banding thickness shall match bearing bar thickness.
3. Banding shall be flush with the top of the grating.
4. Banding depth shall be 1/4-inch less than banding bearing bar depth at supports to account for drainage.

D. Provide hold-downs to firmly anchor grating and treads to supports. The section designated as removable shall not be attached to supports.

1. Minimum of 4-units per panel
2. Shall allow for repeated removal
3. Saddle clip type
4. “G” clip type
5. Clamp type
6. Min. 1/4-inch bolt or self-tapping screws.

E. Crossbars shall not extend more than 1/8-inch past bearing bars at the panel edge.

F. Panels shall bear on supports a min. length equal to bearing bar depth.

G. Grating supports shall conform to requirements of Section 05 50 00 - Metal Fabrication.

2.3 MATERIALS

A. Grating- Aluminum

1. Material: ASTM B 211, Alloy 6061-T6 or 6063-T6.
2. Bearing bars shall be spaced at 1-3/16-inches o.c. and crossbars spaced 4-inches.
3. Construction Type: Swage-Locked, Standard Rectangular Bar.
4. Surface: Smooth.
5. Size bearing bars as follows:

Maximum Clear Span	Bearing Bar Size
3'-6”	1 X 3/16
4'-0”	1-1/4 X 3/16
4'-6”	1-1/2 X 3/16
5'-6”	1-3/4 X 3/16
6'-0”	2 X 3/16

B. Aluminum Bearing Angle: 1/4-inch minimum thickness with 2-inch horizontal leg and vertical legs equal to the depth of grating bearing bars.

1. Frame angles to be set in concrete.
   a. Provide a minimum of a 4-inch embedded anchor at 45 degrees down from the horizontal.
   b. Provide anchors that adjust horizontally to avoid rebar and other obstacles in concrete, space anchors a maximum of 24-inches o.c.
   c. Provide an air gap in the horizontal leg of the angle so the concrete does not interfere with grating hold-downs.
2. Frame angles to be set against a vertical surface.
   a. Provide 1/2-inch stainless steel anchor bolts.
   b. Space anchor bars and anchor bolt holes at a maximum of 24-inches o.c. with not less than 2 each on any frame side.

C. Fasteners- Stainless Steel

1. Interior: Bolts, Nuts, Washers, and Anchors: 304 Stainless Steel
2. Exterior: Bolts, Nuts, Washers, and Anchors: 316 Stainless Steel

2.4 ALUMINUM FINISHES

A. Grind welded joints smooth with adjacent finish surface.

B. Coat aluminum in contact with dissimilar metals, masonry, or lime products with one coat of bituminous paint.

PART 3 – EXECUTION

3.1 FIELD VERIFICATION

A. Take field measurements before preparation of final shop drawings and fabrication where required to ensure proper fitting of the work.

3.2 INSTALLATION

A. Install aluminum grating following the manufacturer's recommendations and approved shop drawings.

END OF SECTION

DIVISION 06

WOOD, PLASTICS, & COMPOSITES

SECTION 06 10 00

CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

A. Rough Carpentry

1.3 REFERENCES

A. All references shall be the latest adopted edition unless noted otherwise.

B. ASTM C 79 - Standard Specification for Gypsum Sheathing Board.

C. AWPA C2 - Lumber, Timbers, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes; American Wood-Preservers' Association.

D. AWPA C20 - Structural Lumber - Fire Retardant Treatment by Pressure Processes; American Wood-Preservers' Association.

E. PS 20 - American Softwood Lumber Standard.

F. IBC - International Building Code, 2012 Edition.

G. ICC - International Code Council

H. WCLB (GR) - Standard Grading and Dressing Rules No. 17; West Coast Lumber Inspection Bureau.

I. WWPA G-5 - Western Lumber Grading Rules; Western Wood Products Association.

1.4 SUBMITTALS

A. Refer to Section Division 1 of the specifications for submittal procedures.

B. Product Data: Provide product data on the following items:

1. Sill Gasket
2. Metal screen

1.5 QUALITY ASSURANCE

A. Lumber: Comply with PS 20 and approved grading rules and inspection agencies.

1. Acceptable Lumber Inspection Agencies: WCLB and WWPA.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Cover wood products to protect against moisture and growth of mold/mildew. Support stacked products to prevent deformation and to allow air circulation.

PART 2 - PRODUCTS

2.1 DIMENSION LUMBER

A. Species: As specified in the General Notes on the Structural Drawings.

B. Grade: As specified in the General Notes on the Structural Drawings.

C. Sizes: Nominal sizes as indicated on drawings, S4S.

D. Moisture Content: Maximum 19 percent, stack or kiln-dried.

E. Backing: 2 x 6 and larger solid lumber, cut from No. 2 Douglas Fir/Larch dimension lumber that is free of large knots, splits, or other defects that would reduce the strength of the backing piece.

F. Vent Blocking: 2x lumber cut from No. 2 Douglas Fir/Larch that is free of large knots, splits, or other defects that would reduce the strength of the blocking piece.

1. Drill vent holes and attach galvanized wire screen securely over vent openings to prevent the entrance of insects and animals.

2.2 TIMBERS

A. Species: As specified in the General Notes on the Structural Drawings.

B. Grade: As specified in the General Notes on the Structural Drawings.

C. Sizes: Nominal sizes as indicated on drawings, S4S.

D. Moisture Content: Maximum 19 percent, stack dried.

E. Wood Nailers & Insulation Stops for Roofing: Preservative pressure treated wood, No. 2 Hem/Fir or Douglas Fir/Larch.

F. For the wood purlins that are trimmed/ripped and are exposed to view and are to receive a stained/clear finish, make sure no burn marks are exposed to view.

2.3 MANUFACTURED LUMBER

A. Manufactured (Engineered) Parallel-Strand Framing Lumber: Provide as specified in the General Notes on the Structural Drawings.

2.4 CONSTRUCTION PANELS

A. APA Rated Subflooring: As specified in the General Notes on the Structural Drawings.

B. APA Rated Roof Sheathing: As specified in the General Notes on the Structural Drawings.

C. APA Rated Roof Sheathing under Asphalt Shingles: T&G plywood sheathing meets the requirements for roof sheathing as specified in the General Notes on the Structural Drawings.

D. APA Rated Wall Sheathing: As specified in the General Notes on the Structural Drawings.

E. Miscellaneous Panels:

1. Electrical /Phone Component Mounting: PS 1, B-C, exterior grade, fire retardant treated.

2.5 ACCESSORIES

A. Fasteners, Anchors, and Anchor bolts: As specified in the General Notes on the Structural Drawings for structural applications.

1. Fasteners on Building Exterior, in High Humidity or Preservative Pressure Treated Wood: Stainless steel or hot-dipped galvanized.
    a. Use only stainless-steel fasteners in wood treated with ACZA preservative treatment.
        1) Anchor For Concrete and Masonry: As specified in the General Notes on the Structural Drawings for structural applications and the following:
    b. Concealed Location: Zinc plated steel, expansion type fasteners manufactured by Rawl or Hilti.
    c. Exposed Location: Hot-dipped galvanized or stainless steel.
    d. Preservative Pressure Treated Wood: Hot-dipped galvanized or stainless steel.
        1) Use only stainless-steel anchors in wood treated with ACZA preservative treatment.

B. Die-Stamped Framing Connectors: As specified on the Structural Drawings; hot-dipped galvanized steel, ICC approved, Simpson StrongTie or similar.

C. Joist Hangers: As specified on the Structural Drawings; hot-dipped galvanized steel, ICC approved, sized to suit framing conditions and loads, Simpson StrongTie or similar.

D. Sill Gasket on Top of Foundation Wall: 1/4 inch thick, match the width of the sill plate, ribbed closed-cell plastic foam from continuous rolls; Owens Corning FoamSealR or similar.

E. Construction Adhesive: APA AFG-01, Waterproof, solvent base, air cure type, cartridge dispensed.

F. Metal Screen (Insect Screen): Heavy-duty hot-dipped galvanized steel woven wire mesh, 1/8 inch square opening, supplied in rolls.

1. Staples for Attaching Metal Screen: Galvanized or stainless steel, 16 gauge, 7/16” crown, 1-inch minimum length, power actuated.

G. Weather Resistive Barrier System (WRB): Specified in Section 07 25 00.

H. Building Paper: 30 lb. asphalt-saturated felt.

2.6 FACTORY WOOD TREATMENT

A. Fire Retardant Treatment: AWPA Treatment C20, Exterior Type, chemical treatment pressure impregnated.

B. Preservative Pressure Treatment (P.P.T.) of Lumber Above Grade: AWPA Treatment C2 using waterborne preservative to 0.25 percent retention.

1. Kiln dry after treatment to a maximum moisture content of 19 percent.
2. Do not incise wood exposed to view in the finish construction.
3. Treat wood in contact with roofing, flashing, or waterproofing.
4. Treat wood in contact with masonry or concrete.

C. Preservative Pressure Treatment (P.P.T.) of Lumber in Contact with Soil: AWPA Treatment C2 using waterborne preservative designated in AWPA C2 is suitable for ground contact to 0.40 percent retention.

PART 3 - EXECUTION

3.1 COORDINATION

A. Review, coordinate and accommodate work of other trades that interface with, affect, or are affected by the work of this Section to facilitate the execution of the overall Work of this project in a coordinated and efficient manner.

B. Coordinate the layout of wall, floor, ceiling, and roof framing to accommodate the location of mechanical and electrical penetrations and recessed items and to minimize cutting framing members and/or framing openings in these assemblies.

C. Coordinate the location of holes in framing and sheathing to assure the free flow of attic ventilation air through building framing.

D. Coordinate the layout and location of wall framing and solid 2x wood backing for attachment of finish wood trim and wainscots with Section 06 20 00 – Interior Finish Carpentry.

E. Coordinate the layout and location of wall framing and solid 2x wood backing required for attachment and support of surface-mounted plumbing items specified in Division 22.

F. Coordinate the layout and location of wall framing and solid 2x wood backing required for attachment and support of surface-mounted electrical items specified in Division 26.

3.2 GENERAL

A. Drilling, Notching & Cutting: Coordinate and control drilling, notching, and cutting of all framing members required to admit or install work of other trades do not violate the structural integrity of any wood framed members, comply with restrictions and requirements of Structural Engineer, IBC and local Building Official.

B. Nailing: Nailing shall conform to the size and spacing shown on the Structural Drawings; where nailing is not indicated, provide nailing per IBC Table 2304.9.1. Fastener Schedule.

C. Wood In Contact with Concrete & Masonry shall be preservative pressure treated.

1. At the ends of beams, behind engineered wood ledgers, or in similar situations, separate wood from concrete or masonry with building paper.

3.3 FRAMING INSTALLATION

A. Cut and fit framing members accurately, set members level, plumb, and true to line. Discard crooked or twisted pieces or with defects that would lower required strength or result in an unacceptable appearance of exposed members.

B. Wall Plates: Comply with the size(s) shown on Structural Drawings.

1. Bottom plates bearing on concrete shall be preservative pressure treated.
2. Boreholes of proper diameter for anchor bolts accurately; oversized or elongated holes are not acceptable.
3. Install continuous sill gasket under bottom plates of exterior walls.

C. Wall Framing: Cull out crooked, twisted, or inconsistent width framing, and align framing members so that finish walls are straight and free of waviness.

D. Make provisions for temporary construction loads and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.

E. Install structural members full length without splices.

F. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated on Drawings and Structural General Notes, but not less than required by applicable codes.

G. Install horizontal spanning members with the crown edge up and not less than 1-1/2 inches of bearing at each end.

H. Provide framing members at all vertical ends/edges of GWB and wall sheathing and ends of floor sheathing.

I. Construct headers at floor, roof, and wall openings required by the design and work of other trades. Where not shown, provide double joist headers; use metal joist hangers unless otherwise detailed.

J. Provide mid-span bridging at joists as shown on the Drawings and at all spans more than 8 feet. Fit solid blocking at ends of members and bearing points.

K. Frame wall openings required by the design and for work of other trades. Where not shown, provide a minimum of two or more studs at each jamb, and support headers on cripple studs.

L. Provide blocking between framing members wherever required by Drawings, IBC, Building Official, or good construction practices.

M. Vent Blocking: Install vent blocking in roof framing with batt insulation under the roof deck to allow code-required ventilation above the insulation. Coordinate placement and layout of vent holes to permit the unrestricted flow of ventilation air from roof eave to roof peak in each roof joist space.

N. Fire Stops: Install solid 2x lumber blocking fire stops (or other approved material) following the requirements of the IBC and the Building Official including, but not limited to the following locations:

1. In concealed spaces of stud walls and partitions, including furred spaces, at the ceiling and floor levels and 10-foot intervals both horizontal and vertical.
2. At all interconnections between concealed vertical and horizontal spaces such as occur at soffits, drop ceilings, cove ceilings, and suspended lay-in ceilings.
3. Concealed spaces behind combustible trim and finish: Fire stop at intervals not exceeding 10 feet.
4. Concealed spaces behind exterior cornices or other elements: Fire stop at intervals not exceeding 20 feet.
5. In wall framing in line with stair stringers and between stair stringers and wall.

O. Provide additional framing members and/or modifications required to accommodate work of other trades.

P. Provide backing and miscellaneous members as indicated or as required to support work provided by other trades (finishes, fixtures, specialty items, trim, etc.).

3.4 INSTALLATION - WOOD BACKING

A. Provide backing and miscellaneous 2x framing members as indicated or as required to support work provided by other trades (finishes, fixtures, specialty items, trim, etc.).

B. Door Hardware:

1. Provide 2x6 backing for door wall stops.
2. Provide 2x8 solid wood backing for magnetic door hold-opens.

C. Corner Guards: Provide solid 2x wood backing for corner guard screw attachment points that do not occur on framing members to facilitate secure attachment of corner guards.

D. Toilet Partitions: Provide solid 2x wood backing for toilet partition screw attachment points that do not occur on framing members to facilitate secure attachment of partitions.

E. Toilet Accessories: Provide solid 2x wood backing for attachment of toilet accessories. Backing for grab bars shall be installed to support a 300-pound sustained load on each backing piece without deflection or failure.

F. Acoustical Treatment: Provide solid 2x wood backing for attachment points that do not occur on framing members to facilitate secure attachment of acoustical treatment edge frame; refer to Division 09 and acoustical treatment manufacturer for installation requirements.

G. Wall-Mounted Adjustable Shelving: Provide solid 2x wood backing for wall-mounted adjustable shelving standards attachment points that do not occur on framing members to provide secure support/attachment.

H. Kitchen & Janitor's Sink Faucet Wall Brace: Provide solid 2x wood backing for screw attachment points on sink faucet wall braces that do not occur on framing members to facilitate secure attachment of faucet wall brace and integral pail hook.

3.5 INSTALLATION OF ACCESSORIES AND MISCELLANEOUS WOOD

A. Install sill gasket directly on concrete foundation under exterior wall plates. Puncture gasket cleanly and fit tightly to protruding foundation anchor bolts.

B. Coordinate installation of glue-laminated structural units, prefabricated wood trusses, and plywood web joists.

C. Construct curbs at roof openings except where prefabricated curbs are provided. Form corners by alternating lapping side members.

D. Backing for Owner Installed Items: Provide backing for Owner installed items indicated on Drawings.

3.6 INSTALLATION OF CONSTRUCTION PANELS

A. Subflooring: Install panels perpendicular to framing with ends staggered and sheet ends centered over firm bearing. Apply a continuous bead of subfloor glue to framing, place panel and nail to framing at the spacing indicated on the Drawings.

1. Use only full-sized panels, cut to fit; do not use cutoff ends pieced together where a full-sized panel will fit.
2. Edge/End Gap: Install sheathing panels with a gap between sheets as recommended by APA.

B. Roof Sheathing: Secure panels perpendicular to framing members, with ends staggered and sheet, ends over firm bearing.

1. Use only full-sized panels, cut to fit; do not use cutoff ends pieced together where a full-sized panel will fit.
2. Edge/End Gap: Install sheathing panels with a gap between sheets as recommended by APA.

3. Provide solid edge blocking between sheets shown on the Drawings.
4. Nail panels to framing at the spacing indicated on the Drawings.
5. Provide ventilation holes through sheathing for each roof joist bay or areas as indicated on Drawings and as required for free flow of code required attic ventilation air.

C. Wall Sheathing: Orient sheathing panels with long dimensions perpendicular to wall studs and ends over firm bearing, stagger end joints between adjacent panels, securely nail as noted on Structural Drawings or, where not noted, per code.

1. Use only full-sized panels, cut to fit; do not use cutoff ends pieced together where a full-sized panel will fit.
2. Edge/End Gap: Install sheathing panels with a gap between sheets as recommended by APA.

3.7 WOOD NAILERS & INSULATION STOPS FOR ROOFING

A. Install wood nailers & insulation stops for roofing wherever shown or required by the roofing system manufacturer.

B. Attach securely to building structure with hot-dipped galvanized fasteners.

3.8 SITE APPLIED WOOD TREATMENT

A. Apply preservative treatment compatible with a factory applied treatment at the site-sawn cuts, complying with manufacturer's instructions.

B. Allow preservative to dry before erecting members.

3.9 DRILLING, CUTTING, AND NOTCHING

A. Do not drill, cut, notch, or alter any structural framing, except as noted on the Drawings and in this specification, without the approval of the Structural Engineer.

3.10 WORKMANSHIP

A. Carpentry work shall be accomplished using the best workmanship, including the following:

1. Crooked, bowed, twisted, or damaged lumber culled out and used for blocking/backing.
2. End cuts at proper angle and length for a tight fit.
3. Nailed connections free of splitting or damage.
4. Framing aligned plumb and square.
5. Framing conforming to specified tolerances.
6. Bolt/anchor holes not oversized or misaligned.
7. Panel ends aligned at the center of the supporting framing member.
8. Panel ends and edges properly gapped.
9. Consistent nail spacing on panels.

B. Any part of the carpentry work installed with improper or poor workmanship shall be removed and replaced at the Contractor's expense.

3.11 TOLERANCES

A. Framing Members: 1/4 inch from a true position, maximum, provided other tolerances are met.

B. Wall Plane (Flatness): Maximum of ¼" in 10'-0" out of the plane (this equates to no more than 1/8" gap at each end of a 10'-0" long straightedge center on a high spot in the wall or no more than 1/8" gap at the center of a 10'-0" long straightedge centered on a low spot in the wall).

C. Surface Flatness of Floor: 1/8 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

D. Variation from Plane (Other than Floors): 1/8 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

END OF SECTION

SECTION 06 17 53

SHOP FABRICATED WOOD TRUSSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

A. Plate Connected Wood Trusses

1.3 REFERENCES

A. All references shall be the latest adopted edition unless noted otherwise.

B. WCLB (GR) - Standard Grading and Dressing Rules No. 17; West Coast Lumber Inspection Bureau.

C. WWPA G-5 - Western Lumber Grading Rules; Western Wood Products Association.

D. IBC – International Building Code, 2018 Edition.

1.4 SUBMITTALS

A. Refer to Division 1 of the specifications for submittal procedures.

B. Shop Drawings: Provide plan view layout of all trusses; indicate sizes and spacing of trusses, loads and truss camber, framed openings.

1. Shop Drawings shall be stamped by a Professional Engineer licensed as such in the State of California.

C. Deferred Submittal to Building Official: Submit shop drawings and structural calculations to the Building Official for review and approval as a deferred submittal; make any corrections and provide any additional information required to obtain approval by Building Official.

1. Approved Fabricator: Provide documentation of the manufacturer’s approved fabricator status conforming to Chapter 17 of the International Building Code as required by the Building Official for approval.

2. Certificate of Compliance: After fabrication, submit a certificate of compliance to the Structural Engineer stating that the work was performed per the approved construction documents (per Section 1704 of the International Building Code).

D. Certification: After fabrication of trusses, provide a Certificate of Conformance acceptable Building Official and Structural Engineer indicating conformance to stamped structural design and code standards.

1.5 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the products specified in this section with a minimum of three years of documented experience.

B. Design under the direct supervision of a Professional Engineer experienced in the design of this Work and licensed in the State of California.

1.6 REGULATORY REQUIREMENTS

A. Conform to applicable code for loads, seismic zoning, and other governing load criteria.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle trusses in conformance with the manufacturer’s instructions.

B. Handle and erect trusses following manufacturer's recommendations.

C. Store trusses in vertical position resting on bearing ends.

D. Cover trusses to protect from the weather; keep up off the ground.

PART 2 - PRODUCTS

2.1 PLATE CONNECTED WOOD TRUSSES

A. Truss Design: The fabricator is responsible for the structural engineering design for trusses and any connections not shown on the Drawings.

1. Engage the services of a qualified Professional Engineer, experienced in the design of plate-connected wood trusses and currently registered in the State of California, to provide the structural engineering design.
2. Design trusses in conformance to the following:
   a. Design plate-connected wood trusses to withstand design loads and with deflection factor(s) in conformance with the requirements shown on the Structural Drawings.
   b. Design Criteria listed in the General Notes on the Structural Drawings.
   c. 2018 International Building Code and State of California Building Code.

3. Work of Other Trades: Review and coordinate work of other trades that interface with, connect to, pass through, or are supported by the plate-connected wood trusses.
    a. Make whatever provisions are necessary to the design, layout, and fabrication of the plate-connected wood trusses to accommodate work by others while maintaining their specified structural capacity.
    b. Design plate-connected wood trusses to allow for support, connection, and installation of mechanical ducts, pipes, or other large items supported by trusses.

B. Wood Members: Size, grade, and species required by truss manufacturer to conform to structural design requirements for truss.

C. Steel Connectors: Type and size required by truss manufacturer to conform to structural design requirements for truss (Minimum requirement: ASTM A 653/A 653M Structural Steel (SS) Grade 33 (230), G90/Z275 galvanized.

D. Truss Bridging and Bracing: Type, size, and spacing recommended by truss manufacturer.

2.2 ACCESSORIES

A. Wood Blocking and Framing for Openings: Wood as noted on the Structural Drawings.

B. Vent Blocking: 2x lumber cut from No. 2 Doug. Fir/Larch that is free of large knots, splits, or other defects that would reduce the strength of the blocking piece. Drill vent holes and attach galvanized wire screen securely over vent openings to prevent the entrance of insects and animals.

C. Fasteners: As specified in General Notes on the Structural Drawings.

2.3 FABRICATION

A. Verify dimensions and site conditions before fabrication.

B. Fabricate trusses to achieve the layout/configuration shown on the Drawings and structural requirements specified in Structural Drawings.

C. Provide additional web members or special web member layout to accommodate field conditions and /or building design and work of other trades.

PART 3 - EXECUTION

3.1 COORDINATION

A. Review, coordinate, and accommodate work of other trades that interface with, affect, or are affected by the work of this Section to facilitate the execution of the overall Work of this project in a coordinated and efficient manner.

B. Coordinate installation with carpentry work and glue-laminated beam installation specified in Section 06 10 00 – Carpentry

3.2 EXAMINATION

A. Verify bearing conditions installed by other Sections are acceptable for truss installation following manufacturer’s instructions.

B. Do not proceed with installation until unacceptable conditions are corrected.

C. Start of installation indicates acceptance of bearing and site conditions.

3.3 PREPARATION

A. Coordinate placement of support items.

3.4 ERECTION

A. Install trusses, braces, and bridging in strict accordance with approved shop drawings and manufacturer's installation instructions.

B. Set members level and plumb, in the correct position.

C. Make provisions for erection loads, and for sufficient temporary bracing to maintain structure plumb, and in true alignment until completion of erection and installation of permanent bracing.

D. Place permanent bridging and bracing.

E. Vent Blocking: Install vent blocking in roof framing with batt insulation under the roof deck to allow code-required ventilation above the insulation. Coordinate placement and layout of vent holes to permit the unrestricted flow of ventilation air from roof eave to roof peak in each roof truss bay.

F. Frame openings and install chord stiffeners, headers, blocking, hangars, supports and other items recommended by the manufacturer as required to accommodate the work of other trades.

G. Frame openings between trusses with lumber following Section 06 10 00 and as shown on the Drawings.

H. Coordinate placement of sheathing with work of this section.

3.5 DRILLING, CUTTING, AND NOTCHING

A. Do not drill, cut, notch, or alter trusses without the written approval of the truss manufacturer and stamped by their Structural Engineer.

END OF SECTION

SECTION 06 20 00

INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including Division 1 Specification Sections apply to work of this Section.

1.2 SECTION INCLUDES

A. Interior Finish Hardwood Trim

B. Plastic Laminate for Sills

1.3 REFERENCES

A. All references shall be the latest adopted edition.

B. AWI - Architectural Woodwork Quality Standards

1.4 SUBMITTALS

A. Refer to Division 1 of the specifications for submittal procedures.

B. Low-Emitting Materials – Adhesives and Sealants: Submit documentation specific to products supplied on this project that clearly states the VOC levels of adhesives and sealants used during construction inside the building envelope and that they do not exceed levels per LEED™.

1. Low Emitting Materials –Submit documentation specific to products supplied on this project that clearly states that the particleboard, medium-density fiberboard (MDF), plywood, and panel substrates are used during construction inside the building envelope contain no added urea-formaldehyde resins.

C. Finish Wood Samples: Submit solid wood finish samples matching selected colors.

1. Number of Samples Required: 2 samples of each different solid wood.
2. Size of Finish Samples: 5”x7”

1.5 QUALITY ASSURANCE

A. Perform work following AWI Quality Standards, Custom Grade, except where noted otherwise for specific elements of the work.

B. Work in this Section shall comply with the specified Grade found in the Architectural Woodwork Institute Quality Standards (AWI).

C. Woodwork Manufacturer/Fabricator: Company specializing in fabricating the products specified in this section with a minimum of 5 years of successful experience.

1.6 QUALIFICATIONS

A. The manufacturer/fabricator and installer engaged in the work of this Section shall be able to demonstrate successful experience with work of comparable extent, complexity, and quality to that shown and specified.

B. Upon request, the manufacturer/fabricator shall submit a fully executed Prequalification Form found in the Appendix of the AWI Quality Standards.

C. Upon request, the manufacturer/fabricator shall submit a listing of all projects completed within the last 3 years along with a description of the scope of work; contract amount; project address, and contact information for the general contractor and building owner/manager.

1.7 DELIVERY, STORAGE & PROTECTION

A. Deliver finished products to Jobsite in packaging suitable to protect finish surfaces from physical or moisture damage.

B. Protect products from moisture damage according to AWI Section 1700, Installation.

C. Protect lumber from damage during shipping and handling by paper wrapping each piece on all four sides and providing corner protectors; use only nylon straps for securing and lifting loads, and provide dunnage to protect edges from straps. Do not allow exposed faces of lumber to be bruised or stained.

1.8 ENVIRONMENTAL REQUIREMENTS

A. All exterior openings shall be enclosed/completed; interior GWB, plaster, and painting shall be completed and building temperature and humidity stabilized at between 68 and 74 degrees F for at least 1 week before starting installing the work of this Section; maintain the temperature of between 68 and 74 degrees F before, during and after installation.

B. Unpackage materials and spread them out to allow materials to acclimate inside the building as required to prevent open joints due to shrinkage, or swelling and buckling of products after installation.

1.9 FIELD MEASUREMENTS

A. Field verify conditions and dimensions before fabrication.

1.10 COORDINATION

A. Coordinate the work with work of other trades and installation of associated and adjacent components.

PART 2 - PRODUCTS

2.1 HARDWOOD LUMBER MATERIALS

A. Hardwood Lumber: AWI Lumber Grade I, Birch, plain sawn, maximum moisture content of 11 percent or less; with a grain of quality suitable for the transparent finish.

1. All hardwood lumber shall have a consistent color and appearance, shall be obtained from the same source, and shall maintain a consistent color and appearance after staining and finishing.
2. LEED™ Requirement – Certified Wood Credit MRc7: Hardwood shall be a minimum of 50% FSC certified wood.

2.2 SHEET MATERIALS

A. Softwood Plywood: Exterior Grade A-C sanded face plywood, APA Rated, PS 1; rotary cut softwood species face and core plies, five-ply construction (minimum).

1. LEED™ Requirements:
   a. Low Emitting Materials Credit IEQc4.4 Requirement: Plywood products shall contain no added urea-formaldehyde resins.

2.3 PLASTIC LAMINATE MATERIALS

A. Plastic Laminate Face Sheet (Exposed Condition): NEMA LD 3, AWI Type HGS – General Purpose plastic laminate 0.048-inch thickness:

1. Manufacturers: Nevamar, Pionite, Wilsonart
2. Color/Pattern: To be selected.

B. Plastic Laminate Backing Sheet (Concealed Condition): VGS grade 0.028-inch thickness plastic laminate for backing sheet in concealed applications.

2.4 ADHESIVE

A. Adhesive: Type recommended by AWI and manufacturer to suit the application.

1. Low-Emitting Materials – Adhesives and Sealants Credit IEQc4.1: VOC levels of adhesive and sealants used during construction inside the building envelope shall not exceed levels shown in the Adhesives and Sealants Maximum VOC Level Chart included in Section 01 81 13.

2.5 FASTENERS

A. Concealed Fasteners: Finish nails, staples, and screws, of size and type to suit the application.

B. Exposed Fasteners: Not allowed except as specifically shown on Drawings.

2.6 ACCESSORIES

A. Lumber for Shimming, Blocking: Softwood lumber.

B. Wood Filler: Solvent base, tinted to match surface finish color.

1. Low Emitting Materials Credit EQc4.1: VOC levels of wood filler used during construction inside the building envelope shall not exceed 30 grams per liter of VOC per LEED™ Requirements.

2.7 FABRICATION – GENERAL

A. All fabrications shall comply with AWI Custom Standards.

B. Coordinate and confirm field dimensions and conditions affecting work before the start of fabrication.

C. Shop assemble work for delivery to site, permitting passage through building openings.

D. When necessary to cut and fit on-site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

2.8 FABRICATION – HARDWOOD TRIM

A. Fabricate from birch hardwood lumber to AWI Custom Standards in conformance with AWI Section 300.

B. Fabricate from single lengths of lumber in lengths that will yield the fewest butt joints possible.

C. Fabricate trim to size and profile shown on the Drawings.

1. Edge Profile: Square edge, eased edges (unless shown otherwise).
2. Thickness: As shown in the Drawings.
3. Height: As shown in the Drawings.
4. Configuration: As shown in Drawings.

D. When necessary to cut and fit on-site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

E. Finishing: Shop finish as specified herein.

2.9 PLYWOOD PANELS FOR TELECOM EQUIPMENT

A. Fabricate from 3/4 inch thick Exterior Grade A-C sanded face plywood, APA Rated, PS 1; rotary cut softwood species face and core plies, five-ply construction (minimum); fire retardant treated.

2.10 FACTORY WOOD TREATMENT

A. Fire Retardant Treatment: AWPA Treatment C20, Exterior Type, chemical treatment pressure impregnated.

1. Each piece/panel shall bear the AWPA stamp identifying the type of treatment and the treatment plant.

2.11 SHOP FINISHING

A. Sand the work smooth and set exposed nails and screws.

B. Apply wood filler in exposed fastener indentations; filler shall match wood grain color to become nearly invisible after finishing.

C. Shop Finish: Shop finish fabricated items following AWI Section 1500 Premium Grade as follows:

1. Hardwood Trim Fabrications: AWI Finish System – Catalyzed Polyurethane, including stain, vinyl sealer, 220 grit sanding, and two (2) separate finish coats.
   a. Match stain color and sheen on approved finish sample colors.

PART 3 - EXECUTION

3.1 COORDINATION

A. Review, coordinate, and accommodate work of other trades that interface with, affect, or are affected by the work of this Section to facilitate the execution of the overall Work of this project in a coordinated and efficient manner.

3.2 EXAMINATION

A. Verify that building interior temperature and humidity are stabilized and temperature is being maintained between 68 and 74 degrees F.

B. Inspect backing and support framing and confirm its adequacy for installation of finish carpentry materials.

C. Verify mechanical, electrical, and building items affecting the work of this section are placed and ready to receive this work.

D. Start of installation indicates approval of building conditions, backing, and support framing.

3.3 INSTALLATION – GENERAL

A. Install work following AWI Section 1700 to AWI Custom Quality Standard.

B. Unbundle and separate fabricated items and allow them to acclimate inside the temperature-controlled building for 72 hours before installing.

B. Set and secure materials and components in place, plumb, level, and straight.

C. Securely attach to the wall with concealed fasteners.

E. Carefully scribe work abutting other components, with hairline joint (maximum gap of 1/32 inch). Do not use additional overlay trim to conceal larger gaps.

F. Install trim with concealed fasteners spaced as required for secure installation, tight to the substrate, free of twists or bowing.

G. Cut openings to accommodate work of other trades.

3.4 INSTALLATION – PLYWOOD PANELS FOR TELECOM EQUIPMENT

A. Layout panels/joints to provide the fewest joints possible with equal width borders on ends.

B. Install panels plumb and square and securely fastened to wall framing with screws.

C. Install panels with hairline tight joints and with top and bottom edges aligned in a straight line.

3.5 PROTECTION

A. Protect surfaces exposed to view from damage and bruising during handling, installation, and construction traffic after installation.

B. Replace finish carpentry work damaged by work of this project to match adjacent.

3.6 CLEANING

A. Clean installed work under provisions of AWI Section 1700.

END OF SECTION

DIVISION 07

THERMAL & MOISTURE PROTECTION

SECTION 07 21 00

THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including Division 1 Specification Sections, apply to work of this Section.

1.2 SECTION INCLUDES

A. Under-slab Insulation.

B. Thermal Batt Insulation

C. Acoustical Sound Batt Insulation

1.3 REFERENCES

A. All references shall be the latest adopted edition.

B. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.

C. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

E. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

F. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association.

1.4 SUBMITTALS

A. Product Data: Submit the manufacturer’s datasheet for each product specified.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to a successful installation.

B. Do not install interior building insulation until after the roof is on and the building structure and interior have been completely dried out.

PART 2 - PRODUCTS

2.1 BOARD INSULATION MATERIALS

A. Rigid Foam Under Slab Insulation: Extruded Polystyrene Board Insulation, ASTM C578, Type IV; extruded cellular type polystyrene board with either natural skin or cut cell surfaces; with the following characteristics:

1. Board Edges: Square.
2. Compressive Resistance: 20 psi.
3. Water Absorption, maximum: 0.3 percent, volume.
4. Surface Burning Characteristics: Flame spread/smoke developed of 5/165 following ASTM E84.
5. R = 10 minimum.

2.2 BATT & BLANKET INSULATION MATERIALS

A. Thermal Batt Insulation (Exterior walls): ASTM C665 Type I; preformed glass fiber batt; kraft-faced, friction fit, widths required for a snug friction fit between framing members free of gaps or voids.

B. Thermal Batt Insulation (Attic space): ASTM C665 Type I; preformed glass fiber batt; unfaced, friction fit, widths required for a snug friction fit between framing members free of gaps or voids.

C. Acoustical Sound Batt Insulation: Preformed glass fiber batt conforming to ASTM C665 Type I, unfaced, widths as required for a snug friction fit between framing members free of gaps or voids.

2.3 ACCESSORIES

A. Adhesive: Type recommended by insulation manufacturer for application.

1. Low Emitting Materials Credit EQc4.1: VOC levels of adhesives used during construction inside the building envelope shall not exceed 50 grams per liter of VOC per LEEDTM Requirements.

B. Insulation Stops: Cardboard insulation stops to prevent batt insulation from blocking ventilation above the insulation.

PART 3 - EXECUTION

3.1 COORDINATION

A. Review, coordinate, and accommodate work of other trades that interface with, affect, or are affected by the work of this Section to facilitate the execution of the overall Work of this project in a coordinated and efficient manner.

3.2 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.

B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

C. Start of insulation installation indicates approval of substrate and site conditions.

3.3 INSTALLATION - THERMAL BATT INSULATION

A. Install insulation per manufacturer's instructions. Friction fit in cavities and spaces to prevent displacement or sagging.

B. Insulate the entire perimeter of the building exterior without gaps or voids, except where rigid insulation is shown. Do not compress insulation.

C Where wall framing is deeper than the insulation, place the batt tight to the exterior wall sheathing (leaving a void space on the interior side of the batt).

D. Install insulation stops above batt insulation in roofs, at walls, and other areas where the height of the insulated cavity is reduced, to allow unrestricted ventilation airflow above the insulation.

E. Trim insulation neatly to fit spaces. Insulate miscellaneous cavities, gaps, and voids.

F. Fit insulation to the exterior side of mechanical and electrical services within the plane of the insulation. Leave no gaps or voids.

1. Where mechanical piping will not allow installation of insulation to the exterior side and prevent freezing, report the condition to the piping installer for correction before insulating or closing the space.

3.4 INSTALLATION - ACOUSTICAL/SOUND BATT

A. Install insulation per manufacturer's instructions. Friction fit in cavities and spaces to prevent displacement or sagging.

B. Insulate the entire width/height of the wall/floor assembly without gaps or voids. Do not compress insulation.

C. Trim insulation neatly to fit spaces. Insulate miscellaneous cavities, gaps, and voids.

D. Coordinate installation during GWB installation to prevent displacement or removal of batts.

3.5 INSTALLATION – RIGID FOAM UNDERSLAB INSULATION

A. Install perimeter insulation against the inside face of exterior perimeter foundation walls.

3.6 PROTECTION OF FINISHED WORK

A. Do not permit installed insulation to be damaged or removed before its concealment.

END OF SECTION

SECTION 07 25 00

WEATHER RESISTIVE BARRIER SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including Division 1 Specification Sections apply to work of this Section.

1.2 SECTION INCLUDES

A. Weather Resistive Barrier System (WRB)

1.3 REFERENCES

A. All references shall be the latest adopted edition.

B. ASTM C920 - Standard Specification for Elastomeric Joint Sealants

C. ASTM C1193 - Standard Guide for Use of Joint Sealants

D. ASTM D882 - Test Method for Tensile Properties of Thin Plastic Sheeting

E. ASTM D1117 - Standard Guide for Evaluating Non-woven Fabrics

F. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials

G. ASTM E96 - Test Method for Water Vapor Transmission of Materials

H. ASTM E1677 - Specification for Air Retarder Material or System for Framed Building Walls

I. ASTM E2178 - Test Method for Air Permeance of Building Materials

J. AATCC - American Association of Textile Chemists and Colorists Test Method 127 Water Resistance: Hydrostatic Pressure Test

K. DuPont Tyvek Installation Guidelines - Dupont Tyvek Weather Barrier Commercial Installation Guidelines

L. DuPont Flashing Installation Guidelines - Dupont Tyvek Flashing Systems Commercial Installation Guidelines

M. TAPPI Test Method T-410; Grams of Paper and Paperboard (Weight per Unit Area)

N. TAPPI Test Method T-460; Air Resistance (Gurley Hill Method)

1.4 SUBMITTALS

A. Refer to Division 1 of the specifications for submittal procedures.

B. Product Data: Submit product data for each component of the weather-resistive barrier system.

C. Quality Assurance Submittals: Provide manufacturer test reports indicating product compliance with indicated requirements.

D. Warranty Authorization: Submit evidence from the manufacturer that the project is approved for warranty coverage.

E. Closeout Submittal: Submit the manufacturer's executed warranty form with authorized signatures and endorsements indicating the date of Substantial Completion.

1.5 DEFINITIONS

A. Weather Resistive Barrier System (System): A vapor permeable secondary barrier installed behind the primary exterior cladding/siding installation that provides liquid water and air barrier preventing the passage of liquid water to the interior side of the weather-resistive barrier system at any point in the system, including penetrations and interfaces between different materials, and reduces air leakage to a defined level.

B. Weathertight: Weatherproof; able to withstand exposure to weather without damage, loss of function, or leakage.

1.6 QUALITY ASSURANCE

A. Installer: Installer shall have a minimum of 5 years of experience with the installation of weather-resistive barrier systems and have a thorough understanding of the theory and practical application of secondary weather-resistive barrier systems in exterior cladding/siding applications.

B. Installation: Installation shall be per the System manufacturer's installation guidelines and recommendations.

C. Source Limitations: Weather Resistive Barrier System components shall be produced or approved in writing by a single manufacturer.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Deliver weather-resistive barrier materials and components in manufacturer's original, unopened, undamaged containers with identification labels intact.

B. Store weather-resistive barrier system materials as recommended by the weather barrier

1.8 SCHEDULING

A. Review requirements for sequencing of installation of weather-resistive barrier system with the installation of windows, doors, louvers, lights, and flashings to provide a weather-tight barrier assembly.

B. Schedule installation of weather-resistive barrier system and exterior cladding within nine months of weather-resistive barrier system installation.

1.9 WARRANTY

A. Provide a special System manufacturer's warranty for weather-resistive barrier system for 10 years from the date of final System installation.

B. Approval by the System manufacturer for warranty is required before System installation.

C. Warranty Areas: All areas shown on the Drawings to receive a weather-resistive barrier system shall be included in the warranty.

PART 2 - PRODUCTS

2.1 WEATHER-RESISTIVE BARRIER SYSTEM (WRB)

A. General: Provide all components and accessories required for a complete and functional watertight weather-resistive barrier system supplied by a single manufacturer, complete with manufacturer-designed installation details for each condition found on the project.

B. Weather-Resistive Barrier Sheet: High-performance, spunbonded polyolefin, non-woven, non-perforated sheet; similar to DuPont™ Tyvek® CommercialWrap, manufactured by DuPont Building Innovations.

1. Performance Characteristics:
   a. Air Penetration: 0.001 cfm/ft2 at 75 Pa, when tested in accordance with ASTM E2178. Type I per ASTM E1677.
   b. Water Vapor Transmission: 28 perms, when tested following ASTM E96, Method B.
   c. Water Penetration Resistance: 280 cm when tested following AATCC Test Method 127.
   d. Basis Weight: 2.7 oz/yd2, when tested following TAPPI Test Method T-410.
   e. Air Resistance: Air infiltration at >1500 seconds, when tested following TAPPI Test Method T-460.
   f. Tensile Strength: 38/35 lbs/in., when tested following ASTM D882, Method A.
   g. Tear Resistance: 12/10 lbs., when tested following ASTM D1117.
   h. Surface Burning Characteristics: Class A, when tested following ASTM E 84. Flame Spread: 10, Smoke Developed: 10.

C. Accessories:

1. Plastic Cap Screws: 2" diameter similar to DuPont™ Tyvek® Wrap Cap Screws with 1-5/8" long drill point screws and high-density polyethylene cap, manufactured by DuPont Building Innovations. Staples are not permitted.

2. Seam Tape: 3 inches wide similar to DuPont™ Tyvek® Tape, manufactured by DuPont Building Innovations.
3. Flexible Flashing: Provide the following as recommended by the System manufacturer for the specific application or substrate condition:
    a. Similar to DuPont™ FlexWrap™, as manufactured by DuPont Building Innovations.
    b. Similar to DuPont™ StraightFlash™, as manufactured by DuPont Building Innovations.
    c. Similar to DuPont™ StraightFlash™ VF, as manufactured by DuPont Building Innovations.
4. Sealant: Provide the following sealants that comply with ASTM C920, elastomeric polymer sealant to maintain watertight conditions as recommended by the System manufacturer.
    a. Similar Tremco 830
    b. Similar Tremco Butyl
    c. Other sealants recommended by the system manufacturer.
5. Primers: Provide the specific primer recommended by the System manufacturer to assist in adhesion between flexible flashing and each different substrate found in this project:
    a. Similar 3M High Strength 90
    b. Similar Denso Butyl Spray
    c. SIA 655
    d. Similar Permagrip 105
    e. ITW TACC Sta' Put SPH
    f. Other primers recommended by the System manufacturer.

D. Sheet Metal Flashing: Specified in Section 07 62 00.

PART 3 - EXECUTION

3.1 COORDINATION

A. Review, coordinate, and accommodate work of other trades that interface with, affect, or are affected by the work of this Section to facilitate the execution of the overall Work of this project in a coordinated and efficient manner.

B. Coordinate the installation of the weather-resistive barrier system and sheet metal flashings specified in Section 07 62 00 and the exterior siding/cladding so that the exterior sheathing and the weather-resistive barrier system are not left exposed to the weather longer than recommended by the manufacturer(s).

C. Coordinate fabrication and installation of sheet metal flashings with Section 07 62 00 as required to achieve a weathertight assembly. Do not install cladding/siding until the flashings have been properly installed.

D. Coordinate installation of flexible flashings at openings in exterior walls with the installation of a vapor retarder on the interior face of walls to allow overlap and seal at openings.

3.2 EXAMINATION

A. Verify that substrates are ready to receive work.

B. Beginning of installation indicates acceptance of substrate and conditions.

3.3 PREPARATION

A. Substrates shall be clean, dry, uniform, and smooth before flashing application. Remove protrusions and fill voids at substrates as necessary. Ensure fastener heads are set flush with substrate surfaces.

B. Allow wet substrates to dry thoroughly. Clean dust and debris from all substrates. Wipe metal surfaces with films or coatings interfering with adhesion clean.

C. Prime substrates according to manufacturer’s recommendations.

D. Provide solid continuous backing or substrate filler to support all portions of self-adhering flashing.

E. Air and substrate surface temperatures for flexible flashing shall be as recommended by the manufacturer.

3.4 INSTALLATION – WEATHER RESISTIVE BARRIER SYSTEM

A. Weathertight Installation: The exterior siding/cladding system and flashings (primary barrier) and the weather-resistive barrier system (secondary barrier) installation shall be completely weathertight upon completion (no water penetration to the interior side of the weather-resistive barrier), install in a manner that sheds water to the exterior of the wall and provides a completely weathertight building exterior.

1. Remove, repair, and replace any element of the exterior siding/cladding system (primary barrier) or the weather-resistive barrier system (secondary barrier) that leaks or admits water behind the weather-resistive barrier system to provide a weathertight exterior wall system.

B. General: The weather-resistive barrier system is required to provide a completely watertight secondary barrier behind the exterior siding/cladding on this building.

1. Install a weather-resistive barrier system over all surfaces of the exterior walls of the building in weather lapped, watertight manner and integrated with the sheet metal flashings around openings and penetrations.
2. Coordinate installation to coincide with siding/cladding installation so that the proper sequence of installation is achieved and so that the weather-resistive barrier system is not left exposed to the weather.
3. Protect the weather-resistive barrier system from damage, and repair any damaged areas for a weathertight installation.
4. Installation Guidelines & Details: Refer to DuPont Tyvek Installation Guidelines and DuPont Flashing Installation Guidelines.

C. Weather Resistive Barrier System (WRB): Install WRB per the System manufacturer's installation instructions to achieve weathertight assembly.

1. Install a weather-resistive barrier sheet with a minimum number of end laps possible.
2. Openings: Install flexible flashing at the perimeter of doors, windows, and louvers in exterior walls to provide a weathertight seal between the window, door, or louver and the weather-resistive barrier sheet.

3. Penetrations: Install flexible flashing at the perimeter of all penetrations of exterior siding (such as thru-wall scuppers, electrical boxes, hose bibs, pipes, exhaust ducts/louver assemblies, light fixtures, fire alarm devices, structural members, etc.) to provide a weathertight seal between item penetrating and the weather-resistive barrier sheet.
4. Coordinate installation requirements under non-standard conditions with the System manufacturer.
5. Protect WRB from damage, and repair any holes or tears before the siding is installed.
6. Do not leave WRB exposed to the weather, conform with the manufacturer's recommendations. Replace any weather-exposed or damaged barrier entirely, do not cut wrinkles.

3.5 FIELD QUALITY CONTROL

A. Contractor Quality Control: Employ/assign quality control personnel to monitor the work of this Section for conformance to the requirements of the Contract Documents and good construction practices.

1. Contractor is solely responsible for managing and controlling the quality of the work and conformance with the requirements of the Contract Documents.

B. Schedule of Contractor Performed Inspections:

1. Inspect installation of weather-resistive barrier system just before cover and confirm that weather-resistive barrier system is installed according to System manufacturer's recommendations and installation details and there are no penetrations or damage.

C. Manufacturer's Field Service:

1. Notify the manufacturer’s designated representative to obtain required periodic observations of weather barrier assembly installation.
2. System Manufacturer’s Authorized Field Service Representative shall inspect work in progress and completed work to ascertain that the System has been installed according to the System manufacturer's recommendations and installation details.

D. Non-conforming work shall be corrected and re-inspected/approved by System Manufacturer’s Authorized Field Service Representative before cover.

END OF SECTION

SECTION 07 31 13

ASPHALT SHINGLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including Division 1 Specification Sections apply to work of this Section.

1.2 SECTION INCLUDES

A. Asphalt Shingle Roofing

1.3 REFERENCES

A. All references shall be the latest adopted edition.

B. ASTM D3018 - Standard Specification for Class A Asphalt Shingles Surfaced with Mineral Granules.

C. ASTM D3161 - Standard Test Method for Wind-Resistance of Asphalt Shingles.

D. ASTM D3909 - Standard Specification for Asphalt Roll Roofing (Glass Felt) Surfaced with Mineral Granules.

E. ASTM D4586 - Standard Specification for Asphalt Roof Cement, Asbestos-Free.

F. ASTM D 4601 -. Standard Specification for Asphalt-Coated Glass Fiber Base Sheet Used in Roofing

G. ASTM E108 - Standard Test Methods for Fire Tests of Roof Coverings

H. NRCA - The NRCA Steep Roofing Manual; National Roofing Contractors Association.

I. SMACNA (ASMM) - Architectural Sheet Metal Manual; Sheet Metal and Air Conditioning Contractors' National Association, Inc.

1.4 SUBMITTALS

A. Refer to Division 1 of the specifications for submittal procedures.

B. Product Data: Provide manufacturer's product data indicating material characteristics for the following:

1. Asphalt shingles
2. Underlayment
3. Roll roofing
4. Ice & Water Membrane
5. Roofing nails
6. Hand-sealing mastic
7. Roof to wall vent

C. Samples: Submit two samples of each shingle color indicating the color range and finish texture/pattern; for color selection.

D. Manufacturer's Warranty authorization indicates the project's eligibility for a completed warranty.

E. Authorized Installer certification from Manufacturer indicating that installer is certified by the manufacturer to install the product.

1.5 QUALITY ASSURANCE

A. Perform Work per the recommendations of the NRCA Steep Roofing Manual and shingle manufacturer's instructions.

B. Installer Qualifications: Approved by the manufacturer to install the specified products and provide the specified warranties.

C. Source Limitations: Obtain ridge shingles and ice & water membrane underlayment from a single manufacturer.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not install shingles when surface or ambient air temperatures are below 45 degrees F.

1.7 EXTRA MATERIALS

A. Provide 4 bundles of extra shingles of each color selected.

1.8 GUARANTEE / WARRANTY

A. Contractor Guarantee: Asphalt shingle work is subject to a 2-year guarantee by the Contractor (separate from any product warranty by the shingle manufacturer). Upon notification by the Government, the Contractor agrees to return to the site to investigate and correct any leaks, defects, or failures connected with the work of this Section at no cost to the Owner within 2 years.

B. Manufacturer's Warranty: Asphalt shingle manufacturer's standard 20-year warranty, including 20-year algae block warranty and 80 miles per hour wind warranty.

PART 2 - PRODUCTS

2.1 ASPHALT COMPOSITION SHINGLES

A. Asphalt Composition Shingles: Laminated shingles, asphalt coating on a fiberglass fiber mat, mineral surfaced, self-sealing, conform to the following:

1. Approximate Weight: 242 lbs. per square
2. Dimensions: 13 ¼" x 40"
3. Exposure: 5 5/8"
4. Granule Adhesion: 1.0-gram loss
5. Fire Rating: Class A
6. Manufacturer's Warranty: 20-year shingle warranty including:
   a. 20-year algae block warranty
   b. 80 mph wind warranty minimum
7. Standards: Meet/exceed the following:
   a. ASTM D7158, Class H
   b. ASTM D3462
   c. ASTM D3018 Type I
   d. ASTM D3161 Class F
   e. ASTM E108 Class A
8. Color: To be selected
9. Acceptable Manufacturers:
   a. Malarky Northwest XL fiberglass laminated shingles
   b. GAF Timberline® Cool Series
   c. or approved

B. Ridge Shingles: Provide ridge shingles matching composition and color of asphalt composition shingle.

C. LEEDTM Requirements:

1. Sustainable Sites Credit SSc7.2 Heat Island Effect: Shingles installed shall have an SRI value of 29 or greater per ASTM E1980

2.2 SHEET MATERIALS

A. Underlayment: Waterproof shingle underlayment, SBS modified asphalt saturated fiberglass mat, Type I, similar to GAF Roof Pro™ Underlayment.

1. Nails: Use only plastic cap roofing nails to attach underlayment, staples shall not be used.

B. Ice & Water Shield: Fiberglass mat impregnated and heavily coated with an SBS modified asphalt, 60 mils thick, self-adhering back with release paper.

2.3 ACCESSORIES

A. Roofing Nails: Hot-dipped galvanized, 3/8" diameter head, 11 to 12 gauge, length as required to fully penetrate roof sheathing, barbed shank roofing nail manufactured in America or Canada, approved by the shingle manufacturer.

B. Hand-Sealing Mastic: Similar to Henry #209 Elastomastic in 11-ounce cartridges.

C. Ridge Vent: Manufacturer's venting ridge shingle.

D. Butyl Sealant: Single component, TT-S-001657, Type I, similar to Tremco Butyl Sealant or approved.

E. Sheathing, blocking specified in Section 06 10 00 – Carpentry.

2.4 METAL FLASHINGS

A. Sheet Metal Flashings: Specified in Section 07 62 00.

2.5 TEMPORARY WATERPROOF TARPS/COVERS

A. Provide reinforced waterproof tarps with reinforced edges and grommets suitable for providing temporary waterproof cover over an area of roofing that is exposed to wet weather.

1. Tarps shall be large enough to cover the entire area of existing roofing that has been removed in one piece.
2. Provide tie-down rope and sandbags as required to secure the tarp in place.

PART 3 - EXECUTION

3.1 COORDINATION

A. Review, coordinate, and accommodate work of other trades that interface with, affect, or are affected by the work of this Section to facilitate the execution of the overall Work of this project in a coordinated and efficient manner.

B. Schedule the underlayment installation to follow immediately upon completion of the roof sheathing to prevent sheathing from becoming wet.

C. Coordinate installation of asphalt shingles to follow the installation of sheet metal eave and rake flashings specified in Section 07 62 00.

3.2 EXAMINATION

A. Before beginning work inspect roof sheathing and installation conditions for conformance to roofing shingle manufacturer's requirements.

B. Verify that roof penetrations and plumbing stacks are in place and flashed to the deck surface.

C. Verify roof openings are correctly framed.

D. Verify deck surfaces are dry, free of damage, ridges, warps, or voids.

E. Confirm that no sheathing nails are projecting above the surface of the sheathing.

F. Start of installation indicates acceptance of roof substrate and conditions.

3.3 PREPARATION

A. Broom clean deck surfaces before installing underlayment.

B. Clean sheet metal flashings free of dirt, grease, and oil.

3.4 INSTALLATION – ICE & WATER SHEILD & UNDERLAYMENT

A. Install ice & water membrane continuous at eaves, ridges, and valleys and in locations indicated on the Drawings.

1. Eaves: Install ice & water membrane over roof sheathing and directly over top of eave flashing.
2. Ridge: Install ice and water membrane over an underlayment.
   a. Cut out attic vent holes to allow free flow of ventilation air.
   b. Do not block the path of ventilation air.
3. Valleys: Refer to the installation described below.
4. Apply ice & water membrane over the top of the flashing and adhere securely.
5. Shingle lap all seams.

B. Install underlayment over ice and water membrane per manufacturer's installation instructions.

1. Slopes Less Than 4 in 12: 2 layers of underlayment.

C. Install underlayment perpendicular to the slope of the roof, with ends and edges shingle lapped a minimum of 4 inches.

1. Install over dry roof sheathing only; installation over wet sheathing is not permitted.
2. Unroll underlayment and allow it to relax before application to avoid subsequent ridging problems.
3. Nail in place with plastic cap roofing nails; do not use staples.
4. Weather lap minimum 6 inches over ice & water membrane.
5. Seal end laps continuous with lap cement.

D. Items projecting through or mounted on the roof: Weather lap and seal underlayment to item watertight with asphalt mastic.

E. Ridge: Underlayment shall not block the path of ventilation air at ridge vents.

3.5 INSTALLATION - VALLEY PROTECTION

A. Construct closed cut valleys per manufacturer’s installation instructions.

B. Install valleys per Drawing details, shingle manufacturer's instructions, SMACNA, and NRCA Steep Roofing Manual (where conflicts exist, the most restrictive requirement shall apply).

C. Install continuous ice and water membrane directly over roof sheathing, centered on and extending the full length of the valley.

D. Overlap joint at the center of valley 4 inches minimum.

E. Install one ply of mineral surface roll roofing over ice and water membrane, minimum 36 inches wide, centered on and extending the full length of the valley in a single, unbroken length.

F. Nail edges of roll roofing in place at 18 inches on center, 1 inch from edges.

3.6 INSTALLATION - METAL FLASHING & ACCESSORIES

A. Installation of sheet metal flashings is specified in Section 07 62 00.

B. Coordinate installation of flashings per Drawings details, shingle manufacturer's instructions, NRCA Steep Roofing Manual requirements, and SMACNA Architectural Sheet Metal Manual requirements (where conflicts exist, the most restrictive requirement shall apply).

C. Nails/screws exposed to the weather are not allowed.

3.7 INSTALLATION – RIDGE VENT

A. Install ridge vent in conformance with manufacturer’s installation instructions.

1. Confirm those vent openings are not blocked by ridge vent installation.

3.8 INSTALLATION - SHINGLES

A. Install shingles per manufacturer's installation instructions and this Section (where conflicts exist, the most restrictive requirement shall apply).

1. Intermix bundles and shingles to prevent visible color patterns in installed roofing.

B. Place shingles in a straight coursing pattern, parallel with the eave edge of the roof, with the manufacturer's recommended weather exposure to produce double thickness over the full roof area.

C. Nailing: Attach shingles with specified nails per shingle manufacturer’s nailing instructions.

1. Install nails in each shingle in quantity and manner as required by the shingle manufacturer for achieving the manufacturer’s 110 mph wind warranty.

2. Nail guns are allowed subject to the following:
    a. Each nail gun shall have an independently regulated air source.
    b. The specified nails shall be used.
    c. Nails shall be installed consistently so that the head is properly seated on the shingle without over or under-driving as recommended by the shingle manufacturer.
3. Proper Nailing Is Mandatory - If nailing is found to be inconsistent and not in conformance, hand nailing will be required.
4. Any shingles improperly nailed and not conforming to the shingle manufacturer's requirements shall be removed and replaced at the Contractor's expense.

D. First Course: Project first course of shingles 3/4 inches beyond the face of eave flashing.

E. Valleys: Install closed cut valleys in conformance with the shingle manufacturer's installation instructions.

F. Ridge Shingles: Install hip/ridge shingles in conformance with the shingle manufacturer's installation instructions, maintaining the manufacturer's recommended weather exposure.

G. Interlace shingles and step flashing for shingle-lapped and watertight installation (one shingle to one step flashing).

H. Completed shingle roofing installation shall provide a watertight roof assembly.

3.9 HAND SEALING SHINGLES

A. Hand seal shingles by using a cartridge in a caulking gun to apply a continuous 1/4 inch bead of asphalt mastic to the weather side of nails in the following locations:

1. Ridge shingles.
2. Rake edge shingles

3.10 PROTECTION

A. Do not permit construction traffic over the finished shingle roofing surface.

3.11 WORKMANSHIP

A. Roofing installation shall be installed using the best workmanship, including the following:

1. No wrinkles in underlayment or ice & water barrier.
2. Align shingle rows straight with consistent exposure width.
3. Proper nail installation; no over or under-driven nails; no crooked or bent nails.
4. Nails installed in the proper location, no exposed nails.
5. No damaged shingles.
6. Straight valley, rake edge, and hip shingle lines.
7. No visible shingle patterning.

B. Roofing installed with improper or poor workmanship shall be removed and replaced at the Contractor's expense.

3.12 FIELD QUALITY CONTROL

A. Contractor Quality Control: Employ/assign quality control personnel to monitor the work of this Section for conformance to the requirements of this Section and good construction practices.

1. Contractor is solely responsible for managing and controlling the quality of the work and conformance with the requirements of this Section.

B. Manufacturer's Field Services: Provide manufacturer's field service consisting of periodic site visits for review of installation procedures with Contractor and inspection of product installation following manufacturer's instructions.

END OF SECTION

SECTION 07 46 46

FIBER-CEMENT SIDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including Division 1 Specification Sections apply to the work of this Section.

1.2 SECTION INCLUDES

A. Fiber Cement Lap Siding

B. Fiber Cement Panel Siding

C. Fiber Cement Trim

1.3 SUBMITTALS

A. Refer to Section 01 33 23 for submittal procedures.

B. Submit product data for fiber cement lap siding, screws, and sealant.

1.4 DELIVERY, STORAGE, AND PROTECTION

A. Store off the ground and cover to protect from exposure to the elements.

1.5 PRE-INSTALLATION CONFERENCE

A. Before the start of siding and soffit installation, the Contractor shall schedule a pre-installation conference at the job site to review the project conditions and installation requirements. Persons attending the pre-installation conference shall include the General Contractor, Siding/Soffit Installer, and Contracting Officer.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Compliant with ÅSTM C 1186 Type-A Grade II.

B. Classified as non-combustible following ÅSTM E 136.

C. Flame spread/Smoke Developed in compliance with ÅSTM E 84 Flame Spread Index = 0, Smoke Developed Index = 5.

2.2 MANUFACTURERS

A. Subject to compliance with the specifications the following manufacturers are acceptable.

1. James Hardie Building Products;
   26300 La Alameda Suite 400;
   Mission Viejo, CA 92691;
   Toll Free Tel: 866-274-3464
2. Certainteed Corporation;
   P.O. Box 860;
   Valley Forge, PA 19482;
   Toll Free Tel: 800.233.8990
3. GAF Premium Products Inc.;
   440 Katherine Rd;
   Wind Gap, PA 18091;
   Tel: 610-863-4101 x.229

2.3 FIBER CEMENT LAP SIDING:

A. HardiePlank Artizan HZ10, Type Smooth 8.25 inches.

1. 5/16 inch thick, factory prime painted ready to field finish.
2. Exposure to Weather: Install siding to provide equal exposure for the height of the siding area with no more than 6-inch exposure maximum.
3. Starter Strip: Fiber cement starter strip

2.4 FIBER CEMENT PANEL SIDING

A. HardiPanel, 5/16 inch thick, off-set shingle style.

1. Provide in longest possible uninterrupted vertical lengths
2. Factory primed ready for field painting

2.5 FIBER-CEMENT TRIM & BATTENS

A. Batten Boards: Hardie Trim HZ10 batten boards 3/4 inch thick smooth.

B. Trim: Hardie Trim 5/4 inch thickness widths as required to match drawings.

2.6 SOFFIT PANELS

A. Smooth-surfaced, vented 16 inches wide by 12 feet, sealed on 5 sides.

B. Factory primed ready for factory field painting.

2.7 ACCESSORIES

A. Screws: Non-rusting stainless steel or corrosion-resistant polymer coated galvanized steel screws; self-drilling with Type A point; long enough to penetrate wood framing 1/2 inch or 3 full screw threads minimum.

B. Weather-Resistive Barrier (WRB) and Flexible Flashing: Specified in Section 07 25 00.

C. Sheet Metal Flashing & Trim: Specified in Section 07 62 00.

D. Sealant: *Pro Series Quad Advanced Formula Sealant* manufactured by OSI Sealants.

PART 3 - EXECUTION

3.1 COORDINATION

A. Review, coordinate and accommodate work of other trades that interface with, affect, or are affected by the work of this Section to facilitate the execution of the overall Work of this project in a coordinated and efficient manner.

B. Coordinate the installation of the weather-resistive barrier and flexible flashings specified in Section 07 25 00 and sheet metal flashings specified in Section 07 62 00 and the siding so that the exterior sheathing and the weather-resistive barrier are not left exposed to the weather.

C. Coordinate fabrication and installation of sheet metal flashings with Section 07 62 00 as required to achieve a weathertight assembly. Do not install siding until the flashings have been properly installed.

D. Coordinate installation of additional framing/backing for securing ends of lap siding as applicable.

3.2 WEATHERTIGHT INSTALLATION

A. Siding, weather-resistive barrier, and flashing system installation shall be completely weathertight upon completion, install in a manner that sheds water to the exterior of the wall, and provides a completely weathertight building exterior.

B. Remove, repair, and replace any element of the complete siding system that leaks or admits water behind the building paper to provide a weatherproof siding system.

3.3 EXAMINATION

A. Verify that substrates are ready to receive work.

B. Confirm that framing/backing is installed for support and fastening all siding and soffit joints and ends.

C. Confirm that framing/sheathing is plumb and straight and that the surface plane is within 1/4 inch in 10 feet tolerance.

D. Inspect secondary barriers (weather-resistive barrier and flexible flashings) for proper installation that will provide watertight installation.

E. The beginning of installation indicates acceptance of substrate, framing/backing, secondary barriers, and conditions.

3.4 PREPARATION

A. Protect weather-resistive barrier and flexible flashings from damage.

3.5 INSTALLATION – FIBER CEMENT LAP SIDING

A. Install siding level, straight, and true per siding manufacturer's installation instructions for lap siding.

1. Siding Exposure: Install siding to provide equal exposure for the height of the siding area with no more than 8-inch exposure maximum.
2. Double lap siding (install two layers) as shown on the Drawings.
3. Fastening: Blind screw top of siding at 16 inches on center into studs or backing using screws of sufficient length to penetrate through stud 1/2 inch minimum. Screws must be located at studs or backing only, screwing into wall sheathing only is not allowed.

B. Cuts Exposed to View: Cut with diamond blade circular saw, do not score and snap.

C. Field coat all cut ends with the manufacturer's recommended sealer/primer.

D. Siding Butt Joints: Install lap siding in the longest lengths possible with the minimum number of joints, do not use short lengths where the full-length piece would eliminate a joint.

1. Layout butt joints to occur randomly on the wall, so that no discernable pattern is visible, stagger the joints between rows of siding.
2. Joints shall be cut square and true.
3. Locate joints over the centerline of wall framing members, joints located at sheathing only are not allowed.
4. Siding Joints Located More Than 8 Feet Below Roof: Install a 12"x 12" piece of flexible flashing behind butt joints with the bottom edge lapped over the siding below (hold up 1/4" above the bottom of siding to conceal from view). Apply 2 vertical beads of sealant onto flexible flashing 4 inches each way from the joint.

E. Fasten siding in place, level, and straight.

1. Blind screw siding to each wall stud and at each end into backing/framing.
2. Install siding for a natural shed of water.
3. Position cut ends over bearing surfaces. Leave a gap at joints as recommended by the manufacturer.

F. Outside corners: Install sheet metal outside corners as recommended by the manufacturer, set corner into 2 beads of fresh sealant and press down tight for flush, tight fit to siding, free of gaps.

1. Blind screw sheet metal corners to the wall stud.
2. Wipe away any excess sealant immediately.

G. Sealant Installation: Apply sealant neatly as recommended by the manufacturer and specified hereafter:

1. Clean siding and trim before applying sealant.
2. Apply sealant to flexible flashing substrate (behind) as siding installation progresses and place siding into fresh sealant; wipe off excess sealant leaving a neat joint; the intent is for the sealant to be behind the siding and in the joint. Do not wait to apply sealant after the siding is installed.
3. Install sealant in the following locations:
    a. At the juncture between siding and trim, apply 2 vertical beads of sealant, one at the end of the siding (to act as the primary seal) and a second vertical bead 4 - 5 inches from the end of siding (to act as the secondary seal).
    b. At siding end (butt) joints; apply 3 vertical beads of sealant, one bead centered on the joint (to act as the primary seal) and the other two beads 4 - 5 inches each way from the first bead (to act as the secondary seal).
4. Before installing the siding piece, apply a sealant to flexible flashing at the joint and place siding into fresh sealant; wipe off excess sealant leaving a neat joint. Do not wait to apply sealant after the siding is installed.

H. Remove any contamination on siding as required for field painting specified in Section 09 90 00.

END OF SECTION

SECTION 07 62 00

SHEET METAL FLASHING & TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including Division 1 Specification Sections, apply to work of this Section.

1.2 SECTION INCLUDES

A. Sheet metal flashing and trim

1.3 REFERENCES

A. All references shall be the latest adopted edition, except as noted.

B. ASTM A653 - Standard Specification for Steel Sheets, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

C. ASTM A792 - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process

D. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

E. NRCA (National Roofing Contractors Association)

F. SMACNA (Sheet Metal and Air Conditioning Contractors' National Association) Architectural Sheet Metal Manual, Fifth Edition

1.4 SUBMITTALS

A. Refer to Division 1 of the Specifications for submittal procedures.

B. Product Data: Submit the manufacturer’s product data for the following:

1. Pre-Finished Sheet metal
2. Fasteners
3. Sealant

C. Submit shop drawings for review before fabrication, including the following:

1. Roof details showing each flashing condition keyed to the roof plan.
2. Profile and dimensions of each sheet metal item, gauge, type/finish of sheet metal, fastener type, location, and spacing. Corner and end details for each different flashing type.
3. Fastener material, type, and size for each condition.
4. Sealant details showing joint configuration, sealant types, and location for each condition.

D. Color Samples for Prefinished Sheet Metal: Submit two 3” x 4” color samples of each standard color selected (actual paint finish on sheet metal).

E. Fastener Samples: Submit samples of each different type of fastener proposed for use, and key the fasteners to the fasteners noted in the shop drawings.

1.5 QUALITY ASSURANCE

A. Fabricator/Installer Qualifications:

1. Minimum of 5 years experience in fabrication and installation of architectural sheet metal similar in material, design, and scope to this project with a record of successful in-service performance.
2. Installer shall employ only skilled, journeyman sheet metal workers to install the work of this section.

B. Workmanship shall be of the best quality; installed work shall be straight and true with neat corners and terminations, free of any visual defects; installation shall be fabricated and installed to inherently shed water without reliance on sealant and be permanently watertight.

1.6 WARRANTY / GUARANTEE

A. 20 Year Pre-finished Sheet Steel Warranty: Warrant coated finish against cracking, peeling, blistering, chalk more than 8 units, and fade more than 5 NBS points, for 20 years, without reducing or otherwise limiting any other rights to correction which the owner may have under the contract documents. The manufacturer shall also warrant that metal will not fail structurally, perforate, rupture or leak due to corrosion.

B. Guarantee the sheet metal installation against defects in installed materials and workmanship including a watertight guarantee. Correct any flashing or sheet metal item that is defective, improperly installed, or leaking.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pre-Finished Sheet Metal: Steel sheet conforming to ASTM A792 with a minimum yield of 40,000 psi and AZ50 (Zincalume or Galvalume) protective coating.

1. Finish Coating shall be a premium fluoropolymer coating with a minimum of 70% Kynar 500 or Hylar 5000 base resin, factory-applied, oven-baked, and applied under controlled conditions; 1 mil dry film thickness minimum (exclusive of primer); 20-year warranty.
2. Color: As submitted.
3. Protective film: Provide strippable plastic film, applied to the finish of coil stock before forming, or plastic interleaf, applied to the panel after forming.
4. Manufacturers:
    a. AEP-Span
    b. Varco Pruden Buildings
    c. Other manufacturers are acceptable subject to compliance with the specifications.

2.2 ACCESSORIES

A. Fasteners:

1. Fasteners For Pre-Finished Sheet Metal Fabrications:
    a. Exposed Condition - Wood or Sheet Metal Substrate: Type 304 stainless steel screws with self-sealing neoprene head.
    b. Exposed Condition - Masonry/Concrete Substrate: 1/4" diameter Rawl Zamac Nailin expansion anchor with mushroom-style head, and body formed of Zamac 7 alloy, Type 304 stainless steel nail; one and 1-1/2” minimum embedment; seal head with sealant.
        1) Powder/power-driven fasteners are not permitted.
    c. Concealed Condition: Hot dipped galvanized nails or screws or expansion anchors as appropriate for the substrate.
        1) Powder/power-driven fasteners are not permitted.
2. Fasteners for Continuous Cleats (Concealed): Hot dipped galvanized screws, nails, or expansion anchors as appropriate for the substrate.
    a. Powder/power-driven fasteners are not permitted.
3. Fasteners For Downspout Brackets:
    a. Into Sheet Metal: Stainless steel sheet metal screws.
    b. Into Masonry/Concrete: Stainless steel expansion anchors, 1/4" diameter (minimum), 1-3/4” embedment (minimum).
        1) Powder/power-driven fasteners are not permitted.

B. Tape for Separation between Dissimilar Metals: 10 mil PVC adhesive-backed tape.

C. Sealant: Provide sealant and accessories specified in Section 07 92 00.

2.3 FABRICATION

A. General:

1. Field measure and verify site conditions before fabrication, accommodate field conditions.
2. Fabricate following SMACNA (Architectural Sheet Metal Manual, Sixth Edition, 2003), NRCA, and as required by roofing manufacturer to profiles shown on Drawings (where conflicts exist, the most restrictive requirement shall apply).

3. Form sections true to shape, accurate in size, square, and free from distortion or defects.
4. Furnish in minimum 10-foot lengths.
5. Hem all exposed edges 1/2 inch on the underside.
6. Lap joints shall be fabricated to allow 6 inches minimum overlap.
7. Fabricate head flashings in walls (at windows, louvers, etc.) with end dams to prevent water from running off ends and behind the siding.
8. Shop fabricates all items including corners, end terminations, and special conditions for a neat appearance, field bending and fabrication are not acceptable.
9. Protect pre-finished metal from scratches or damage during fabrication.
10. End conditions, corners, transitions, terminations, and changes in the plane or direction of flashings and other sheet metal fabrications shall be custom fit and fabricated to accommodate field conditions and to provide weather-lapped, watertight assembly and transition. Workmanship and custom fabrications shall conform to similar conditions found in SMACNA Manual and to good sheet metal fabrication practice and shall not rely solely on sealant for their watertight integrity.

B. Miscellaneous Flashings: Fabricate to match profiles/configurations shown on Drawings from 24 gauge factory pre-finished sheet metal.

1. Slope horizontal leg of flashings to provide positive water drainage.
2. Provide end dams at all head and sill flashings to prevent water from leaking off of the ends.

C. Window Sills/Sillpan: Fabricate to match profile/configuration shown on Drawings from 24 gauge factory pre-finished sheet metal.

1. Sills shall extend full depth to the interior face of the window frame.
2. Provide concealed back and end dams with corners lapped, riveted, and sealed watertight.
3. Hem exposed edge 1/2 inch.

D. Sheet Metal Fillers and Miscellaneous Fabrications: Fabricate from 22 gauge prefinished galvanized sheet steel to match the configuration shown on the Drawings.

1. Field verifies dimensions and connections.

PART 3 - EXECUTION

3.1 COORDINATION

A. Review, coordinate, and accommodate work of other trades that interface with, affect, or are affected by the work of this Section to facilitate the execution of the overall Work of this project in a coordinated and efficient manner.

B. Coordinate installation of sheet metal flashings with roofing specifications.

C. Schedule installation of windowsill/sillpan flashing before window installation.

3.2 PREPARATION

A. Field verify that existing conditions and substrate layout are acceptable and comply with the drawing layout.

B. Report any variations, unacceptable substrates/conditions, and potential problems.

C. Do not start work until unsatisfactory conditions have been corrected.

D. Start of installation indicates acceptance of substrate and conditions.

3.3 INSTALLATION - GENERAL

A. Installation shall conform to this Section and the Drawings, the roofing manufacturer's requirements, SMACNA Architectural Sheet Metal Manual, and NRCA Roofing Manual (where conflicts exist, the most restrictive requirement shall apply).

B. Protect pre-finished metal from scratches or damage during fabrication.

C. Separate dissimilar metals with 2 wraps/layers of PVC tape.

3.4 INSTALLATION – FLASHINGS

A. Install flashings to achieve a weathertight, leak-free installation.

B. Install flashings straight and true with a neat appearance.

C. Lap Joints: Lap 6 inches minimum and seal with two heavy beads of butyl sealant just before making lap;

1. Clean metal surfaces to be sealed thoroughly with solvent just before sealant application;
2. Trim off the back of the hem to allow tight interface and proper fit.
3. Flashing shall fit tight to each other, free of any gaps or misfits.

D. Fasten flashings to substrate securely using specified fasteners sized to hold flashings securely and as recommended by the manufacturer for substrate and condition.

1. Powder/power-actuated fasteners are not permitted.

E. Fasteners shall be concealed wherever possible, seal exposed fasteners watertight.

F. Coping/Cap Flashing:

1. Install continuous cleat on the exterior side of the wall straight and true and fasten securely at 12” o.c. maximum.
2. Connect horizontal seams with 1-inch standing seam; weather lap vertical joints 6 inches and seal watertight, cut off back of hem to allow a proper fit.

3. Secure interior side with exposed fasteners spaced at no more than 30 inches apart.
4. Installation shall be completely watertight and free of any looseness or movement.

3.5 INSTALLATION – SEALANT

A. Install sealant as specified in Section 07 90 00.

1. Exposed Sealant Joints: Clean and prime surfaces to be sealed per sealant manufacturer’s instructions. Install backer rod and sealant per the sealant manufacturer's installation requirements to achieve the proper sealant performance. Install sealant so that width, shape, bonding width, and width to depth ratios conform to the sealant manufacturer's joint design recommendations based on the amount of movement (expansion/ contraction) anticipated at each joint condition to achieve a permanently watertight joint.
2. Concealed (Lap) Sealant Joints: Clean and prime surfaces to be sealed per sealant manufacturer’s instructions. Install two continuous beads of butyl sealant (primary and secondary) at each lap joint to achieve a watertight connection.
3. Exposed Fastener Heads: Where fastener heads are exposed to the weather and not self-sealing type, install sealant over fastener head and seal to metal surface watertight.

END OF SECTION

SECTION 07 81 00

APPLIED FIREPROOFING

PART 1 – GENERAL

1.1 DESCRIPTION:

A. This section specifies spray-applied mineral fiber and cementitious coverings to provide fire resistance to interior structural steel members shown.

1.2 RELATED WORK:

A. Sustainable Design Requirements: Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.

1.3 SUBMITTALS:

A. Submit following Section 01 33 23, SUBMITTAL PROCEDURES

B. Sustainable Design Submittals, as described below:

1. Volatile organic compounds per volume as specified in PART 2 - PRODUCTS.

C. Installer qualifications.

D. Testing laboratory accreditations.

E. Manufacturer's Literature and Data:

1. Manufacturer's complete and detailed application instructions and specifications.
2. Manufacturer's repair and patching instructions.

F. Certificates:

1. Certificate from testing laboratory attesting fireproofing material and application method meet the specified fire ratings.
   a. List thickness and density of material required to meet fire ratings.
   b. Accompanied by complete test report and test record.
2. Manufacturer's certificate indicating sprayed-on fireproofing material supplied under the Contract is same within manufacturing tolerance as fireproofing material tested.

G. Miscellaneous:

1. Manufacturer's written approval of surfaces to receive sprayed-on fireproofing.
2. Manufacturer's written approval of completed installation.
3. Manufacturer's written approval of the applicators of fireproofing material.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING:

A. Deliver to Jobsite in sealed containers marked and labeled to show manufacturer's name and brand and UL certification markings of compliance with the specified requirements.

B. Remove damaged or opened containers from the site.

C. Store the materials off the ground, undercover, away from damp surfaces.

D. Keep dry until ready for use.

E. Remove materials that have been exposed to water before installation from the site.

1.5 FIELD CONDITIONS:

A. Temperature: Do not apply to fireproof when the substrate or ambient temperature is below 40 degrees F unless temporary protection and heat are provided to maintain the temperature at or above the stated value during application and for 24 hours before and after application.

B. Humidity: Maintain relative humidity levels within the limits recommended by fireproofing manufacturers.

C. Ventilation: Provide ventilation to properly dry the fireproofing after application. Provide a minimum of 4 air exchanges per hour by forced air circulation. When permitted by Contracting Officer Representative (COR), ventilate by natural circulation.

1.6 QUALITY ASSURANCE:

A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by fireproofing manufacturer as experienced and with sufficient trained staff to install manufacturer’s products according to specified requirements. Submit manufacturer’s certification that each installer is trained and qualified to install the specified fireproofing. Submit evidence that each installer has a minimum of 3 years of experience and a minimum of 4 installations using the specified fireproofing.

B. Testing Laboratory Accreditation Requirements: Construction materials testing laboratories must be accredited by a laboratory accreditation authority. Submit a copy of the Certificate of Accreditation and Scope of Accreditation.

C. Test for fire endurance following ASTM E119, for fire rating, specified, in a nationally recognized laboratory.

D. Manufacturer's inspection and approval of surfaces to receive fireproofing.

E. Manufacturer's approval of fireproofing applications.

F. Manufacturer's approval of completed installation.

G. The manufacturer's representative is to observe and advise at the commencement of application and is required to visit the site as required thereafter to ascertain proper application.

H. Pre-Application Test Area.

1. Apply a test area consisting of a typical overhead fireproofing installation, including not less than 15 feet of beam and deck.
   a. Apply to 1 column.
   b. Apply for the hourly ratings required in the construction documents.
2. Install in the location selected by the COR, for approval by the representative of the fireproofing material manufacturer and the COR.
3. Perform Bond test for cohesive and adhesive strength following ASTM E736 for each applied fireproofing design used.
4. Perform density test following ASTM E736 for each applied fireproofing design used.
5. Do not proceed in other areas until the installation of the test area has been completed and approved.
6. Keep the approved installation area open for observation as criteria for sprayed-on fireproofing.

1.7 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

B. ASTM International (ASTM):

C841-03(R2013).....Installation of Interior Lathing and Furring
C847-14.....Metal Lath
E84-14.....Surface Burning Characteristics of Building Materials
E119-12a .....Fire Tests of Building Construction and Materials
E605-93(R2011).....Thickness and Density of Sprayed Fire-Resistive Materials Applied to Structural Members
E736-00(R2011).....Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members
E759-92(R2011).....The Effect of Deflection on Sprayed Fire-Resistive Material Applied to Structural Members
E760-92(R2011).....Impact on Bonding of Sprayed Fire-Resistive Material Applied to Structural Members

E761-92(R2011).....Compressive Strength of Fire-Resistive Material Applied to Structural Members
E859-93(R2011).....Air Erosion of Sprayed Fire-Resistive Materials Applied to Structural Members
E937-93(R2011).....Corrosion of Steel by Sprayed Fire-Resistive Material Applied to Structural Members
E1042-02(R2014).....Acoustically, Absorptive Materials Applied by Trowel or Spray.
G21-13.....Determining Resistance of Synthetic Polymeric Materials to Fungi

C. Underwriters Laboratories, Inc. (UL):

Fire Resistance Directory...Latest Edition including Supplements

D. Warnock Hersey (WH):

Certification Listings.....Latest Edition

E. Factory Mutual System (FM):

Approval Guide.....Latest Edition including Supplements

F. Environmental Protection Agency (EPA):

40 CFR 59 (2014).....National Volatile Organic Compound Emission Standards for Consumer and Commercial Products

PART 2 - PRODUCTS

2.1 SPRAYED-ON FIREPROOFING:

A. ASTM E1042, Class (a), Category A.

1. Type I, factory mixed cementitious materials with approved aggregate.
2. Type II, factory mixed mineral fiber with integral inorganic binders minimum 15 lb. per cubic feet density per ASTM E605 test unless specified otherwise. Use in areas that are completely encased.

B. Materials containing asbestos are not permitted.

C. Fireproofing characteristics when applied in the thickness and density required to achieve the fire-rating specified.

	Characteristic	Test	Results
1.	Deflection	ASTM E759	No cracking, spalling, or delamination when backing to which it is applied has a deflection up to 1/120 in 10 ft.
2.	Corrosion-Resistance	ASTM E937	No promotion of corrosion of steel.
3.	Bond Impact	ASTM E760	No cracking, spalling, or delamination.
4.	Cohesion/Adhesion (Bond Strength)	ASTM E736	Minimum cohesive/adhesive strength of 200 lbf per sq. ft. for protected areas. 400 lbf per sq. ft. for exposed areas.
5.	Air Erosion	ASTM E859	Maximum gain weight of the collecting filter is 0.025 gm per sq. ft.
6.	Compressive Strength	ASTM E761	Minimum compressive strength 1000 psf.
7.	Surface Burning Characteristics with adhesive and sealer to be used	ASTM E84	Flame spread 25 or less smoke developed 50 or less
8.	Fungi Resistance	ASTM G21	Resistance to mold growth when inoculated with aspergillus niger (28 days for general application)

2.2 ADHESIVE:

A. Bonding adhesive for Type II (fibrous) materials as recommended and supplied by the fireproofing material manufacturer.

B. The adhesive may be an integral part of the material or applied separately to the surface receiving fireproofing material.

2.3 SEALER:

A. Sealer for Type II (fibrous) material as recommended and supplied by the fireproofing material manufacturer.

B. Surface burning characteristics as specified for fireproofing material.

C. Fungus resistant.

D. Sealer may be an integral part of the material or applied separately to the exposed surface. When applied separately use a contrasting color pigmented sealer, white preferred.

E. VOC content: Product to comply with VOC content limits of authorities having jurisdiction and the following VOC limits when calculated according to 40 CFR 59, (EPA Method 24):

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 150 g/L.
3. Primers, Sealers, and Undercoaters: 200 g/L.

2.4 WATER:

A. Clean, fresh, and free from organic and mineral impurities.

B. pH of 6.9 to 7.1.

2.5 MECHANICAL BOND MATERIAL:

A. Expanded Metal Lath: ASTM C847, minimum weight of 1.7 pounds per square yard or as required, according to fire-resistance designs indicated and fireproofing manufacturer's written instructions.

B. Fasteners: ASTM C841.

C. Reinforcing Fabric: Glass- or carbon-fiber fabric of type, weight, and form required to comply with fire-resistance designs indicated; approved and provided by the fireproofing manufacturer.

D. Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with fire-resistance design indicated; approved and provided by the fireproofing manufacturer. Include pins and attachments.

PART 3 – EXECUTION

3.1 EXAMINATION:

A. Verify surfaces to receive fireproofing are clean and free of dust, soot, oil, grease, water-soluble materials, or any foreign substance which would prevent adhesion of the fireproofing material.

B. Verify hangers, inserts, and clips are installed before the application of fireproofing material.

C. Verify ductwork, piping, and other obstructing material and equipment are not installed that will interfere with fireproofing installation.

D. Verify concrete work on steel decking and concrete-encased steel is completed.

E. When applied in conjunction with roof structures or roof decks, verify that roofing, installation of rooftop equipment, and other related work are complete.

F. Verify temperature and enclosure conditions required by fireproofing material manufacturer.

G. Conduct tests according to fireproofing manufacturer's written instructions to verify that substrates are free of substances capable of interfering with bond. Submit test report.

3.2 APPLICATION:

A. Do not start the application until written approval has been obtained from the manufacturer of fireproofing materials that surfaces have been inspected by the manufacturer or his representative and are suitable to receive sprayed-on fireproofing.

B. Coordinate application of fireproofing material with other trades.

C. Cover other work and exterior openings subject to damage from fallout or overspray of fireproofing materials during application.

D. Application of Metal Lath:

1. Apply to beam and columns having painted surfaces that fail ASTM E736 Bond Test requirements in the pre-application test area.
2. Apply to beam flanges 12-inches or more in width.
3. Apply to column flanges 16-inches or more in width.
4. Apply to beam or column web 16-inches or more in depth.
5. Tack weld or a mechanically fasten-on maximum of 12-inch center.
6. Lap and tie lath member following ASTM C841.

E. Mix and apply per the manufacturer's instructions.

1. Mechanically control material and water ratios.
2. Apply adhesive and sealer, when not an integral part of the materials, per the manufacturer's instructions.
3. Apply to density and thickness indicated in UL Fire Resistance Directory, FM Approval Guide, or WH Certification Listings unless specified otherwise. Test following ASTM E119.
4. Minimum ASTM E605 applied dry density per cubic foot for the underside of the walk on deck (interstitial) hung purlin or beam and steel deck, columns in interstitial spaces, and mechanical equipment rooms to be as follows:
   a. Type I - 22 lb. per cubic ft.
   b. Type II - 15 lb. per cubic ft.
   c. Provide materials with a higher density of 40 lb. per cubic foot in mechanical rooms and parking garages.

F. A complete application is to be completed in one area. Inspection and approval by COR are required before removal of application equipment and proceeding with further work.

3.3 FIELD TESTS:

A. The applied fireproofing is to be tested by a COR-approved independent testing laboratory and paid for by the Contractor. Submit test reports documenting results of tests on the applied material in the project.

B. COR will select the area to be tested in specific bays on each floor using a geometric grid pattern. Apply a test sample every 10,000 square feet of floor area or 2 for each floor, whichever produces the greatest number of test areas.

C. Test for thickness and density following ASTM E605. Areas showing thickness less than that required because of the fire endurance test are not acceptable.

D. Areas showing less than required fireproofing characteristics are not suitable for the following field tests.

1. Test for cohesion/adhesion: ASTM E736.
2. Test for bond impact strength: ASTM E760.

3.4 PATCHING AND REPAIRING:

A. Inspect after mechanical, electrical, and other trades have completed work in contact with fireproofing material, but before sprayed material is covered by subsequent construction.

B. Perform corrective measures per fireproofing material manufacturer's recommendations.

1. Respray areas require additional fireproofing material to provide the required thickness and replace dislodged or removed material.
2. Spray material for patching by machine directly on point to be patched, or into a container and then hand apply.
3. Do not hand mix material.

C. Repair:

1. Respray test and rejected areas.
2. Patch fireproofing material that is removed or disturbed after approval.

D. Perform final inspection of sprayed areas after patching and repair.

3.5 SCHEDULE:

A. Apply fireproofing material in interior structural steel members and on the underside of interior steel floor and roof decks, except on the following surfaces:

1. Structural steel and underside of steel decks in elevator or dumbwaiter machine rooms.
2. Steel members in elevator hoistways.
3. Areas used as air handling plenums.
4. Steel to be encased in concrete or designated to receive another type of fireproofing.

Fire Rating Schedule			
Type	Element	Hourly Rating	UL Design Reference
//____//	Columns supporting one floor	//____//	//____//
//____//	Columns supporting more than one floor	//____//	//____//
//____//	Columns supporting roof	//____//	//____//
//____//	Floor decks	//____//	//____//
//____//	Floor supports	//____//	//____//
//____//	Roof decks	//____//	//____//
//____//	Roof supports	//____//	//____//

END OF SECTION

SECTION 07 84 00

FIRESTOPPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide UL or equivalent approved firestopping system for the closures of openings in walls, floors, and roof decks against penetration of flame, heat, and smoke or gases in fire-resistant rated construction.

B. Provide UL or equivalent approved firestopping system for the closure of openings in walls against penetration of gases or smoke in smoke partitions.

1.2 RELATED WORK

A. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS: Sustainable Design Requirements.

B. Section 07 95 13, EXPANSION JOINT COVER ASSEMBLIES: Expansion and seismic joint firestopping.

C. Section 07 81 00, APPLIED FIREPROOFING: Spray applied to fireproof.

D. Section 07 92 00, JOINT SEALANTS: Sealants and application.

1.3 SUBMITTALS

A. Submit per Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Sustainable Design Submittals, as described below:

1. Volatile organic compounds per volume as specified in PART 2 - PRODUCTS.

C. Installer qualifications.

D. Inspector qualifications.

E. Manufacturer’s literature, data, and installation instructions for types of firestopping and smoke stopping used.

F. List of FM, UL, or WH classification number of systems installed.

G. Certified laboratory test reports for ASTM E814 tests for systems not listed by FM, UL, or WH proposed for use.

H. Submit certificates from the manufacturer attesting that firestopping materials comply with the specified requirements.

1.4 DELIVERY AND STORAGE

A. Deliver materials in their original unopened containers with the manufacturer's name and product identification.

B. Store in a location protected from damage and exposure to the elements.

1.5 QUALITY ASSURANCE

A. FM, UL, WH, or other approved laboratory-tested products will be acceptable.

B. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991 or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements." Submit qualification data.

C. Inspector Qualifications: Contractor to engage a qualified inspector to perform inspections and final reports. The inspector to meet the criteria contained in ASTM E699 for agencies involved in quality assurance and to have a minimum of two years of experience in construction field inspections of firestopping systems, products, and assemblies. The inspector is to be completely independent of and divested from, the Contractor, the installer, the manufacturer, and the supplier of the material or item being inspected. Submit inspector qualifications.

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

B. ASTM International (ASTM):

E84-20	Surface Burning Characteristics of Building Materials
E699-16	Standard Specification for Agencies Involved in Testing, Quality Assurance, and Evaluating of Manufactured Building Components
E814-13a (2017)	Fire Tests of Penetration Firestop Systems
E2174-20a	Standard Practice for On-Site Inspection of Installed Firestop Systems
E2393-20	Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers

C. FM Global (FM): Annual Issue Approval Guide Building Materials

4991-13	Approval of Firestop Contractors

D. Annual Issue Fire Resistance Directory

723-Edition 11 (2018) ..... Standard for Test for Surface Burning Characteristics of Building Materials

1479-04 (2015) ..... Fire Tests of Penetration Firestops

E. Intertek Testing Services - Warnock Hersey (ITS-WH): Annual Issue Certification Listings

F. Environmental Protection Agency (EPA):

40 CFR 59 (2014) ..... National Volatile Organic Compound Emission Standards for Consumer and Commercial Products

PART 2 - PRODUCTS

2.1 FIRESTOP SYSTEMS

A. Provide either factory-built (Firestop Devices) or field erected (through-Penetration Firestop Systems) to form a specific building system maintaining the required integrity of the fire barrier and stopping the passage of gases or smoke. Firestop systems should accommodate building movements without impairing their integrity.

B. Through-penetration firestop systems and firestop devices tested following ASTM E814 or UL 1479 using the "F" or "T" rating to maintain the same rating and integrity as the fire barrier being sealed. "T" ratings are not required for penetrations smaller than or equal to 4 inches nominal pipe or 16 square inches in overall cross-sectional area.

C. Firestop sealants used for firestopping or smoke sealing have the following properties:

1. Contain no flammable or toxic solvents.
2. Release no dangerous or flammable outgassing during the drying or curing of products.
3. Water-resistant after drying or curing and unaffected by high humidity, condensation, or transient water exposure.
4. When installed in exposed areas, capable of being sanded and finished with similar surface treatments as used on the surrounding wall or floor surface.
5. VOC Content: Firestopping sealants and sealant primers to comply with the following limits for VOC content when calculated according to 40 CFR 59, (EPA Method 24):
   a. Sealants: 250 g/L.
   b. Sealant Primers for Nonporous Substrates: 250 g/L.
   c. Sealant Primers for Porous Substrates: 775 g/L.

D. Firestopping systems or devices used for penetrations by glass pipe, plastic pipe or conduits, unenclosed cables, or other non-metallic materials have the following properties:

1. Classified for use with the particular type of penetrating material used.
2. Penetrations containing loose electrical cables, computer data cables, and communications cables are protected using firestopping systems that allow unrestricted cable changes without damage to the seal.

E. Maximum flame spread of 25 and smoke development of 50 when tested following ASTM E84 or UL 723. Material to be an approved firestopping material as listed in UL Fire Resistance Directory or by a nationally recognized testing laboratory.

F. FM, UL, or WH rated or tested by an approved laboratory following ASTM E814.

G. Materials to be nontoxic and noncarcinogen at all stages of application or during fire conditions and do not contain hazardous chemicals. Provide firestop material that is free from Ethylene Glycol, PCB, MEK, and asbestos.

H. For firestopping exposed to view, traffic, moisture, and physical damage, provide products that do not deteriorate when exposed to these conditions.

1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
2. For floor penetrations with annular spaces exceeding 4 inches or more in width and exposed to possible loading and traffic, provide firestop systems capable of supporting the floor loads involved either by installing floor plates or by other means acceptable to the firestop manufacturer.
3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

2.2 SMOKE STOPPING IN SMOKE PARTITIONS

A. Provide silicone sealant in smoke partitions as specified in Section 07 92 00, JOINT SEALANTS.

B. Provide mineral fiber filler and bond breaker behind sealant.

C. Sealants have a maximum flame spread of 25 and smoke developed of 50 when tested following ASTM E84.

D. When used in exposed areas capable of being sanded and finished with similar surface treatments as used on the surrounding wall or floor surface.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Submit product data and installation instructions, as required by article, submittals, after an on-site examination of areas to receive firestopping.

B. Examine substrates and conditions with the installer present for compliance with requirements for opening configuration, penetrating items, substrates, and other conditions affecting the performance of firestopping. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove dirt, grease, oil, laitance, and form-release agents from concrete, loose materials, or other substances that prevent adherence and bonding or application of the firestopping or smoke-stopping materials.

B. Remove insulation on the insulated pipe for 6 inches on each side of the fire-rated assembly before applying the firestopping materials unless the firestopping materials are tested and approved for use on insulated pipes.

C. Prime substrates where required by joint firestopping system manufacturers using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

D. Masking Tape: Apply masking tape to prevent firestopping from contacting adjoining surfaces that will remain exposed upon completion of work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestopping materials. Remove tape as soon as it is possible to do so without disturbing the seal of firestopping with substrates.

3.3 INSTALLATION

A. Do not begin firestopping work until the specified material data and installation instructions of the proposed firestopping systems have been submitted and approved.

B. Install firestopping systems with smoke stopping per FM, UL, WH, or other approved system details and installation instructions.

C. Install smoke-stopping seals in smoke partitions.

3.4 CLEAN-UP

A. As work on each floor is completed, remove materials, litter, and debris.

B. Clean up spills of liquid-type materials.

C. Clean off excess fill materials and sealants adjacent to openings and joints as work progresses by methods and with cleaning materials approved by manufacturers of firestopping products and of products in which openings and joints occur.

D. Protect firestopping during and after the curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at the time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated firestopping immediately and install new materials to provide firestopping complying with specified requirements.

3.5 INSPECTIONS AND ACCEPTANCE OF WORK

A. Do not conceal or enclose firestop assemblies until the inspection is complete and approved by the Contracting Officer Representative (COR).

B. Furnish service of an approved inspector to inspect firestopping following ASTM E2393 and ASTM E2174 for firestop inspection, and document inspection results. Submit written reports indicating locations of and types of penetrations and type of firestopping used at each location; type is to be recorded by UL listed printed numbers.

END OF SECTION

SECTION 07 92 00

JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including Division 1 Specification Sections, apply to work of this Section.

1.2 SECTION INCLUDES

A. Interior Joint Sealers

B. Exterior Joint Sealers

1.3 SUBMITTALS

A. Refer to Division 1 of the specifications for submittal procedures.

B. Low Emitting Materials:

1. Submit a certification statement on company letterhead specific to products supplied on this project that clearly states the VOC levels of sealants used during construction inside the building envelope and that they do not exceed levels per LEED™.
2. Submit a certification statement on company letterhead specific to products supplied on this project that clearly states the VOC levels of primers used during construction inside the building envelope and that they do not exceed levels per LEED ™.

C. Product data for each product specified.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this Section with a minimum of 5 years experience.

B. Applicator Qualifications: Company specializing in performing the work of this Section with a minimum of 5 years experience.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

1.6 COORDINATION

A. Coordinate the work with all Sections referencing this Section.

1.7 GUARANTEE

A. The Contractor shall guarantee the sealant installation for 5 years against defects in installed materials and workmanship including a 5-year watertight warranty. Correct any sealant that is found to be defective, improperly installed, or leaks within 5 years at no cost to the Owner.

PART 2 - PRODUCTS

2.1 SEALANTS

A. Type A - Exterior Joint Sealant: Silicon; ASTM C920, Type S, Grade NS, Class 50, Uses NT, M, G, A, and O; single component.

1. Color: Color as selected to match adjacent material, selected from the manufacturer's full range of available colors.
2. Product: Similar to 795 Silicone Building Sealant manufactured by Dow Corning.
3. Applications:
   a. Masonry control joints - (sand sealant to match mortar joint).
   b. Joints between window frames and adjacent construction - (match frame color).
   c. Joints between door and louver frames and adjacent construction - (match mortar color at brick veneer).
   d. Exposed joints in prefinished metal panels.

B. Type B - Exterior Joint Sealant: Polyurethane; ASTM C920, Type S, Grade NS, Class 25, Uses NT, M, G, A, and O.

1. Color: Color as selected to match adjacent material, selected from the manufacturer's full range of available colors.
2. Product: Dynatrol I XL single component or Dynatrol II two-component (as required to achieve required color) manufactured by Pecora, or approved.
3. Applications:
   a. Sealant for sheet metal reglet and flashing installation/joints.
   b. Exterior locations requiring a painted finish over the sealant.
   c. Other exterior joints for which no other sealant is indicated.

C. Type C - Exterior Metal Lap Joint Sealant: Butyl rubber, nondrying, non-skinning, non-curing.

1. Product: Similar to BC-158 Butyl Rubber Sealant manufactured by Pecora or approved.
2. Applications:
   a. Concealed sealant bead in lap joints for sheet metal work.
   b. Concealed sealant bead in lap joints in prefinished wall and roof panels
   c. Sealant for bedding door thresholds.
   d. Do not use in any location exposed to view or exposed to the sun.

D. Type D - General Purpose Interior Sealant: Siliconized acrylic emulsion latex; ASTM C834, single component, paintable.

1. Product: Similar to AC-20+ Silicone manufactured by Pecora or similar by Tremco or approved.
2. Color: Match color of adjacent materials; or as selected by Contracting Officer.
3. LEED™ Requirement - Low Emitting Materials Credit EQc4.1: VOC levels of sealants used during construction inside the building envelope shall not exceed 250 grams per liter.
4. Applications:
   a. Interior wall and ceiling control joints.
   b. Joints between interior door/relite frame and wall surfaces.
   c. Joints between the interior side of window frames and wall surfaces.
   d. Between GWB and other materials.
   e. Joints between counter backsplash and wall.
   f. Other interior joints for which no other type of sealant is indicated.

E. Type E - Plumbing Fixture/Tile Sealant: Neutral-curing silicone; ASTM C920, Class 50; single component, mildew resistant.

1. Product: Similar to 898 Sanitary Mildew Resistant Silicone Sealant manufactured by Pecora or approved.
2. Color: Match color of plumbing fixture or adjacent materials as approved by Contracting Officer.
3. LEED™ Requirement - Low Emitting Materials Credit EQc4.1: VOC levels of sealants used during construction inside the building envelope shall not exceed two-hundred-fifty (250) grams per liter.
4. Applications: Use for:
   a. Joints between plumbing fixtures and counter, floor, and wall surfaces.
   b. Interior joints in stone and ceramic tile or between tile and adjacent materials.

F. Type G – Exterior Concrete Pavement Joint Sealant: Polyurethane, single component, pourable grade, moisture-cured.

1. Color: Match concrete color.
2. Manufacturer/Product: Pecora Urexpan NR-201, or approved
3. Applications: Use for:
   a. Expansion, Contraction, and Construction joints in exterior concrete pavement.

2.3 ACCESSORIES

A. Primer: Non-staining type, recommended by sealant manufacturer to suit the application.

1. LEED™ Requirement - Low Emitting Materials Credit EQc4.2: VOC levels of primers used during construction inside the building envelope shall not exceed 750 grams per liter.

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

C. Joint Backing: Round closed cell foam rod compatible with sealant; type recommended by sealant manufacturer for type of sealant; ASTM D1667, oversized as recommended by sealant manufacturer.

D. Bond Breaker: Pressure-sensitive tape recommended by sealant manufacturer to suit the application.

PART 3 - EXECUTION

3.1 COORDINATION

A. Review, coordinate, and accommodate work of other trades that interface with, affect, or are affected by the work of this Section to facilitate the execution of the overall Work of this project in a coordinated and efficient manner.

B. Coordinate work sequence and installation with work of other trades to provide a weathertight installation at exterior applications.

3.2 EXAMINATION

A. Inspect the substrate surfaces and joint openings and confirm they are ready to receive sealant work.

B. Confirm that joint size, configuration, and conditions conform to the sealant manufacturer's requirements to achieve the manufacturer's published sealant performance.

C. Verify that joint backing and release tapes are recommended for use by the sealant manufacturer with the specified sealant.

D. Do not start sealant installation until substrate surfaces and joint openings conform to the sealant manufacturer’s requirements.

E. Start of sealant installation indicates installer’s acceptance and confirmation that substrate, joint openings, and conditions are in conformance with sealant manufacturer’s requirements.

3.3 PREPARATION

A. Thoroughly clean and prepare joint substrate surfaces per sealant manufacturer's instructions to achieve published sealant performance.

B. Remove loose materials and foreign matter which might impair the adhesion of the sealant.

C. Clean and prime joints per manufacturer's instructions.

D. Protect elements surrounding the work of this Section from damage or disfigurement.

3.4 INSTALLATION

A. Perform work per sealant manufacturer's requirements for preparation of surfaces and material installation instructions to achieve published sealant performance.

B. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by the manufacturer.

C. Install bond breaker where joint backing is not used.

D. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.

E. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

F. Tool joints concave.

3.5 CLEANING

A. Clean adjacent soiled surfaces.

3.6 PROTECTION OF FINISHED WORK

A. Protect sealants until cured.

END OF SECTION

SECTION 07 95 13

EXPANSION JOINT COVER ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Prefabricated floor, wall, and ceiling, seismic and building expansion joint assemblies.
   a. Metal plate covers at floor, wall, and ceiling joints.
   b. Elastomeric joint covers wall and ceiling joints.
   c. Preformed elastomeric sealant joint at interior floor and wall control joints.
   d. Exterior wall joints.

1.2 RELATED WORK

A. Section 05 50 00, METAL FABRICATIONS: Steel Plate Expansion Joint Covers.

1.3 APPLICABLE PUBLICATIONS

A. Comply with references to the extent specified in this Section.

B. American Society of Civil Engineers (ASCE):

ASCE/SEI 7-10 ..... Minimum Design Loads for Buildings and Other Structures.

C. ASTM International (ASTM):

A36/A36M-19 ..... Structural Steel.
A240/A240M-20 ..... Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
A283/A283M-18 ..... Low and Intermediate Tensile Strength Carbon Steel Plates.
A786/A786M-15 ..... Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
B36/B36M-18..... Brass, Plate, Sheet, Strip, and Rolled Bar.
B121/B121M-16..... Leaded Brass Plate, Sheet, Strip and Rolled Bar.
B209-14..... Aluminum and Aluminum-Alloy Sheet and Plate.
B209M-14 ..... Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
B221-14..... Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
B221M-13 ..... Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).
B455/B455M-20..... Copper-Zinc-Lead Alloy (Leaded-Brass) Extruded Shapes.
C864-05(2019) ..... Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.

D1187/D1187M-97(2018)...Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
E1399/E1399M-97(2017) ...Standard Test Method for Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems.
E1966-15(2019).....Standard Test Method for Fire-Resistive Joint Systems.

D. National Association of Architectural Metal Manufacturers (NAAMM):

AMP 500-06.....Metal Finishes Manual.

E. UL LLC (UL):

2079-15.....Standard for Tests for Fire Resistance of Building Joint Systems.

1.4 PREINSTALLATION MEETINGS

A. Conduct preinstallation meeting at project site minimum 30 days before beginning Work of this Section.

1. Required Participants:
   a. Contracting Officer's Representative.
   b. Architect Engineer.
   c. Inspection and Testing Agency.
   d. Contractor.
   e. Installer.
   f. Manufacturer's field representative.
   g. Other installers are responsible for adjacent and intersecting work.
2. Meeting Agenda: Distribute the agenda to participants a minimum of 3 days before the meeting.
   a. Installation schedule.
   b. Installation sequence.
   c. Preparatory work.
   d. Protection before, during, and after installation.
   e. Installation.
   f. Terminations.
   g. Transitions and connections to other work.
   h. Other items affecting successful completion.
3. Document and distribute meeting minutes to participants to record decisions affecting the installation.

1.5 SUBMITTALS

A. Submittal Procedures: Section 01 33 23, SUBMITTAL PROCEDURES.

B. Submittal Drawings:

1. Include large-scale details indicating profiles of each type of expansion joint cover, splice joints between joint sections, transitions to other assemblies, terminations, anchorages, fasteners, and relationship to adjoining work and finishes.

2. Show size, configuration, fabrication, and installation details.
3. Include composite drawings showing work specified in other Sections coordinated with expansion joints.

B. Manufacturer's Literature and Data:

1. Description of each product specified.
2. Show movement capability of each cover assembly and suitability of material used in exterior seals for ultraviolet exposure.
3. Description of materials and finishes.
4. Installation instructions.

C. Samples: Submit 12-inch-long samples.

1. Each type and color of metal finish for each required thickness and alloy.
2. Each type and color of the flexible seal.

D. Sustainable Construction Submittals:

1. Recycled Content: Identify post-consumer and pre-consumer recycled content percentage by weight.
2. Low Pollutant-Emitting Materials:
   a. Identify volatile organic compound types and quantities.

E. Qualifications: Substantiate qualifications comply with specifications.

1. Installer with project experience list.

F. Certificates: Indicate products comply with specifications.

1. Fire-rated expansion joint cover assemblies.

G. Operation and Maintenance Data:

1. Care instructions for each exposed finish product.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

1. Regularly installs specified products.
2. Installed specified products with satisfactory service on five similar installations for a minimum of five years.
   a. Project Experience List: Provide contact names and addresses for completed projects.

1.7 DELIVERY

A. Deliver products in manufacturer's original sealed packaging.

B. Mark packaging, legibly. Indicate the manufacturer's name or brand, type, color, and manufacture date.

C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

1.8 STORAGE AND HANDLING

A. Store products indoors in a dry, weathertight facility.

B. Protect products from damage during handling and construction operations.

1.9 FIELD CONDITIONS

A. Field Measurements: Verify field conditions affecting expansion joint cover assembly fabrication and installation. Show field measurements on Submittal Drawings.

1. Coordinate field measurement and fabrication schedule to avoid delay.

1.10 WARRANTY

A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Provide joint cover assemblies that permit unrestrained movement of joint without disengagement of cover, and, where applicable, maintain moisture, watertight, and fire-rated protection.

B. Provide templates to related trades for the location of support and anchorage items.

2.2 SYSTEM PERFORMANCE

A. Design expansion joint cover assemblies complying with specified performance.

B. Joint Movement: ASTM E1399.

1. Minimum Movement Capability: 25 percent.
2. Movement Type: Thermal and wind and seismic.

C. Floor Joints: Live loads, including rolling loads.

1. Load Resistance: ASCE/SEI 7; Design criteria as indicated on Drawings.
2. Maximum Deflection: 1/360 of span, maximum.

D. Fire Rated Joints: ASTM E1399, ASTM E1966, or UL 2079, including hose stream test at full-rated period.

1. Fire rating: Match adjacent floor, wall, and ceiling construction.
2. System: Capable of anticipated movement while maintaining fire rating.
3. Coverless Applications: Maintain fire rating without a joint cover system.

2.3 MATERIALS

A. Stainless Steel: ASTM A240/A240M, Type 302 or 304.

B. Structural Steel Shapes: ASTM A36/A36M.

C. Steel Plate: ASTM A283/A283M, Grade C.

D. Rolled Steel Floor Plate: ASTM A786/A786M.

E. Aluminum:

1. Extruded: ASTM B221M (ASTM B221), alloy 6063-T5, 6063-T6, or 6061-T6.
2. Plate and Sheet: ASTM B209M (ASTM B209), alloy 6061-T6.

F. Bronze: Manufacturer's standard alloy.

1. Extruded: ASTM B455.
2. Plate: ASTM B121.

G. Brass: ASTM B36/B36M.

H. Elastomeric Sealant: As specified in Section 07 92 00, JOINT SEALANTS.

I. Elastomeric Seals:

J. Flexible extruded polyvinyl chloride, meeting a Shore A hardness of 75 with UV stabilizer. Manufacturer's standard colors.

K. Thermoplastic Rubber:

1. ASTM C864.
2. Dense Neoprene or another material standard with expansion joint manufacturers having the same physical properties.

L. Compression Seals: Pre-compressed secondary sealant using preformed expanding foam sealant; open-cell polyurethane foam impregnated with polymer-modified acrylic adhesive.

M. Water Barrier Sheets: Neoprene or EPDM flexible sheet materials minimum 45 mils thick.

1. Provide drain tubes for horizontal applications.

N. Vinyl Invertor Sealant Waterstops: Manufacturer's standard shapes and grade.

O. Moisture Barrier: Fabric reinforced clear vinyl sheet material sized to accommodate opening.

P. Flexible Membrane: 1.5 mm (60 mils) EPDM sheet, with manufacturer's standard support foam.

Q. Fire Barrier: Labeled by an approved independent testing laboratory for fire resistance ratings indicated for maximum joint width.

1 Thermal Insulation: Manufacturer's standard with factory cut miters and transitions.
2 Fire Barrier Lengths:
a. Joint widths up to and including 6 inches: Maximum 50 feet to minimize field splicing.
b. Other Joint widths: 10 feet with overlapping ends for field splicing.

R. Ceramic Blanket: Manufacturer's standard joint filler to achieve fire rating indicated.

S. Butyl Caulk Tape: Self-adhering double-sided butyl rubber sealant tape with easy-release silicone coated paper.

2.4 PRODUCTS – GENERAL

A. Provide each product from one manufacturer.

1. Provide ceiling and wall expansion joint cover assemblies design matching floor to wall and floor to floor expansion joint cover design.
2. Provide expansion joint cover assembly designs, profiles, materials, and configuration indicated, as required to accommodate joint size variations in adjacent surfaces and anticipated movement.

B. Sustainable Construction Requirements:

1. Steel Recycled Content: 30 percent total recycled content, minimum.
2. Stainless Steel Recycled Content: 70 percent total recycled content, minimum.
3. Aluminum Recycled Content: 80 percent total recycled content, minimum.
4. Low Pollutant-Emitting Materials: Maximum VOC content by weight.
a. Non-Flooring Adhesives and Sealants.

2.5 FABRICATION

A. Fabricate Expansion Joint Cover Assemblies:

1. As the complete assembly, it is ready for installation.
2. In longest practicable lengths to minimize the number of end joints.
3. With factory mitered corners where joint changes directions or abuts other materials.
a. With closure materials and transition pieces, tee-joints, corners, curbs, cross-connections, and other assemblies.

4. Joints within enclosed spaces such as chase walls include a 1 mm (0.04 inch) thick galvanized steel cover where conventional expansion joint cover is not used.
5. Where the floor slab is fire rated provide a ceramic blanket at joints.
6. Seal Strip: Factory-formed and bonded to metal frames and anchor members.
7. Compression Seals: Fabricate from expanding foam as a secondary seal and elastomeric sealant to sizes and profiles shown.

B. Floor-to-Floor Metal Plate Joints:

1. Frames: Metal, continuous on both sides of joint designed to support cover plate.
   a. Flush Design: Seating surface and raised floor rim to accommodate adjacent flooring.
   b. Anchorage: Concealed bolt and steel anchors for embedment in concrete.
2. Cover Plate: Metal, matching frames where exposed.
   a. Supported Load: 400 psf, minimum.
   b. Rattle-free due to traffic.
3. Fillers: Resilient material between the raised rim of the frame and edge of the cover plate, where shown.
   a. No gaps or bulges over full design range joint movement.
4. Fire Barrier: As required for a fire-resistance rating.
5. Water Stop: Manufacturer's standard, continuous, the full length of joint.
6. Seismic: As required by Code.

C. Floor-to-Wall Metal Plate Joints:

1. Frames: Metal, continuous on the floor side of joint only.
   a. Provide wall side frame where required by manufacturer's design.
2. Cover Plates: Angle cover plates with the countersunk flat-head exposed fasteners for securing the cover plate to the wall unless shown otherwise.
   a. Fastener Spacing: As recommended by the manufacturer.
3. Joint Design: Match adjacent floor to floor design.
4. Fire Barrier: As required for a fire-resistance rating.
5. Water Stop: Manufacturer's standard, continuous, the full length of joint.
6. Seismic: As required by Code.

D. Interior Wall Joint Cover Assemblies:

1. Frame: Metal, surface mounted, concealed fastening to the wall on one side of joint.
2. Cover Plate: Metal, smooth surface, lap both sides of the joint and permitting free movement on one side.
   a. Fabricate with the concealed attachment of the cover to the frame when the cover is in close contact with the adjacent wall surface finish.
   b. Use angle cover plates at intersecting walls.
3. Joint Design: Match adjacent floor to floor design.
4. Fire Barrier: As required for a fire-resistance rating.
5. Seismic: As required by Code.

E. Exterior Wall Joint Assemblies:

1. Design seal for variable movement and prevention of water and air infiltration.
2. Frame: Metal, concealed, for fastening to the wall on one side of the joint.

3. Cover Plate: Metal, surface mounted, lap both sides of joint, permitting free movement on one side.
    a. Fabricate with the concealed attachment of the cover to frame for cover with cover in close contact with adjacent finish surfaces.
    b. Use angle cover plate at intersecting walls.
4. Water Seal: Vinyl seal strip as secondary seal behind the primary seal.
5. Seismic: As required by Code.

F. Extruded Thermoplastic Rubber Joint Assemblies:

1. Frames: Aluminum, both sides of joint.
2. Primary Seal: Flexible rubber on exposed face after frame installation with factory welded watertight miters and transitions.
    a. Anchor spaced at ends and not over 24 inches.
    b. Variable movement extruded rubber primary seal designed to remain in aluminum frame, throughout movement of joint.
    c. Flush mounted seal minimum 0.12 inch thick with dual movement grooves designed for plus or minus 50 percent, movement of joint width.
    d. Seismic seal minimum 0.12 inch thick with multi-movement grooves designed for plus or minus 100 percent movement of joint width.
    e. Recessed front face seals minimum 0.12 inch thick with no movement grooves, designed for plus or minus 50 percent movement of joint width.
    f. Provide pantographic wind load supports, maximum 8 feet on center to support seal systems of 12 inches wide and greater.
3. Secondary Seal: Continuous vinyl sheet seal.

G. Ceiling and Soffit Assemblies:

1. Frames: Metal, continuous on both sides of joint, flush-mounted with no exposed fasteners.
2. Flexible Insert: Variable movement semi-rigid vinyl locked into the frame.
    a. Face Style: Flush or accordion, as shown, to span joint width without sagging.
3. Seismic: As required by Code.

H. Garage Floor Joint Cover Plate:

1. Frame: Angle edge frame on both sides of joint, size as shown.
    a. Anchors: Stud bolts minimum 4 inches long and 3/8 inch diameter welded to angle spaced maximum 24 inches on center.
    b. Drill and top one frame for cover plate fasteners.
2. Cover Plate: Aluminum or steel cover plate minimum 3/8 inch thick with edges beveled, smooth finish, drilled for countersunk fasteners at ends and maximum 24 inches on center.
3. Seismic: As required by Code.

I. Preformed Sealant Joint: Factory installed elastomeric sealant between extruded aluminum angle frame on both sides.

1. Frames: Extruded aluminum angle on both sides of joint.
2. Filler: Elastomeric sealant.
3. Anticipated movement: 25 percent maximum.

2.6 FINISHES

A. Carbon Steel: NAAMM AMP 500, Galvanized G90.

B. Stainless Steel: NAAMM AMP 500, No. 2B bright finish.

C. Aluminum Anodized Finish: NAAMM AMP 500.

1. Clear Anodized Finish: AA-C22A41; Class I Architectural, 0.018 mm (0.7 mil) thick.
2. Color Anodized Finish: AA-C22A42 or AA-C22A44; Class I Architectural, 0.018 mm (0.7 mil) thick.

D. Aluminum Paint Finish:

1. Fluorocarbon Finish: AAMA 2605; 70 percent fluoropolymer resin, 2-coat system.
2. Fluorocarbon Finish: AAMA 605; 70 percent fluoropolymer resin, 2-coat system.

E. Bronze Finish: NAAMM-AMP 500, M32 mechanical finish, directional textured, natural medium satin.

2.7 ACCESSORIES

A. General: Manufacturer's standard anchors, fasteners, set screws, spaces, protective coating, filler materials, adhesive, and other accessories required for installation.

B. Barrier Coating: ASTM D1187/D1187M.

C. Adhesives: Low pollutant-emitting, water-based type recommended by the adhered product manufacturer for each application.

D. Fasteners: Type and size recommended by expansion joint cover assembly manufacturer.

1. Exterior Applications: Stainless steel.
2. Fasteners for Aluminum: Stainless steel.
3. Other Applications: Galvanized steel or stainless steel.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine and verify substrate suitability for product installation.

1. Provide items embedded in concrete and masonry in time for building into work without delaying work.

B. Protect existing construction and completed work from damage.

C. Apply barrier coating to aluminum, brass, bronze, and steel surfaces in contact with dissimilar metals and cementitious materials to a minimum of 0.7 mm (30 mils) dry film thickness.

3.2 INSTALLATION

A. Install products according to manufacturer's instructions and approved submittal drawings.

1. When the manufacturer's instructions deviate from specifications, submit a proposed resolution for Contracting Officer's Representative consideration.

B. Install anchorage devices and fasteners for securing expansion joint assemblies to in-place construction where anchors are not embedded in concrete and masonry.

1. Secure with metal fasteners, type, and size to suit the application.

C. Perform cutting, drilling, and fitting required for installation of expansion joint cover assemblies.

D. Install joint cover assemblies aligned and positioned in correct relationship to expansion joint opening and adjoining finished surfaces measured from established lines and levels.

1. Allow for thermal expansion and contraction of metal to avoid buckling.
2. Accommodate joint opening size at the time of installation.

E. Set floor covers at elevations flush with adjacent finished flooring unless shown otherwise.

F. Grout floor frames are set in prepared recesses.

G. Locate wall, ceiling, and soffit covers in continuous contact with adjacent surfaces. Secure with required accessories.

H. Locate anchors at the interval recommended by the manufacturer, but a minimum of 3 inches from each end, and a maximum of 24 inches on centers.

I. Maintain continuity of expansion joint cover assemblies with end joints held to a minimum and metal members aligned mechanically using splice joints.

J. Cut and fit ends to accommodate thermal expansion and contraction of metal to avoid buckling of frames and cover plates.

K. Flush Metal Cover Plates:

1. Secure flexible filler between frames to allow compression and expansion.
2. Adhere flexible filler materials to frames with adhesive or pressure-sensitive tape as recommended by the manufacturer.

L. Waterstops:

1. Install in conjunction with floor joints, and where shown.
2. Install continuously to prevent water damage to finish spaces.
3. Seal waterstop to frames to prevent water leakage.
4. Install drainage tubes from waterstops to discharge collected water in the nearest plumbing air gap drain.

M. Fire Barriers:

1. Install in compliance with tested assembly.
2. Install at joints in floors and fire-rated walls.
3. Use fire barrier sealant furnished with expansion joint assembly.

N. Apply sealant where required to prevent water and air infiltration.

O. Vertical Exterior Extruded Thermoplastic Rubber.

1. Install side frames mounted on sealant or butyl caulk tape with appropriate anchors 24 inches on center complete with a secondary seal.
2. Install primary seals retained in extruded aluminum side frames.

P. Extruded Thermoplastic Rubber or Seals:

1. For straight sections, install preformed seals in continuous lengths.
2. Vulcanize or heat-seal field spliced joints to provide watertight joints as recommended by the manufacturer.

Q. Preformed Elastomeric Sealant Joint:

1. Locate joints directly over joints in wall and floor substrates.
2. Fasten full length to the substrate using construction adhesive.
3. Install flush or slightly below finishes material.

3.3 CLEANING

A. Remove excess adhesive before adhesive sets.

B. Clean exposed metal surfaces. Remove contaminants and stains.

3.4 PROTECTION

A. Cover floor joints with plywood where wheel traffic occurs before Substantial completion.

B. Remove protective covering when adjacent work areas are completed. Clean exposed surfaces in compliance with the manufacturer's printed instructions.

END OF SECTION

DIVISION 08

OPENINGS

SECTION 08 11 13

HOLLOW METAL DOORS & FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

A. Exterior Hollow Metal Doors and Frames

B. Hollow Metal Relite, Sidelite, and Borrowed Lite Frames

1.3 REFERENCES

A. All references shall be the latest adopted edition unless noted otherwise.

B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frame Anchors and Hardware Reinforcing's.

C. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.

D. ANSI/SDI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.

E. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.

F. ASTM A568 - Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.

G. ASTM A591 - Specification for Steel Sheet, Electrolytic Zinc-Coated, for Light Coating Mass Applications.

H. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

I. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.

J. ASTM A1008 - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.

K. ASTM A1011 - Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability

L. ASTM C476 - Standard Specification for Grout for Masonry

M. DHI A115.1G - Installation Guide for Doors and Hardware; Door and Hardware Institute.

N. IBC - International Building Code, 2012 Edition.

O. NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.

P. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies

Q. SDI 111-D - Door, Frame and Hardware Schedule for Standard Steel Doors and Frames.

R. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies.

S. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.

1.4 SUBMITTALS

A. Product Data: Provide manufacturer's product literature and standard details.

1. Provide the manufacturer’s technical data sheet on each different type of anchor and hardware reinforcement required.

B. Shop Drawings: Provide elevation and details of each different frame and door type, including frame anchors, glass stops, vision panels, and special conditions.

C. Door Schedule: Provide frame, and hardware schedule on format matching SDI 111-D per Door Schedule included on Drawings.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Provide all products from a single manufacturer who is a member of the Steel Door Institute.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect products from moisture, construction traffic, and damage.

B. Store vertically under cover. Do not use non-vented plastic or canvas shelters. Should wrappers become wet, remove them immediately.

C. Place units on 4-inch high wood sills or in a manner that will prevent rust or damage. Provide 1/4 inch space between doors to promote air circulation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Manufacturers: Member of Steel Door Institute with products conforming to these specifications.

B. Steel Sheet for Doors and Frames:

1. Cold Rolled Steel: ASTM A1008 and ASTM A586.
2. Hot Rolled Steel: Pickled and oiled, ASTM A1011 and ASTM A586.
3. Galvanized Steel: ASTM A924 and A653; hot-dipped zinc-coated steel.

C. Steel Sheet for Anchors and Accessories: Electrolytically deposited zinc-coated steel; ASTM A 591/A 591M, coating 40Z (12G), minimum.

2.2 HOLLOW METAL (HM) DOORS AND FRAMES

A. Frames: ANSI/SDI A250.8 Level 3 is the minimum performance standard; special requirements in this Section exceed these minimum requirements:

1. Frames: 16 gauge steel sheet, fabricated to size, profile, and configuration shown on Drawings.
2. Frame Construction:
   a. Face weld corners, grind welds flush and smooth.
   b. Fabricate knock-down frames with mitered or coped corners, for field assembly in the remodel areas of the project.
3. Reinforcement For Hardware: Conform to ANSI/SDI A250.6 and the following special requirements:
   a. Hinge Reinforcement: Provide 7 gauge hinge reinforcement indoors, the full width of the frame (lesser gauge with equivalent threads is not acceptable). Weld reinforcement securely to frame.
   b. Floor Anchors: Provide 14 gauge floor anchors on all frames, the full width of the frame, securely welded to the foot of each frame leg, with 2 holes in each anchor for floor attachment.
   c. Closer: Provide reinforcement sleeve full width of the frame, formed to match frame profile.
4. Holes For Silencers: Drill stops to receive rubber silencers on frames not scheduled for weatherstripping or smoke gasket.
5. Glazed Lights in Frames: Provide rolled steel channel shape glazing stops prepared for countersunk oval head screws and butted corners.
6. Exterior Frames: Galvanized steel.
   a. Install a Pemko 346C Overhead Rain Drip on each exterior frame head. Length shall be 4” longer than the door width.
7. Frames In Concrete/Masonry Walls or Grouted Frames: Coat interior surfaces of the frame with asphalt mastic.
   a. Provide grout guards at hardware locations.

B. Doors: ANSI/SDI A250.8 Level 2 – Heavy-Duty, Model 2 – Seamless is the minimum performance standard; special requirements in this Section exceed these minimum requirements:

1. Regular Use Doors: 18 gauge sheet steel, fabricated to size and configuration shown on Drawings.
2. Hardware Reinforcement: Conform to ANSI/SDI A250.6.
3. Door Construction:
    a. Face: Full flush, no seams.
    b. Edge Seam: Seamless, continuously welded, and ground smooth.
    c. Edge Bevel: Bevel strike side.
    d. Hinge Cutouts: Provide handed hinge cutouts for door swing (non-handed doors with hinge fillers are not allowed).
    e. Edge Reinforcement Channels: Provide doors with full height 14 gauge steel lock channels (rails) and 12 gauge steel hinge channels (rails) concealed in the construction of the door and securely welded to both faces.
4. Door Core:
    a. Interior Doors: Honeycomb cores.
    b. Exterior Doors: Insulated core with U-value of at least 0.060 when tested following SDI 113.
    c. Fire Rated Doors: Cores per listed construction.
5. Exterior Door Tops: Invert reinforcement channel to prevent place for water to collect and seal the top of door watertight.
6. Door Undercuts: Provide undercuts to accommodate door hardware provided by Section 08 87 00 - Glazing Surface Films and as required by applicable codes.
7. Door Vision Panels Frames: Fabricated steel frame with mitered corners designed to securely hold glazing and meet fire door requirements, prime painted.
8. Exterior Doors: Galvanized steel.

C. Fire-Rated Openings: Comply with Section 715 of the IBC; door and frame assembly shall conform to the test requirements of NFPA 252 or UL10C and shall be listed by a code-approved third-party testing agency.

1. Affix permanent metal labels to both door and frame conforming to NFPA 80 attesting to fire resistance.
2. Doors shall be tested and labeled to meet the requirements of UL 1784 and the fire label shall include the "S" endorsement.

D. Solid Grout: USG Structolite plaster or as approved by Contracting Officer.

2.3 FABRICATION

A. Fabricate steel doors and frames to sizes and profiles shown on the Drawings in conformance to the requirements of this Section, ANSI/SDI A250.6, ANSI/SDI A250.8, and fire listing requirements.

B. Prepare and reinforce steel doors and frames to receive door hardware specified in Section 08 71 00.

C. Finish:

1. Factory Prime Paint Finish: Prime paint all surfaces of doors and frames under controlled conditions at the factory.
   a. Doors and frames shall be thoroughly cleaned, and chemically treated to ensure maximum paint adhesion.
   b. 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.
   c. The finish shall meet the requirements for acceptance stated in ANSI/SDI A250.10.
2. Shop Prime Paint Touch-Up: Repair any factory-applied prime paint damaged by shipping or by shop modifications to doors/frames.
   a. Surface preparation, prime paint, and application shall conform to factory finishing standards and be compatible with field painting applied by others.
   b. The finish shall meet the requirements for acceptance stated in ANSI/SDI A250.10.

2.4 DOOR & FRAME CLEARANCES

A. Door and frame clearances shall conform to ANSI/SDI A250.8, 2.06, and fire listing requirements on fire-rated doors.

PART 3 - EXECUTION

3.1 COORDINATION

A. Review, coordinate, and accommodate work of other trades that interface with, affect, or are affected by the work of this Section to facilitate the execution of the overall Work of this project in a coordinated and efficient manner.

B. Coordinate the size and layout of reinforcement and preparation for door hardware with Section 08 87 00.

3.2 EXAMINATION

A. Verify that project conditions are suitable before beginning the installation of frames.

B. Correct unsatisfactory conditions before proceeding with the installation.

3.3 SOLID GROUTING FRAMES

A. Solid grout frames with Structolite before installing, leave space for GWB to be inserted full depth behind the frame.

1. Frames in masonry shall be filled with mortar as the masonry wall is constructed.

3.4 INSTALLATION

A. Install frames plumb, level, rigid, and in true alignment as recommended in ANSI/SDI 250.11, NFPA 80, DHI A115.1G, and per fire labeling requirements on fire-rated openings.

B. Secure frame floor anchors to floor with steel anchors/screw of size, length, and type appropriate for secure attachment to substrate material, 2 anchors per jamb anchor.

C. Exposed Jamb Anchor Screws: Grind the head of the screw flush with the frame and fill with polyester patching/filling compound (body filler) and sand surface flush and smooth to conceal screw and dimple.

D. Coordinate installation of glazing stops and vision panel frames by Section 08 80 00 - Glazing.

E. Install doors plumb and in true alignment and fasten to achieve the maximum operational effectiveness and appearance of the unit. Maintain clearances specified in ANSI/SDI 250.8, on fire-rated doors conform to NFPA 80 and door listing requirements.

3.5 ADJUST AND CLEAN

A. Adjust doors for proper operation, free from binding or other defects.

B. Clean and restore soiled surfaces. Remove scraps and debris and leave the site and a clean condition.

3.6 SCHEDULE – REFER TO DRAWINGS

END OF SECTION

SECTION 08 14 00

WOOD DOORS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including Division 1 Specification Sections apply to work of this Section.

1.2 SECTION INCLUDES

A. Interior wood doors with Plastic laminate faces.

1.3 SUBMITTALS

A. See Section 01 33 23 for submittal procedures.

B. Product Data: Indicate door core materials and construction; veneer species, type, and characteristics.

C. Shop Drawings: Illustrate door opening criteria, elevations, sizes, types, swings, undercuts required, special beveling, factory finishing criteria, and identify cutouts for glazing.

1.4 QUALITY ASSURANCE

A. Perform work following AWI Quality Standards, Section 1300, Custom Grade.

1.5 DELIVERY, STORAGE, AND PROTECTION

A. Package, deliver, and store doors following AWI Section 1300.

B. Accept doors on site in manufacturer's packaging. Inspect for damage.

C. Protect doors with individual resilient packaging. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored for more than one week. Break the seal on-site to permit ventilation.

1.6 PROJECT CONDITIONS

A. Coordinate the work with door opening construction, door frame, and door hardware installation.

1.7 WARRANTY

A. Provide warranty for the following term:

1. Interior Doors: Life of installation.

B. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Algoma Hardwoods Inc.

B. Ampco Products, Inc.

C. Buell Door Company.

D. Eggers Industries; Architectural Door Division.

E. GRAHAM Manufacturing Corp.

F. VT Industries Inc.

G. Other manufacturers are acceptable subject to compliance with specifications.

2.2 DOOR TYPES

A. Flush Doors: 1-3/8 inches thick; hollow core construction.

2.3 DOOR CORES

A. Non-Rated Solid Core Doors: AWI Section 1300, Type PC - Particleboard bonded to stiles and rails.

2.4 DOOR FACINGS

A. Plastic Laminate

2.5 ACCESSORIES

A. Metal Vision Panel Frames for Glazing: Similar to Anemostat FGS-75, prime painted steel ready for field finishing by Section 09 90 00. Frames shall be listed to meet or exceed the fire rating of the door in which they are installed.

2.6 FABRICATION

A. Fabricate doors following AWI Quality Standards requirements.

B. Fabricate fire-rated doors following UL requirements. Attach fire rating label to door.

C. Fit door edge trim to edge of stiles after applying veneer facing.

D. Bond edge banding to cores.

E. Factory machine doors for finish hardware per hardware requirements and dimensions. Do not machine for surface hardware.

F. Door Undercuts: Provide undercuts to accommodate door hardware provided by Section 08 71 00 and as required by applicable codes.

G. Factory fit doors for frame opening dimensions.

H. Provide edge clearances following AWI 1600.

2.7 FINISH

A. Plastic laminate complying with NEMA LD 3 Grade HGS

PART 3 EXECUTION

3.1 COORDINATION

A. Review, coordinate, and accommodate work of other trades that interface with, affect, or are affected by the work of this Section to facilitate the execution of the overall Work of this project in a coordinated and efficient manner. Make minor revisions not affecting function, performance, or architectural appearance so that other trades can complete their work without delay or unreasonable hardship.

3.2 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Do not install doors in frame openings that are not plumb or are out of tolerance for size or alignment.

D. Beginning of installation indicates acceptance of frame installation and conditions.

3.3 INSTALLATION

A. Install doors following manufacturer's instructions and AWI Quality Standards requirements.

B. Installation of doors in knockdown metal frames (KDM) is specified in Section 08 11 13 – Hollow Metal Doors and Frames.

C. Trim door height by cutting bottom edges to a maximum of 3/4 inch (19 mm).

1. Trim fire door height at the bottom edge only, per fire rating requirements.

D. Machine cut for hardware.

E. Coordinate installation of doors with the installation of frames specified in Sections 08 11 13 and hardware specified in Section 08 71 00.

F. Coordinate installation of glass and glazing.

3.4 ADJUSTING

A. Adjust doors for smooth and balanced door movement.

B. Adjust closers for full closure.

3.5 SCHEDULE - SEE DRAWINGS

END OF SECTION

SECTION 08 31 00

ACCESS DOORS & PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included: Provide factory-fabricated floor access doors (BILCO TYPE K) or equal.

1.2 SUBMITTALS

A. Product Data: Submit the manufacturer's product data.

B. Shop Drawings: Submit shop drawings including profiles, accessories, location, adjacent construction interface, and dimensions.

C. Warranty: Submit an executed copy of the manufacturer's standard warranty.

1.3 QUALITY ASSURANCE

A. Manufacturer: A minimum of 5 years of experience manufacturing similar products.

B. Installer: A minimum of 2 years of experience installing similar products.

C. Manufacturer's Quality System: Registered to ISO 9001 Quality Standards including in-house engineering for product design activities.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in the manufacturer's original packaging. Store materials in a dry, protected, well-vented area. Inspect product upon receipt and report damaged material immediately to delivering carrier and note such damage on the carrier's freight bill of lading.

1.5 WARRANTY

A. Manufacturer's Warranty: Provide manufacturer's standard warranty. Materials shall be free of defects in material and workmanship for five years from the date of purchase. Should a part fail to function in normal use within this period, the manufacturer shall furnish a new part at no charge.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Basis-of-Design Manufacturer: Type K Floor Access Door by The BILCO Company, P.O. Box 1203, New Haven, CT 06505, 1-800-366-6530, Fax: 1-203-535-1582, Web: www.bilco.com.

2.2 ACCESS DOOR

A. Furnish and install where indicated on plans vault access door Type KD and Type JD, size indicated on drawings. Length denotes hinge side. The floor access door shall be double-leaf and pre-assembled by the manufacturer.

B. Performance characteristics:

1. Cover: Shall be reinforced to support a minimum live load of 150 psf (732 kg/m2) with a maximum deflection of 1/150th of the span.
2. Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.
3. The operation of the cover shall not be affected by temperature.

C. Cover: Shall be 1/4” (6mm) aluminum diamond pattern plate.

D. Frame: Shall be extruded aluminum with strap anchors bolted to the exterior.

E. Hinges: Shall be specifically designed for horizontal installation and shall be bolted to the underside of the cover.

F. Lifting mechanisms: Cam-action hinges shall pivot on torsion bars to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and to act as a check-in retarding downward motion of the cover when closing.

G. A removable exterior turn/lift handle with a spring-loaded ball detent shall be provided to open the cover.

H. Hardware:

1. Hinges: Cast steel cam-action hinges that pivot on torsion bars shall be provided.
2. The cover shall be equipped with a steel hold open arm that automatically locks the cover in the open position.
3. The cover shall be fitted with the required number and size of torsion bars.
4. A Type 316 stainless steel snap lock with a fixed handle shall be mounted on the underside of the cover.
5. Hardware: Shall be zinc plated and chromate sealed. Type 316 stainless steel hardware is available for installation in corrosive environments.

I. Finishes: Factory finish shall be mill finish aluminum with a bituminous coating applied to the exterior of the frame.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and openings for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install products in strict accordance with manufacturer's instructions and approved submittals. Locate units' level, plumb, and in proper alignment with adjacent work.

1. Test units for proper function and adjust until the proper operation is achieved.
2. Repair finishes damaged during installation.
3. Restore finishes so no evidence remains of corrective work.

3.3 ADJUSTING AND CLEANING

A. Clean exposed surfaces using methods acceptable to the manufacturer which will not damage the finish.

END OF SECTION

SECTION 08 54 13

FIBERGLASS WINDOWS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including Division 1 Specification Sections apply to the work of this Section.

1.2 SECTION INCLUDES

A. Single-hung fiberglass windows

B. Fixed fiberglass windows

C. Awning fiberglass windows

1.3 REFERENCES

A. ASTM International

1. ASTM E283; Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
2. ASTM E330; Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights, and Curtain Walls by Uniform Static Pressure Difference
3. ASTM E331; Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
4. ASTM E547; Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Difference

B. National Fenestration Rating Council (NFRC)

1. NFRC 100; Procedure for Determining Fenestration Thermal Properties
2. NFRC 200; Solar Heat Gain Coefficient and Visible Transmittance

1.4 SUBMITTALS

A. Refer to Division 1 of the specifications for submittal procedures.

B. Product Data: Provide manufacturer's product literature and standard details.

1. Provide the manufacturer’s technical data sheet on each different type of anchor and hardware reinforcement required.

C. Shop Drawings: Provide elevation and details of each different window type, including frame anchors, glass stops, vision panels, and special conditions.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Provide all products from a single manufacturer who is a member of the American Architectural Manufacturers Association (AAMA) and the National Rated Fenestration Council.

B. Installer 5 years of continued experience in installing exterior windows.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect products from moisture, construction traffic, and damage.

B. Store vertically undercover. Comply with all manufacturer’s handling and storage requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Fiberglass: AAMA 305 glass fiber reinforced thermoset profile.

2.2 GENERAL PERFORMANCE REQUIREMENTS

A. Thermal Performance: Comply with NFRC 100.

B. Air Leakage, Water Resistance, Structural Test: Comply with ANSI/AAMA /NWWDA 101/I.S.2.

C. Forced-Entry Resistance: Comply with CAWM 301-90.

2.3 MANUFACTURER’S

A. Milgard Series Ultra™. Basis of Design.

B. Color: To be selected from one of the manufacturer’s standard colors

C. Other manufacturers are acceptable subject to compliance with the specifications.

2.4 WINDOW TYPES

A. Single-Hung, 1-3/8 inch (35 mm) nail fin setback.

1. Frame: Minimum 4-1/4 inch (108 mm) deep, multi-chambered fiberglass pultrusion.
2. Sash: Minimum 1-9/16 inch (39.7 mm) deep, multi-chambered fiberglass pultrusion.
3. Sightlines: Equal for operating and fixed sash.
4. Structural Class: H-C30.
5. Hardware:
   a. Concealed block and tackle balancer.
   b. Sash lift.
   c. Positive action locking mechanism.
6. Weatherstripping: Foam-filled seal and fin seal polypropylene pile.

B. Fixed - 1-3/8 inch (35 mm) nail fin setback.

1. Frame: Minimum 3-1/4 inch (83 mm) deep, multi-chambered fiberglass pultrusion.
2. Sightlines: Equal to operating windows
3. Structural Class: F-C50.

2.5 INSECT SCREEN

A. Provide a tight-fitting screen for operating sash with hardware to allow easy removal.

B. Screen Cloth: Fiberglass screen mesh

C. Frame: Extruded or cold-rolled for awning and single-hung windows.

2.6 FABRICATION

A. Fabricate frames and panels with milled and mitered joints and mechanically joined corners. Trim and finish corners to match adjacent surfaces.

B. Provide concealed metal reinforcement in sash frame for attaching lock mechanism.

C. Factory exterior wet silicone glaze with snap-on fiberglass glazing stops matching interior sash and frame finish. Windows shall be re-glazable without dismantling sash framing

PART 3 - EXECUTION

3.1 COORDINATION

A. Review, coordinate, and accommodate work of other trades that interface with, affect, or are affected by the work of this Section to facilitate the execution of the overall Work of this project in a coordinated and efficient manner.

B. Coordinate installation of glazing with Section 08 80 00.

3.2 EXAMINATION

A. Verify that substrate and project conditions are suitable before beginning the installation of frames.

B. Correct unsatisfactory conditions before proceeding with the installation.

C. Start of installation indicates acceptance of substrate and conditions.

3.3 INSTALLATION

A. Install frames plumb, level, rigid, and in true alignment as recommended in AAMA 2400. Provide continuous shim support along the full length of the sill.

B. Do not remove temporary labels.

3.4 ADJUST AND CLEAN

A. Adjust windows for proper operation, free from binding or other defects.

B. Clean and restore soiled surfaces. Remove scraps and debris, and leave the site and a clean condition.

END OF SECTION

SECTION 08 71 00

DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 MATERIAL INCLUDED

A. Provide all items of finish hardware for the project as shown on the drawings or included herein, including appropriate fasteners and miscellaneous materials as required to complete the work of the section and provide a proper installation.

B. Except as noted herein, Hardware items listed elsewhere in this specification shall not be a requirement of this division.

1.3 QUALITY ASSURANCE

A. Codes and Standards

1. All work shall conform to the following codes, regulations, and standards of the latest issue.
   a. The International Building Code – 2012
   b. ANSI/NFPA - NO. 101 LIFE SAFETY CODE 2006
   c. UL 10C - Underwriters Laboratories, “Positive Pressure Fire Tests of Door Assemblies
   d. Department of Justice Public Law 101-336 – Americans with Disabilities Act.

B. Supplier Qualifications

1. A recognized distributor who has been furnishing hardware in the same area as the project for not less than 5 years and has successfully completed projects similar in type and scope. The distributors’ organization shall employ qualified Architectural Hardware Consultants and locksmiths who are available at all reasonable times during construction to meet with the Contracting Officer or contractor for hardware or keying consultation.
2. The Hardware supplier shall be a factory authorized distributor of the material provided and shall maintain a stock and parts inventory of all standard items supplied on the project for future service to the owner.

1.4 SUBMITTALS

A. Submit the following per the Conditions of the Contract and Division 1 Specification sections.

B. Finish Hardware Schedule:

1. At the earliest possible date after receipt of the Contract submit 6 copies of the complete detailed hardware schedule (or electronic copy). List hardware schedule for each door opening separately, using a vertical format. The schedule is to include all quantities, part numbers, sizes, and finishes. Provide 4 copies of catalog cuts for each item proposed for use in this project. Provide physical samples when requested by the Contracting Officer.
2. Upon receipt of reviewed schedule, promptly incorporate any corrections and changes in the reviewed submittal and return 2 copies of the revised schedule and complete sets of templates to the contractor for his use. These schedules shall be kept current throughout the project with new pages being issued to reflect any changes that may occur.
3. Acceptance of the hardware schedule does not relieve the supplier of responsibility for errors or omissions.
4. The hardware schedule shall include a Keying Schedule showing all keyed items of hardware for the Owners use.

C. Templates: Upon receipt of reviewed schedule supply templates or physical hardware to the fabricator of factory prepared doors, frames, and other work affected. Upon request, check the associated shop drawings to confirm that adequate provisions are made for proper installations.

D. Special Tools: The contractor is to provide to the owner two sets of any special tools shipped with the finished hardware products required for maintenance and installation. Deliver to the owner at completion of work.

E. Warranty: The finish hardware shall carry a limited warranty against defects in workmanship and operation for one year from the date of substantial completion. Door Closers shall have a 10-year limited warranty. Exit devices are to have a 3-year warranty.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Tag each item or package to identify the item and its intended location. Provide a packing list that clearly indicates the carton location of each item.

B. Inventory hardware jointly with contractor and hardware supplier’s representative until both parties are satisfied that the count is correct. Dry, locked storage space shall be provided for the checking, sorting, and storage of the hardware.

1.6 SUBSTITUTIONS

A. To assure a uniformly high quality of materials for the project it is intended that only specified items be furnished.

B. Material by other manufacturers listed as acceptable may be submitted subject to the acceptance of the Contracting Officer that they are equal to the specified item in quality, design, finish, and function.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Provide products listed in the Hardware Schedule in sufficient quantities to complete the job requirements. Specified products are listed in bold. No requests for substitution will be accepted before bidding.

Butts & Hinges:	McKinney, Ives, Bommer, Hager Locks and Schlage, Corbin, Sargent Overhead Closers
Cylinders:	LCN, Dor-O-Matic
Flat goods & trim:	Ives, Rockwood, Trimco
Thresholds & Gasket:	Pemko, National Guard
Exit Devices:	Monarch, Corbin, Von Duprin
Overhead stops & holders:	GJ, Rixson

B. Any Item occurring in the Hardware Schedule but not listed in this section shall be furnished as shown in the schedule.

2.2 HARDWARE FINISH

A. Finish of Locksets will be US26D (626). Except as noted otherwise in the schedule, other items of finished hardware shall be of a finish and texture to match the lockset finish. Closers will have the manufacturer's standard finish system unless plated closes are specified. The designations used for the hardware finishes are those listed in ANSI/BHMA A156.18, "Materials and Finishes."

2.3 BUTTS

A. Type: as scheduled. Solid brass at exterior out-swing openings.

B. Size: 3'4" wide and under - 4-1/2" x 4-1/2". 3'4" wide and over - 5" x 4-1/2". Provide wide throw hinges where required due to trim applications or other conditions. Provide heavy-duty hinges for heavily used locations.

C. Quantity: 3 each up to and including 90" in height. Add 1 additional hinge for every additional 30" or fraction thereof. Dutch doors will have a minimum of 2 pairs of hinges. For unusual size or weight doors, furnish type, size, and quantity are recommended by the manufacturer.

D. All locking out swinging doors to have non-removable pins.

2.4 LOCKSETS

A. All locksets and latch sets shall be the product of one manufacturer with functions as indicated in the hardware groups. All locksets shall be ANSI/BHMA A156.2 Series 4000 Grade 2 as indicated.

B. Backset: 2 3/4”

C. Locksets and latchsets shall be furnished with strikes having a sufficient strike lip to protect trim.

D. Locksets to be provided with interchangeable cores that are completely compatible with Park Service’s existing lock system.

2.5 KEYING

A. All cylinders are to be keyed as directed into the existing SFIC master key system. Provide construction cores for all locks for the contractor's use during construction as requested. Construction cores are the property of the hardware supplier.

B. Provide 6 construction keys for the contractor’s use.

C. All keys shall be stamped with keyset symbols and "DO NOT DUPLICATE".

D. Furnish:

1. 4-each Master Keys
2. 3-each Keys each keyed lock
3. 6-each Keys each KA group

2.6 MANUAL FLUSH BOLTS

A. Provide as specified in hardware groups.

2.7 DOOR CLOSERS, SURFACE

A. Furnish drop plates or other mounting plates where required. Provide a Closer of proper size and mounting style for each opening.

B. Furnish sex nuts and bolts for all doors.

C. Provide as specified in hardware groups.

2.8 OVERHEAD STOPS

A. Provide proper size overhead stop for door width.

B. All surface overhead stops shall be through-bolted with six nuts and bolts.

2.9 PROTECTION PLATES

A. Size: all plates shall be 2” less than door width on push side except pairs of doors shall be 1” less than door width where the application permits. All plates shall be 1” less than door width on the pull side except where metal door edges are used. When any plates are used in conjunction with vertical rod exit devices, modify the width, as necessary. Kickplates shall be 10” in height. and Mop plates shall be 4” in height. Armor plates shall be 36” in height.

2.10 GASKET AND THRESHOLD

A. Types as specified in hardware groups.

B. Provide material of proper size and configuration for the specified Opening.

PART 3 - EXECUTION

3.1 HARDWARE INSTALLATION

A. Installation shall be by skilled craftsmen experienced in the installation of commercial builders' Hardware and shall be per the approved shop drawings of sections 08 11 13, Hollow Metal Door & Frames and 08 14 00, Wood Doors. The manufacturer’s standard locations shall apply except as otherwise directed by the Contracting Officer or as required to meet applicable code requirements. Where cutting and fitting are required to install hardware onto or into surfaces that are later to be finished, coordinate removal, storage, and reinstallation with the finishing work specified in Division 9 sections. Do not install surface-mounted items until finishes have been completed on the substrates involved.

B. Set units level, plumb, and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

C. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors per industry standards.

D. Set thresholds for exterior doors in full bed of butyl-rubber or polyisobutylene mastic sealant complying with requirements specified in Division 7 Section “Joint Sealants.”

E. Weatherstripping and Seals: Comply with manufacturer’s instructions and recommendations to the extent installation requirements are not otherwise indicated.

3.2 ADJUSTING, CLEANING, AND DEMONSTRATING

A. Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate freely and smoothly or as intended for the application made. Where hardware is installed more than one month before the acceptance or occupancy of a space or area, the installer is to return to the installation during the week before the acceptance or occupancy and make a final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for the final operation of the heating and cooling equipment. Clean any adjacent surfaces soiled by hardware operation.

B. Approximately six months after acceptance of hardware in each area, the Installer shall return to the project and make any necessary adjustments to the hardware to restore the properly operating functions of the door and hardware. Consult with and instruct the Owner's personnel in any recommended additions or maintenance procedures. Replace hardware items that have deteriorated or failed due to faulty design or installation. Prepare a written report of the current or predictable problem (of a substantial nature) in the hardware performance. If there is a hardware problem the installer cannot resolve, the finish hardware supplier and a representative of the manufacturer of the product concerned shall be contacted. At a mutually convenient time, the installer, the hardware supplier, and the manufacturer's representative shall meet at the Jobsite to review and try to resolve the problem. This meeting shall be at no charge to the owner or contractor unless the problem is determined to be the result of faulty installation.

3.3 HARDWARE SCHEDULE

A. Refer to door schedule and related information concerning the following hardware groups. Quantities indicated in any instance are for supplier convenience only and are not guaranteed.

Hardware Groups:
Note 1: Where thresholds are specified, the Hardware Supplier is to verify the floor conditions and provide the proper threshold to meet the labeling requirements and the conditions.

HARDWARE GROUPS

H01 INTERIOR ENTRY FUNCTION

3	HINGE	MCK	MP79
1	LOCK	SCH	AL53HD SAT
1	STOP	TR	1270WV

H02 INTERIOR STORE ROOM FUNCTION

3	HINGE	MCK	MP79
1	LOCK	SCH	AL80HD SAT
1	STOP	TR	1270WV

H03 INTERIOR PASSAGE/CLOSER

3	HINGE	MCK	MPB79
1	LATCH	SCH	AL10S SAT
1	CLOSER	DOM	SC71
1	KICKPLATE	TR	K0050 10X34
1	STOP	TR	1270WV
1	GASKET	PEM	S88D17

H04 INTERIOR PRIVACY

3	HINGE	MCK	MP79
1	PRIVACY	SCH	AL40S SAT
1	CLOSER	DOM	SC71
1	STOP	TR	1270WV

H05 INTERIOR PASSAGE

3	HINGE	MCK	MPB79
1	LATCH	SCH	AL10S SAT
1	STOP	TR	1270WV

H06 EXTERIOR STORE ROOM FUNCTION

3	HINGE	MCK	TA2314 NRP
1	LATCH	SCH	L9453F-F09
1	CYLINDER	SCH	80-159
1	CLOSER	DOM	SC71
1	KICKPLATE	TR	K0050 10X34
1	STOP	TR	1270WV
1	GASKET	PEM	S88D17
1	THRESHOLD	PEM	271A36
1	SWEEP	PEM	18061CP-36

H07 EXTERIOR STORE ROOM FUNCTION

3	HINGE	MCK	TA2314 NRP
1	LATCH	SCH	LV9480F-F07
1	CYLINDER	SCH	80-159
1	CLOSER	DOM	SC71
1	KICKPLATE	TR	K0050 10X34
1	STOP	TR	1270WV
1	GASKET	PEM	S88D17
1	THRESHOLD	PEM	271A36
1	SWEEP	PEM	18061CP-36

H08 OVERHEAD SECTIONAL DOORS

1	CYLINDER	1E-72 or 1E-74 as required
	Balance by overhead sectional door manufacturer	

END OF SECTION

SECTION 08 80 00

GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including Division 1 Specification Sections, apply to work of this Section.

1.2 SECTION INCLUDES

A. Flat Glass

B. Insulating Glass Units

C. Glazing Accessories.

1.3 REFERENCES

A. All references shall be the latest adopted edition.

B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test

C. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers

D. ASTM C1036 - Standard Specification for Flat Glass

E. ASTM C1048 - Standard Specification for Heat-Treated Flat Glass--Kind HS, Kind FT Coated and Uncoated Glass

F. ASTM C1193 - Standard Guide for Use of Joint Sealants

G. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass

H. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror

I. ASTM E773 - Standard Test Method for Accelerated Weathering of Sealed Insulating Glass Units

J. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation

K. CPSC 16 CFR 1201 - Safety Standard for Architectural Glazing Materials

L. GANA (GM) - FGMA Glazing Manual; Glass Association of North America

M. GANA (SM) - FGMA Sealant Manual; Glass Association of North America

1.4 SUBMITTALS

A. Refer to the Purchase Order for submittal procedures.

B. Product Data: Provide manufacturer's descriptive literature and performance data on each different type of glass and insulated glass unit specified.

1. Confirm fire rating on fire-rated glazing.

C. Exterior Insulated Glass Unit Samples: Provide a 12" x 12" sample of an exterior insulated glass unit in a specified type of glass.

D. Single Glazing Samples: Provide 4" x 6" samples of each different single glazing type specified.

1.5 PERFORMANCE REQUIREMENTS

A. Glass Thickness: Select thickness of exterior glass to withstand dead loads and positive and negative live loads acting normal to plane of glass at design pressures calculated per requirements in the International Building Code and UFC 4-010-01.

1. Limit glass deflection to 1/200 or flexure limit of glass, whichever is less, with full recovery of glazing materials.

1.6 QUALITY ASSURANCE

A. Perform Work following "FGMA Glazing Manual" and "FGMA Sealant Manual" for glazing installation methods.

B. Fabricator, Sealed Insulating Glass Units: Minimum five years of documented experience producing sealed insulating glass units specified in this Section.

C. Installer Qualifications: Company specializing in the installation of products specified in this Section on projects of similar scope and complexity, with not less than 5 years of documented experience. Upon request, provided a listing of all projects completed within the last 2 years along with names and contact information of general contractors and building owner representatives for each project.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not install glazing when the ambient temperature is less than 50 degrees F.

B. Maintain minimum ambient temperature before, during, and 24 hours after installation of glazing compounds.

1.8 WARRANTY

A. Sealed insulating glass units shall be warranted for 10 years against seal failure, interpane dusting, or misting, and shall include removal of failed unit and replacement with the new unit.

PART 2 - PRODUCTS

2.1 FLAT GLASS MATERIALS

A. Clear Uncoated Float Glass:

1. Clear heat-strengthened float glass complying with ASTM C1048, Type I transparent flat, Class 1 (clear), Quality Q3 (glazing select), Kind HS.
2. Performance Values: Minimum 88 percent visible light transmission and a maximum solar heat gain coefficient of 0.82 (based on ¼" thickness).

B. Clear Uncoated Heat Tempered Safety Glass: Fully heat tempered with horizontal tempering.

1. Clear tempered float glass complying with ASTM C1048, Type 1 (transparent flat), Class 1 (clear), Quality Q3 (glazing selects), Kind HT.
2. Performance Values: Minimum 88 percent visible light transmission and a maximum solar heat gain coefficient of 0.82 (based on ¼" thickness).
3. Fully heat temper glass to comply with CPSC 16 CFR 1201 and ANSI Z97.1 impact safety standard.
4. Permanently etch one corner of each piece of tempered glazing indicating compliance with ANSI Z97.1, locate etch mark so it is visible after installation.

C. Acid-Etched Laminated Glass:

1. Clear annealed float glass complying with ASTM C1048, Type I transparent flat, Class 1 (clear), Quality Q3 (glazing selects).
2. Laminate 2 panes of glass with a 0.030-inch thick polyvinyl-butyral (PVB) interlayer complying with ASTM C1172.
3. Low-iron satin acid etched. Light transmission of approximately eighty-nine percent (89%)
4. Permanently etch one corner of each piece of tempered glazing indicating compliance with ANSI Z97.1, locate etch mark so it is visible after installation.
5. Refer to Schedule at the end of this Section for performance values.

D. Clear Low-Emissivity Coated Glass:

1. Manufacturer/Product: PPG Solarban 60 Clear.
2. Clear tempered float glass complying with ASTM C1048, Type 1 (transparent flat), Class 1 (clear), Quality Q3 (glazing selects), Kind HT; with pyrolytic coating meeting the requirements of ASTM C1376.

3. Fully heat temper glass to comply with CPSC 16 CFR 1201 and ANSI Z97.1 impact safety standard.
4 Permanently etch one corner of each piece of tempered glazing indicating compliance with ANSI Z97.1, locate etch mark so it is visible after installation.
5. Refer to Schedule at the end of this Section for performance values for insulating glass unit.

2.2 GLAZING ACCESSORIES

A. Glazing Compound: Silicone sealant single component; chemical curing; capable of water immersion without loss of properties; non-bleeding, non-staining; cured Shore A hardness of 15 to 25; color as selected.

B. Setting Blocks: Neoprene, 80 to 90 Shore A durometer hardness, ASTM C864 Option I. Length of 0.1 inches for each square foot of glazing or minimum 4-inch x width of glazing rabbet space minus 1/16-inch x height to suit glazing method and pane weight and area.

C. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness, ASTM C864 Option I. Minimum 3 inches long x one-half the height of the glazing stops x thickness to suit the application, self-adhesive on one face.

D. Glazing Tape: Closed cell polyvinyl chloride foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume of 2%, designed for compression of 25% to affect an air barrier and vapor retarder seal.

1. Fire Rated Glazing: Glazing tape shall conform to fire listing requirements of the fire-rated glazing.

2.3 FABRICATION

A. Heat-Tempered Glass:

1. Cut float glass materials to indicated sizes and provide cut-outs and holes, if indicated, before heat strengthening.
2. Fully temper float glass materials following ASTM C1048, Kind FT.
3. Comply with CPSC 16 CFR 1201 and ANSI Z97.1.
4. Permanently etch one corner of each piece of tempered glazing indicating compliance with ANSI Z97.1, locate etch mark so it is visible after installation.

B. Low-Emissivity Coated Glass: Fabricate using methods and equipment recommended by the manufacturer; to protect the coating from damage.

C. Sealed Insulating Glass Units:

1. Fabricate units following ASTM E2190 with components and performance characteristics specified in the Schedule paragraph at the end of this Section.
2. Components:
   a. Glass Type: As specified in the Schedule paragraph at the end of this Section.

b. Heat Treatment: As specified in the Schedule paragraph at the end of this Section.
c. Air Space: Hermetically sealed, dehydrated air-filled.

3. Edge Seals: Silicon sealant for glass-to-spacer seals; provide unit edge seals meeting requirements of ASTM E773, with aluminum spacers having mitered corners.

PART 3 - EXECUTION

3.1 COORDINATION

A. Review, coordinate, and accommodate work of other trades that interface with, affect, or are affected by the work of this Section to facilitate the execution of the overall Work of this project in a coordinated and efficient manner.

3.2 EXAMINATION

A. Verify that openings for glazing are correctly sized and within tolerance.

B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear and ready to receive glazing.

C. Beginning of installation indicates acceptance of openings, substrate, and conditions.

3.3 PREPARATION

A. Clean contact surfaces with solvent and wipe dry.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces are scheduled to receive sealant.

3.4 INSTALLATION - GENERAL

A. Install glazing in conformance with FGMA Glazing Manual.

3.5 INSTALLATION - INTERIOR WOOD DOORS - INTERIOR DRY METHOD (TAPE & TAPE)

A. Cut glazing tape to length and set against permanent stops straight and true to line, do not project above sightline.

B. Place setting blocks at 1/4 points with edge block no more than six 6 inches from corners.

C. Rest glazing on setting blocks and push against tape for full contact at the perimeter of the pane or unit.

D. Place glazing tape on the free perimeter of glazing in the same manner described above.

E. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.

F. Knife trim protruding tape.

G. Workmanship: Glazing tape shall be installed neatly, parallel with the edge of the stop, in a straight line, and shall not extend beyond the edge of the stop or be installed crooked or wavy.

3.6 CLEANING

A. Remove glazing materials from finish surfaces.

B. Remove labels after Work is complete.

C. Clean glass and adjacent surfaces.

3.7 PROTECTION

A. Protect installed products until completion of the project.

B. Repair or replace damaged products before Substantial Completion.

3.8 GLAZING TYPE SCHEDULE (Refer to Drawings for Locations)

A. GL-1: 1-inch insulating glass unit with Clear Low-Emissivity Coated Glass exterior pane (with Low-E coating on the number 2 surface) and Clear Uncoated Float Glass interior pane. Unit performance shall be as follows (values shown are based on ¼" thick glass, actual glass thickness may result in slightly different values):

1. U-Value: 29 (Winter Night-Time)
2. Solar Heat Gain Coefficient: 0.38

B. GL-2: 1-inch insulating glass unit with Clear Low-Emissivity Coated Heat Tempered Safety Glass exterior pane (with Low-E coating on the number 2 surface) and Acid-Etched Laminated Glass interior pane. Unit performance shall be as follows (values shown are based on ¼" thick glass, actual glass thickness may result in slightly different values):

1. U-Value: 29 (Winter Night-Time)
2. Solar Heat Gain Coefficient: 0.38

C. GL-3: Single pane of ¼ inch thick Clear Uncoated Heat Tempered Safety Glass.

END OF SECTION

SECTION 08 87 00

GLAZING SURFACE FILMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Interior/Exterior Window Film

B. Decorative Window Film

C. Privacy Window Film

1.2 RELATED SECTIONS

A. Section 08 80 00 - Glazing: Windows to receive architectural window film

1.3 REFERENCES

A. STM International (ASTM)

1. ASTM E 903 - Standard Methods of Test for Solar Absorbance, Reflectance, and Transmittance of Materials Using Integrating Spheres.
2. ASTM E 308 - Standard Recommended Practice for Spectrophotometry and Description of Color in CIE 1931 System.

1.4 SUBMITTALS

A. Manufacturer's product data for specified products.

B. Submit shop drawings showing layout, profiles, and product components, including dimensions, anchorage, and accessories.

C. Samples: 4 inches by 4 inches samples of specified color and pattern for verification.

D. Submit operation and maintenance data for installed products, including precautions against harmful cleaning materials and methods.

E. Mockups: as required

1.5 QUALITY ASSURANCE

A. Obtain all products in this section from a single Manufacturer with a minimum of 10 years of experience.

B. Installer: Installation shall be performed by a trained and qualified installer, specialized and experienced in the work required for this project. A list of experienced installation integrators is available at 3M.com/AMD or 3M Commercial Solutions Division at 1-888-650-3497.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.

B. Store products protected from weather, temperature, and other harmful conditions as recommended by the supplier.

C. The product must remain in its original plastic bag and boxes and have storage conditions as follows:

1. 40 °F - 90 °F
2. Out of direct sunlight
3. Clean dry area
4. Original container
5. Do not stack boxes over 6 units high. Excessive weight can damage the film
6. Products are not recommended for interior applications where condensation consistently occurs.
7. Handle products per the manufacturer's instructions.
8. Shelf life: 2 years

1.7 PROJECT/SITE CONDITIONS

A. Confirm appropriate substrate is suitable for mounting glass finish components before the start of installation.

B. Apply materials when environmental conditions are within the limits recommended by the manufacturer for optimum results. Do not install products under environmental conditions outside the manufacturer’s absolute limits. The application temperature range is 60 °F - 100 °F.

C. Environmental Limitations: Do not install until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.8 WARRANTY

A. Manufacturer's Warranty: Submit the manufacturer's standard warranty document by the authorized manufacturer.

B. Standard Product Warranty: Refer to the applicable 3M Technical Data Sheet for product warranty.

1.9 EXTRA MATERIALS

A. Furnish 2 percent extra material at the time of installation. Deliver in protective packaging for storage and label contents appropriately.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. 3M Company - Commercial Solutions Division [CSD]
3M Center, Building 0220-12-E-04
St. Paul, MN 55144-1000, USA
1-888-650-3497

2.2 MATERIAL STANDARD

A. Design based upon 3M™ CRYSTAL Glass Finishes

2.3 MATERIAL PROPERTIES

A. General: Glass finishes field-applied application to glass or plastic material as visual opaque or decorative film.

B. Film: Vinyl

C. Option to Electrocut (by other than Manufacturer)

D. Adhesive: Acrylic, Pressure Sensitive, Permanent

E. Liner: Silicone-coated Polyester

F. Thickness (Film and Adhesive without Liner):

1. Dusted - 3.2 mils (81 microns)
2. Frosted - 4.7 mils (120 microns)

G. Fire Performance: Surface burning characteristics when tested following ASTM E84, Class A:

1. Flame Spread: 25 maximum.
2. Smoke Developed: 450 maximum.

2.4 OPTICAL PERFORMANCE

A. CRYSTAL Dusted Decorative / Privacy Glazing Film:

1. Ultraviolet Transmittance (ASTM E 903): 27 percent.

2. Visible Light Transmittance (ASTM E 903, ASTM E308): 85 percent.
3. Visible Light Reflectance (ASTM E 903): 79 percent.
4. Solar Heat Transmittance: 76 percent.
5. Solar Heat Reflectance: 7 percent.
6. Shading Coefficient at 90 Degrees (Normal Incidence) (ASTM E 903): 0.93.

B. CRYSTAL Frosted Decorative / Privacy Glazing Film:

1. Ultraviolet Transmittance (ASTM E 903): 20 percent.
2. Visible Light Transmittance (ASTM E 903, ASTM E308): 72 percent.
3. Visible Light Reflectance (ASTM E 903): 12 percent.
4. Solar Heat Transmittance: 64 percent.
5. Solar Heat Reflectance: 10 percent.
6. Shading Coefficient at 90 Degrees (Normal Incidence) (ASTM E 903): 0.82.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrate(s) for compliance. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Refer to the applicable 3M Technical Data Sheet to determine the compatibility of finish to the substrate.

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

D. Responsibility for state of surfaces before installation to be pre-determined by installation specialist.

E. Scheduling of installation by the Owner or its representative implies that substrate and conditions are prepared and ready for product installation per the recommendations of the installation specialist.

F. Proceeding with installation implies the installer’s acceptance of substrate and conditions.

3.2 SURFACE PREPARATION

A. Comply with all manufacturer’s instructions for surface preparation.

B. Thoroughly clean substrate of substances that could impair the overlay’s bond, including mold, mildew, oil, and grease.

C. Re-clean surfaces with appropriate surface prep solvent and remove any haze or surface contamination.

3.3 APPLICATION

A. The application must be performed by a qualified installer.

B. Do not proceed with installation until all finishing work has been completed in and around the work area.

C. Verify pattern before material acquisition.

D. Comply with manufacturer’s installation instructions applicable to products and applications indicated, except where more stringent requirements apply.

E. Install substrates with no gaps or overlaps. Form a smooth, wrinkle-free, bubble-free surface for finished installation.

F. Remove air bubbles, wrinkles, blisters, and other defects. Use approved procedures to prevent the formation of air bubbles, wrinkles, blisters, and other defects.

G. Refer to the applicable 3M Installation Guide for additional details.

3.4 CLEANING AND PROTECTION

A. Use cleaning methods recommended by architectural surfacing manufacturers for the applicable environment.

B. Protect completed glass finish during the remainder of the construction period.

C. Consult with an authorized installation specialist for project specifics.

END OF SECTION

SECTION 08 90 00

LOUVERS & VENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. The Contractor's attention is specifically directed, but not limited, to the following documents for additional requirements:

1. Construction plans.

1.2 SUMMARY

A. Section Includes:

1. Fixed, extruded-aluminum louvers.
2. Wall vents.

B. Related Sections:

1. Section 05 50 00 "Metal Fabrications" for louver frames for wall penetrations.
2. Section 06 10 00 “Carpentry” for louver frames for wall penetrations.

1.3 DEFINITIONS

A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or referenced standards.

B. Horizontal Louver: Louver with horizontal blades, i.e., the axes of the blades are horizontal.

C. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to the bottom of the unit and away from opening.

D. Storm-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise, metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

1. Wind Loads: Determine loads based on pressures as indicated on the Drawings.
2. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

B. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Rating Seals.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
2. Show mullion profiles and locations.

C. Samples for Verification: For each type of metal finish required.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain louvers and vents from a single source from a single manufacturer indicated to be of the same type, design, or factory-applied color finish.

1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."
3. AWS D1.6, "Structural Welding Code - Stainless Steel."

B. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5, T-52, or T6.

B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with a temper as required for forming, or as otherwise recommended by the metal producer for the required finish.

C. Aluminum Castings: ASTM B 26/B 26M, Alloy 319.

D. Fasteners: Use types and sizes to suit unit installation conditions.

1. Use hex-head or Phillips pan-head screws for exposed fasteners unless otherwise indicated.
2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
3. For color-finished louvers, use fasteners with heads that match the color of louvers.

E. Post installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with the capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.2 FABRICATION, GENERAL

A. Assemble louvers in the factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Vertical Assemblies: Where the height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.

1. Continuous Vertical Assemblies: Fabricate units without interrupting blade-spacing pattern unless horizontal mullions are indicated.

C. Maintain equal louver blade spacing to produce a uniform appearance.

D. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

1. Frame Type: Channel unless otherwise indicated.

E. Include supports, anchorages, and accessories required for complete assembly.

F. Provide vertical mullions of type and at spacings indicated, but not more than recommended by the manufacturer, or 72 inches o.c., whichever is less.

1. Exposed Mullions: Where indicated, provide units with exposed mullions of the same width and depth as the louver frame. Where the length of the louver exceeds fabrication and handling limitations, provide interlocking split mullions designed to permit expansion and contraction.

G. Provide subsills made of the same material as louvers.

H. Join frame members to each other and fixed louver blades with fillet welds, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or the size of louver assembly makes bolted connections between frame members necessary.

2.3 FIXED, EXTRUDED-ALUMINUM LOUVERS

A. Horizontal Storm-Resistant Louver:

1. Basis-of-Design Product: Subject to compliance with requirements, provide model SCH601 by Airolite Company, LLC, www.airolite.com, or comparable product by one of the following:
   a. Carnes Company, Inc., model FRWB, www.carnes.com.
   b. Greenheck Fan Corporation, model EHH-601D, www.greenheck.com.
   c. Substitutions: See Section 01 26 01 - Contract Modification Procedures.
2. Louver Depth: 6 inches.
3. Frame and Blade Nominal Thickness: Not less than 0.060 inches for blades and 0.080 inches for frames.
4. Louver Performance Ratings:
   a. Free Area: Not less than 7.0 sq. ft. for a 48-inch wide by 48-inch- high louver.
   b. Air Performance: Not more than 0.10-inch WG static pressure drop at 600-fpm free-area intake velocity.
   c. Wind-Driven Rain Performance: Not less than 95 percent effectiveness when subjected to a rainfall rate of 8 inches per hour and a wind speed of 50 mph at a core-area intake velocity of 500 fpm.
5. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

B. Horizontal, Drainable-Blade Louver:

1. Basis-of-Design Product: Subject to compliance with requirements, provide model K6846 by Airolite Company, LLC, www.airolite.com, or comparable product by one of the following:
   a. Carnes Company, Inc., model FPNB, www.carnes.com.
   b. Greenheck Fan Corporation, model EDD-601, www.greenheck.com.
   c. Substitutions: See Section 01 26 01 - Contract Modification Procedures.
2. Louver Depth: 6 inches.
3. Frame and Blade Nominal Thickness: Not less than 0.080 inches.

4. Louver Performance Ratings:
    a. Free Area: Not less than 7.5 sq. ft. or 48-inch wide by 48-inch high louver.
    b. Point of Beginning Water Penetration: Not less than 950 fpm.
    c. Air Performance: Not more than 0.10-inch WG static pressure drop at 800-fpm free-area intake velocity.
5. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

C. Horizontal, Non-drainable-Blade Louver:

1. Basis-of-Design Product: Subject to compliance with requirements, provide model K6096, by Airolite Company, LLC, www.airolite.com, or comparable product by one of the following:
    a. Carnes Company, Inc., model FLGC, www.carnes.com.
    b. Greenheck Fan Corporation, model ESK-602, www.greenheck.com.
    c. Substitutions: See Section 01 26 00 - Contract Modification Procedures.
2. Louver Depth: 6 inches.
3. Blade Profile: Plain blade without center baffle.
4. Frame and Blade Nominal Thickness: Not less than 0.080 inches.
5. Louver Performance Ratings:
    a. Free Area: Not less than 8.0 sq. ft. for a 48-inch wide by 48-inch high louver.
    b. Point of Beginning Water Penetration: Not less than 750 fpm.
    c. Air Performance: Not more than 0.10-inch WG static pressure drop at 700-fpm free-area intake velocity.

2.4 LOUVER SCREENS

A. General: Provide a screen at each exterior louver.

1. Screen Location for Fixed Louvers: Interior face.
2. Screening Type: Insect screening.

B. Secure screen frames to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches from each corner and at 12 inches O.C.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.

1. Metal: Same kind and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.
2. Finish: Same finish as louver frames to which louver screens are attached.
3. Type: Non-rewirable, U-shaped frames.

2.5 WALL VENTS (BRICK VENTS)

A. Extruded-Aluminum Wall Vents:

1. Basis of Design Product: Subject to compliance with requirements, provide model BVE by Airolite Company, LLC, www.airolite.com, or comparable product by one of the following:
    a. Air Flow Company, Inc, model EA-BVL, www.airflowco.net.

b. Construction Specialties, Inc., Brick Vent, www.c-sgroup.com.
c. Substitutions: See Section 01 33 23 - Submittal Procedures.

2. Extruded-aluminum louvers and frames, not less than 0.125-inch nominal thickness, assembled by welding; with 18 by 14 mesh, aluminum insect screening on the inside face; incorporating weep holes, continuous drip at the sill, and integral waterstop on the inside edge of sill; of load-bearing design and construction.
3. Dampers: Aluminum blades and frames mounted on inside of wall vents; operated from the exterior with Allen wrench in socket-head cap screw. Fabricate operating mechanism from Type 304 stainless-steel components.
4. Finish: Mill finish.

2.6 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2.7 ALUMINUM FINISHES

A. Finish louvers after assembly.

B. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

C. Color Anodic Finish: AAMA 611, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

1. Color: As selected by Contacting Officer from the full range of industry colors and color densities.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and openings, with the Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to the Project site.

3.3 INSTALLATION

A. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire units or provide new units.

F. Protect unpainted galvanized and nonferrous-metal surfaces that will be in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

G. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 07 92 00 "Joint Sealers" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

A. Test operation of adjustable louvers and adjust as needed to produce fully functioning units that comply with requirements.

B. Clean exposed surfaces of louvers and vents that are not protected by temporary covering, to remove fingerprints and soil during the construction period. Do not let soil accumulate during the construction period.

C. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry them.

D. Restore louvers and vents damaged during installation and construction so no evidence remains of corrective work. If the results of the restoration are unsuccessful, as determined by Architect, remove damaged units, and replace them with new units.

1. Touch up minor abrasions in finishes with an air-dried coating that matches the color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION

DIVISION 09

FINISHES

SECTION 09 29 00

GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including Division 1 Specification Sections, apply to work of this Section.

1.2 SECTION INCLUDES

A. Interior Gypsum Board (GWB)

B. Water Resistant Panels (WRGWB)

C. Tile Backer Board (TBB)

D. Finishing Gypsum Board

1.3 REFERENCES

A. All references shall be the latest adopted edition.

B. ASTM C36 - Standard Specification for Gypsum Board

C. ASTM C475 - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board

D. ASTM C630 - Standard Specification for Water-Resistant Gypsum Backing Board

E. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board

F. ASTM C1002 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases

G. ASTM C1178 - Standard Specification for Glass Mat Water-Resistant Gypsum Backing Panel

H. GA-214 - Recommended Levels of Gypsum Board Finish; Gypsum Association

I. GA-216 - Application and Finishing of Gypsum Board; Gypsum Association

1.4 SUBMITTALS

A. Refer to Division 1 of the specifications for submittal procedures.

B. Product Data: Submit manufacturer's product data for each proposed product sufficient to show compliance with each product specified.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: Company specializing in performing the work of this Section with a minimum of 5 years of consecutive successful experience.

1.6 REGULATORY REQUIREMENTS

A. Conform to applicable codes and installation requirements for fire-rated assemblies indicated on drawings.

1.7 DELIVERY, STORAGE & HANDLING

A. Deliver materials in original and unopened packages, containers, or bundles, with brand names and manufacturer's labels intact and legible.

B. Store materials in a dry location, fully protected from weather and direct exposure to sunlight.

C. Stack gypsum board products are flat and level, properly supported to prevent sagging or damage to ends and edges.

D. Store corner beads and other metal and plastic accessories to prevent bending, sagging, distortion, or other mechanical damage.

1.8 PROJECT CONDITIONS

A. Environmental Conditions: Establish and maintain environmental conditions for applying and finishing gypsum board to comply with ASTM C840 requirements or gypsum board manufacturer's recommendations, whichever are more stringent.

B. Ventilation: Provide controlled ventilation during joint finishing operations, to eliminate excessive moisture. Avoid drafts during hot, dry weather to prevent finishing materials from drying too quickly.

PART 2 - PRODUCTS

2.1 GYPSUM BOARD MATERIALS (GWB)

A. Gypsum Board (GWB): ASTM C36; Type X, fire-rated, UL or WH tested and listed; sizes to minimize joints in place; ends square cut.

1. Thickness: 5/8 inch.
2. Edges: Tapered.
3. Length: Longest length possible for least number of butt joints.

B. Water Resistant Panels (WRGWB):

1. Manufacturers/Products:
   a. G-P Gypsum DensArmor Plus
   b. USG Fiberock Brand Aqua-Tough Interior Panels
2. Location: Where shown or indicated on Drawings.
3. Thickness: 5/8”
4. Edges: Tapered
5. Size: Largest size practicable to minimize joints in place.
6. Ends: Square cut
7. Standards: Conform to ASTM C1278 and physical property requirements of ASTM C630 and C1178.

2.3 ACCESSORIES

A. Acoustic Sealant: Non-hardening, non-skinning, for use in conjunction with gypsum board; Similar to USG Sheetrock Acoustical Sealant or similar.

B. Outside Square Corners: Galvanized metal corner bead factory clad with paper tape; Beadex Microbead or equal.

C. Angled Corners: Similar to Beadex B1 Flex 100’ Tape-On Flexible Corner Bead, or equal.

D. GWB Abuts Dissimilar Material (Exposed to View): Galvanized metal J-shaped trim factory clad with paper; Similar to Beadex B9J Tape-On “J” Trim or equal.

1. GWB Abuts Windows: Provide a temporary heavyweight cardboard strip 3 inches wide between trim and face of the window frame to protect the frame from dirt and damage.

E. Control Joint: GA 216; roll-formed metal control joint with removable strip, similar to USG No. 93, or equal.

F. Joint Materials: Provide products by the manufacturer of gypsum board. Conform to ASTM C475 and as recommended by gypsum board manufacturer for project conditions.

1. Interior Applications - Gypsum board (except Water Resistant Panels): Ready-mixed vinyl-based joint compound:
   a. Taping Compound: Type specifically formulated for embedding tape and accessories and pre-filling.

b. Topping Compound: Type specifically formulated for finishing drywall over taping compound.
c. Joint Tape: Manufacturer's standard paper reinforcing tape.

2. Water Resistant Panels: Similar to Sheetrock Brand Durabond Setting- Type Joint Compound or Sheetrock Brand Easy Sand Joint Compound manufactured by U.S. Gypsum.
   a. Joint Tape: Paper tape, Similar to Sheetrock Brand Joint Tape manufactured by U.S. Gypsum.

H. Sealer: Product specifically recommended by gypsum board manufacturer for sealing gypsum board before texturing.

I. Screws: Conform to ASTM C1002; bugle-head steel, self-drilling type, black phosphate finish.

1. Exterior Gypsum Sheathing Board, GWB Roof Board & Water Resistant Panels: Provide with yellow zinc corrosion-resistant coating.

J. Nails: Not allowed.

PART 3 - EXECUTION

3.1 COORDINATION

A. Review, coordinate, and accommodate work of other trades that interface with, affect, or are affected by the work of this Section to facilitate the execution of the overall Work of this project in a coordinated and efficient manner.

B. Coordinate installation and requirements of fire-rated assemblies with other trades affected.

C. Coordinate installation of sound batt insulation by Section 07 21 00.

D. Inspect finished surfaces with Section 09 90 00 painting applicator and project superintendent, mark areas that require additional finishing.

3.2 EXAMINATION

A. Verify that project conditions are appropriate for work of this Section to commence.

B. Confirm that the framing is straight, is within specified tolerances, and meets minimum allowable deflection requirements.

C. Confirm that utility rough-in fits properly within framing width and will not prevent GWB from fitting tight to the face of framing members.

D. Confirm that there is adequate temporary heat and light.

E. Beginning of installation indicates acceptance of framing and conditions.

3.3 PROTECTION

A. Protect unsealed concrete floors from contact with GWB dust, taping mud, and primer/surfacer using heavy paper or another method.

3.4 GYPSUM BOARD INSTALLATION

A. Install GWB in conformance with ASTM C840, GA-216, and manufacturer's installation instructions.

1. Install in the longest lengths possible for the minimum number of joints.
2. Install to minimize butt end joints, especially in highly visible locations.
3. Comply with the installation requirements of fire-rated assemblies listed on the Drawings.
4. Water Resistant Panels: Use corrosion-resistant screws.

B. Install full-width panels with cut pieces only at top of the wall (no "belly bands").

C. Place wrapped edges adjacent to one another; do not place cut edges or butt ends adjacent to wrapped edges.

D. Maintain 1/4 inch maximum gap between the bottom of gypsum board and floor.

E. Single-Layer Fire-Rated: Install gypsum board, with edges and ends occurring over firm bearing.

F. Double-Layer Installation: Use a gypsum backing board for the first layer, placed perpendicular to framing or furring members. Place the second layer parallel to the first layer. Offset joints of the second layer from joints of the first layer.

G. Acoustic Sealant: Install at all sound walls per manufacturer's instructions and as follows:

1. Place continuous bead at the perimeter of each layer of gypsum board.
2. Seal around all penetrations by conduit, pipe, ducts, rough-in boxes, and at other similar penetrations.

H. Installation on Metal Framing: Use screws for attachment of all gypsum boards.

3.5 INSTALLATION OF TRIM & ACCESSORIES

A. Corner Beads & Reveals: Install at external corners in a single full-length piece free of butt joints, using the longest practical lengths, no short pieces; place into a solid bed of soft joint compound for secure installation.

1. Align bead straight and plumb.
2. Align juncture with other corner bead flush.

B. J-Shaped Edge Trim: Install at any exposed to view location where gypsum board abuts any dissimilar material or ends with an exposed edge.

1. Install heavy cardboard continuously at the window perimeter to protect the frame from dirt and damage.

C. Control Joints: Place control joints consistent with lines of building spaces and as follows:

1. As determined by the installer to avoid cracking in finished surfaces, not more than 30 feet apart on walls and ceilings over 50 feet long. Location and layout subject to Architect's approval; review with Architect before starting installation.

3.6 JOINT TREATMENT

A. Finish gypsum board (whether exposed to view or not) following GA-214 to the following minimum level of finish:

1. Painted Finish Exposed to View: GA Level 5, substitute a coat of Primer/Surfacer (15 - 20 wet mil thickness) instead of skim coating with the joint compound; sand surface of Primer-Surfacer smooth.
2. Surfaces in mechanical/electrical and storage rooms: GA Level 4.
3. Concealed from view with adhered surface finish (sheet vinyl or rubber base, plastic laminate, FRP panels, etc.): GA Level 3.
4. Concealed from view without surface finish above suspended lay-in ceilings: GA Level 1.
5. Exterior Gypsum Sheathing Board: No finish when joints are butted tight except as required to achieve required fire rating per fire test/listing.
6. Concealed From View with Tile Finish: No joint treatment in this Section.

B. Tape, fill, and sand exposed joints, edges, and corners to produce a smooth surface ready to receive finishes.

1. Feather coats of the joint compound so that camber is maximum 1/32 inch.

3.7 TOLERANCES

A. Gap between Bottom of GWB and Floor: 1/4 inch Maximum.

B. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

C. Butt Joint Finishing: Not readily visible under the normal lighting conditions found for any given area/surface.

D. Finishing Tolerances: All exposed surfaces shall be smooth and free from visible ridges, waves, ripples, holes, defects, delamination, roughness, depressions, screw pops, etc. Taped joints shall not be visible after finishing paint application.

3.8 CLEAN UP

A. Remove all excess gypsum board and finishing materials from the site.

B. Remove gypsum board scraps and dust from all concealed spaces including interior spaces of the wall framing.

C. Remove gypsum dust, taping mud, and primer/sealer completely from window frames, door frames, subfloor surfaces, and any surface/material exposed to view.

1. Subfloor cleanliness/condition shall conform to floor covering installation requirements.

END OF SECTION

SECTION 09 65 00

RESILIENT FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

A. Linoleum Sheet Flooring (LSF)

B. Rubber Base (RB)

1.3 REFERENCES

A. All references shall be the latest adopted edition unless noted otherwise.

B. ASTM F1861 - Standard Specification for Resilient Wall Base

C. ASTM F1913 - Standard Specification for Vinyl Sheet Floor Covering Without Backing

1.4 SUBMITTALS

A. Refer to Division 1 of the specifications for submittal procedures.

B. Samples: Submit 2 color samples of each color selected for each item specified.

C. Certification: Provide written certification on company letterhead stating that concrete subfloors were tested and found to be in conformance with the floor covering manufacturer's requirements before the start of floor covering installation.

1.5 DELIVERY, STORAGE, AND PROTECTION

A. Protect roll materials from damage by storing them on end.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Maintain the temperature in the storage area between 55 degrees F and 90 degrees F.

B. Store materials for not less than 48 hours before installation in the area of installation at a temperature above 65 degrees F to achieve temperature stability. After the flooring has been installed, maintain conditions above 60 degrees F.

1.7 EXTRA MATERIALS

A. Provide 72 sq ft (6'X12') of each sheet vinyl type matching the selected color.

B. Provide 1 case of each VCT type matching the selected color.

PART 2 - PRODUCTS

2.1 LINOLEUM SHEET FLOORING

A. Linoleum Sheet Flooring (LSF)

1. Comply with ASTM F2034, Type I. The wear surface shall consist of a polyurethane-coated homogeneous mixture of linoleum cement (linseed oil, natural tree resins, drying oil catalysts), wood flour, cork flour, color pigments, and filler calendared onto a jute fabric backing. Colors and pattern detail shall be dispersed throughout the thickness of the wear layer.
2. Thickness: 0.100in. (2.5mm).
3. Seams: Provide solid color linoleum weld rod as produced by flooring manufacturer and intended for heat welding of linoleum seams. The color shall be compatible with the field color of flooring'.
4. Provide integral flash cove wall base by extending sheet flooring [4 in. (10.16 cm) up the wall using adhesive, welding rod, and accessories recommended and approved by the flooring manufacturer.
5. Color: To be selected by the Contracting Officer from the manufacturer's full range of standard colors.
6. Manufacturer/Product: Armstrong Colorette with Naturcote
    a. Substitutions: Refer to Section 01 3323.

2.2 MATERIALS - RUBBER BASE (RB)

A. Rubber Base (RB): ASTM F 1861, Type TV, Group 1, homogenous, thermoplastic, and as follows:

1. Height: 4 inches.
2. Thickness: 0.125 inches thick.
3. Configuration: Cove (Style B).
4. Finish: Satin.
5. Length: Roll (100 feet or longer).
6. Colors: Refer to Section 01 3323.
7. Manufacturers: Roppe or approved.
    a. Substitutions: Refer to Section 01 3323.

2.3 ACCESSORIES

A. Linoleum flooring:

1. For patching, smoothing, and leveling monolithic concrete subfloors, provide Fast-Setting Cement-Based Underlayment, patch, and skim coat and or patch and underlayment as recommended by the flooring manufacturer.
2. Provide top edge trim caps of anodized aluminum for integral flash cove base.
3. Provide a fillet support strip for an integral cove base with a minimum radius of 1 inch, made from wood or plastic.
4. Provide transition/reducing strips tapered to meet abutting materials.

PART 3 - EXECUTION

3.1 COORDINATION

A. Review, coordinate, and accommodate work of other trades that interface with, affect, or are affected by the work of this Section to facilitate the execution of the overall work of this project in a coordinated and efficient manner.

B. Coordinate concrete floor finish and curing/drying requirements with Division 3.

C. Schedule flooring installation to follow drying of concrete floor slab and completion of interior painting in the area to receive resilient flooring.

3.2 EXAMINATION

A. Verify that concrete sub-floor surfaces are ready for resilient flooring installation and within the limits recommended by resilient flooring manufacturer and adhesive materials manufacturer by testing the moisture emission rate, alkalinity, and any other tests in the manner recommended by manufacturers.

B. Verify that sub-floor surfaces are flat within tolerances specified in Section 03 30 01 using a 10-foot long straight edge.

C. Perform an adhesive bond test on the concrete subfloor per the flooring manufacturer’s instructions to confirm flooring will bond properly to the subfloor.

D. Examine sub-floors before installation to determine that surfaces are smooth and free from cracks, holes, ridges, and other defects that might prevent adhesive bonds or impair the durability or appearance of the flooring material.

E. Verify that wall surfaces are smooth and flat within tolerances specified in Section 09 29 00; are free of voids, openings, or gaps; are dust-free, and are ready to receive a resilient base.

F. Inspect sub-floors before installation to determine that surfaces are free from curing, sealing, parting, and hardening compounds; residual adhesives; adhesive removers; oil, grease, and other foreign materials that might prevent adhesive bond.

1. Visually inspect for evidence of moisture, alkaline salts, carbonation, dusting, mold, or mildew.

G. Verify that sub-floor surfaces are free of all construction dirt, gypsum dust, taping mud, paint, sand, etc.

H. Verify that required floor-mounted utilities (drains, electrical outlets, etc.) are in the correct location and installed to the proper height to flush out with flooring material.

I. Report conditions contrary to contract requirements that would prevent a proper installation. Do not start installation until the substrate/sub-floor meets the requirements of material and adhesive manufacturers.

J. Provide certification letter documenting concrete subfloor as conforming to floor covering manufacturer's requirements.

K. Start of installation indicates acceptance of substrate/sub-floor and conditions as conforming to all requirements. Failure to call attention to defects or imperfections will be construed as acceptance and approval of the sub-floor.

3.3 PREPARATION

A. Sub-floor surface shall be smooth and free of waviness, ridges, bumps, depression, or other irregularities that will be visible after resilient flooring is laid.

1. Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve a smooth, flat, hard surface.

B. Prohibit traffic until the filler is cured.

C. Vacuum clean substrate thoroughly; sand and dirt particles trapped under floor tile will require replacement of the tile.

D. Apply primer if recommended by flooring material or adhesive manufacturers for product or substrate/subfloor conditions.

3.4 INSTALLATION – LINOLEUM FLOORING

A. Smooth concrete surfaces, removing rough areas, projections, ridges, and bumps, and filling low spots, control or construction joints, and other defects with Armstrong Cement-Based Underlayment, Patch, and Skim Coat and/or Patch and Underlayment as recommended by the flooring manufacturer.

B. Remove paint, varnish, oils, release agents, sealers, and waxes. Remove residual adhesives as recommended by the flooring manufacturer. Remove curing and hardening compound not compatible with the adhesives used, as indicated by a bond test or by the compound manufacturer's recommendations for flooring. Avoid organic solvents.

C. Perform subfloor moisture testing following [ASTM F 2170, “Standard Test Method for Determining Relative Humidity in Concrete Slabs Using in-situ Probes”, or ASTM F 1869, “Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride” and Bond Tests as described in publication F-5061, "Armstrong Guaranteed Installation System," to determine if surfaces are dry; free of curing and hardening compounds, old adhesive, and other coatings; and ready to receive flooring. Relative humidity shall not exceed 80%. MVER shall not exceed 5 lbs./1000 sq. ft./24 hrs. On installations where both the Percent Relative Humidity and the Moisture Vapor Emission Rate tests are conducted, results for both tests shall comply with the allowable limits listed above. Do not proceed with flooring installation until the results of moisture tests are acceptable. All test results shall be documented and retained.

D. Perform pH tests on concrete floors regardless of their age or grade level. All test results shall be documented and retained.

E. Vacuum or broom-clean surfaces to be covered immediately before the application of flooring. Make the subfloor free from dust, dirt, grease, and all foreign materials.

F. Install flooring and accessories per manufacturer’s instructions.

3.5 INSTALLATION – RUBBER BASE (RB)

A. Install base per manufacturer’s installation instructions to properly prepared substrate.

B. Install base in continuous, unbroken lengths with joints at inside corners only.

C. Miter or cope internal corners for tight, hairline joint; at external corners, 'V' cut back of the base strip to 2/3 of its thickness and fold.

D. Tightly bond base to the vertical substrate with continuous contact at horizontal and vertical surfaces.

1. Top of the base shall fit tight to the wall, free of open cracks or lack of adhesion.

E. Scribe and fit to door frames and other interruptions.

F. Install base behind removable casework, equipment, or any other non-permanent item.

3.6 PROTECTION OF FINISHED WORK

A. Prohibit traffic on resilient flooring for 48 hours after installation.

B. Protect flooring from any marring or damage resulting from construction operations.

3.7 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

END OF SECTION

SECTION 09 72 00

PLASTIC SHEET WAINSCOTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

A. Fiberglass Reinforced Plastic (FRP) Wainscots

1.3 SUBMITTALS

A. Refer to Division 1 of the specifications submittal procedures.

B. Product Data: Provide manufacturer's standard details and catalog data demonstrating compliance with referenced standards.

C. Samples:

1. Submit 6 inches square samples of each product and color required.
2. Submit 6 inches long samples of each trim profile and trim color required.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store products indoors and protect them from moisture, construction traffic, and damage.

B. Store panels flat on a clean, dry surface. Do not stand on edge or stack on fresh concrete or other surfaces that emit moisture.

C. Store panels for at least 24 hours at temperature and humidity conditions approximating the average environment of the finished room.

PART 2 – PRODUCTS

2.1 FIBERGLASS REINFORCED PLASTIC PANELS (FRP)

A. Available Manufacturers: Subject to conformance with the requirements of this Section, manufacturers offering products that may be provided for this project include, but are not limited to, the following:

1. Kemlite
2. Marlite (Specified)
3. Sequentia
4. Substitutions: Refer to requirements in Section 01 33 23.

B. General:

1. Composite plastic panels of randomly chopped fiberglass roving modified polyester copolymer, inorganic fillers, and pigments.
2. Resistant to rot, corrosion, staining, denting, peeling, and splintering.
3. USDA accepted.

C. Surface burning classification: Class III.

1. Flame spread (ASTM E 84): 200 or less.
2. Smoke developed (ASTM E 84): 450 or less.

D. Size: 48 inches in width, full-height panels as required to fit spaces shown.

1. Thickness: 3/32 inch

E. Color/Texture: Refer to Section 01 33 23 for color selections.

F. Trim Accessories:

1. Provide panel manufacturer's standard extruded aluminum moldings to meet project conditions.
2. Adhesive: Structural construction adhesive as recommended by the manufacturer for good adhesion to the substrate material.
3. Sealant: Clear silicone sealant as recommended by the manufacturer.

PART 3 – EXECUTION

3.1 COORDINATION

A. Review, coordinate and accommodate work of other trades that interface with, affect, or are affected by the work of this Section to facilitate the execution of the overall work of this project in a coordinated and efficient manner.

3.2 EXAMINATION

A. Examine substrates that will receive panels to ensure that surfaces are smooth, dry, true, and free of dirt, dust, oil, or grease.

B. Remove high spots. Fill low spots.

C. Verify that substrate construction is completed and approved.

D. Correct deficiencies in the substrate before installing panels.

E. The beginning of installation indicates acceptance of substrate and conditions.

3.3 INSTALLATION

A. Install panels/wainscots and trim per manufacturer's printed installation instructions, using manufacturer’s recommended adhesive.

B. Lay out panels for the minimum number of joints and equal width cuts at the ends of walls (or as directed by the Contracting Officer).

C. Install panels full length without horizontal joints.

D. Install trim at all edges and changes of wall plane.

E. Cut openings for utility penetrations tight and seal the gap with silicone sealant.

F. Sealants: Seal corner seams, ceiling, and base junctures, around door frames and other openings, and between penetrating items and panel cut-outs.

1. At the trim, set panels into a continuous bead of fresh sealant so that sealant oozes out of the joint after the panel is fully inserted into the channel, remove excess sealant, and leave the joint crack-free.

3.4 ADJUST AND CLEAN

A. Remove scraps and debris from the site and leave it in a neat and clean condition.

END OF SECTION

SECTION 09 90 00

GENERAL PAINTING, CONCRETE STAIN & COATING REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL

A. General procedures and requirements for surface preparation and field-applied painting and coating.

1.2 RELATED DOCUMENTS

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

1.3 REFERENCES

A. All references shall be the latest adopted edition.

1. MPI - Architectural Painting Specification Manual, as published by the Master Painters and Decorators Association.
   a. MPI(a), Sept 2012, 'Architectural Painting Specification Manual'
2. SSPC - Steel Structures Painting Council, Steel Structures Painting Manual.

1.4 SUBMITTALS

A. Refer to Section 01 33 23 for submittal procedures.

B. Product Data: Provide product data on each different paint finishing product.

1. Include the following information for each painting system, arranged in the same order as in Project Manual.
   a. Manufacturer's cut sheets for each component of the system indicating ingredients and percentages by weight and by volume, environmental restrictions for application, and film thicknesses and spread rates.
      1) If using a manufacturer based on MPI approval, also include copies of appropriate entries from the MPI Approved Product List. Listing in MPI Approved Product List is mandatory for Section 09 97 13.23. If the proposed manufacturer has products listed for these three Sections, but not for other Sections, Contracting Officer may approve products submitted by the proposed manufacturer for other Sections.

b. Manufacturer's substrate preparation instructions and application instructions for each painting system used on Project.
c. Confirmation of colors selected and that each area to be painted or coated has a color selected for it.

2. Provide 2 copies of the Product Data submission.

C. Paint Schedule: Provide a schedule of all proposed paint products for the items to be painted in a format matching the Schedule found in Part 3 of this Section.

D. Paint Draw Down Samples: Provide two 12"x12" minimum brush out cards, using heavy paper card stock, for each paint, concrete stain, or coating color selected for this Project.

1. Sheen Samples: Submit samples of different sheens for each color as directed by Contracting Officer for selection.

E. Paint-Downs: Paint sample of actual surface/item with each paint color selected by Contracting Officer for review and approval before applying any paint finish coats as follows (sizes listed are minimum):

1. Interior Wall: 100 square feet.
2. Exterior Wall: 100 square feet.

F. LEED™ Documentation: Provide LEED™ documentation related to LEED™ Construction IAQ Management Plan EQc3.1 & EQc3.2 as determined by Contractor for compliance with General LEED™ Product Requirements.

1. Low Emitting Materials EQ Credit 4.2: Submit a certification statement on company letterhead specific to products supplied on this project that clearly states the VOC levels of paints and coatings used during construction inside the building envelope and conforms to Green Seal Standard GS-11 and contains the following statement: This product meets Green Seal GS-11 environmental standards for volatile organic compounds (VOCs) and other ingredients.

1.5 QUALITY ASSURANCE

A. Single Source Responsibility: All paint or concrete stain system products used for painting a given material/surface shall be manufactured by the same company unless approved otherwise in writing by the painting system manufacturer. Include such approvals in the Product Data submittal.

B. Applicator Qualifications: Company specializing in performing the work of this section with a minimum of 5 years of successful experience.

C. Field Samples

1. Before application of any paint or concrete stain system, if required by Contracting Officer, meet on Project site with Contracting Officer, Owner's representative, and Manufacturer's representative. Contracting Officer may select one surface for the application of each paint system specified. This process will include establishing acceptable substrate conditions required for the Project before the application of paints and coatings.
2. Apply paint or concrete stain systems to surfaces indicated by Contracting Officer following procedures outlined in Contract Documents and Product Data submission specified above.
3. After approval of samples, proceed with the application of the paint system throughout the Project. Approved samples will serve as the standard of acceptability.

1.6 REGULATORY REQUIREMENTS

A. Conform to applicable code for flame and smoke rating requirements for products and finishes.

B. Paint and painting materials shall be free of lead and mercury and have VOC levels acceptable to local jurisdiction.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Deliver products to the site in sealed, original containers with the Manufacturer’s original labels intact on each container. Deliver the amount of materials necessary to meet Project requirements in a single shipment. Notify Contracting Officer 2 working days before delivery of paint. and labeled containers. Inspect to verify acceptability upon delivery.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store materials in a single ventilated place at a minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, or as required by manufacturer's instructions and/or MPI MANUAL.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Provide environmental conditions as required by the paint manufacturer, MPI Manual and as follows:

1. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer’s written licensure.
2. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer’s written literature.
3. Apply painting systems at a lighting level of 540 Lux (fifty foot-candles) minimum measured mid-height at the substrate surface.

4. Inspection of painting work shall take place under the same lighting conditions as the application. If painting and coating work is applied under temporary lighting, deficiencies discovered upon installation of permanent lighting will be considered latent damage as defined in MPI Manual, PDCA P1-92

1.9 SCHEDULING

A. Coordinate with other trades for materials and systems that require painting before installation.

B. Schedule painting and coating work to begin when work upon which painting and coating work is dependent has been completed. Schedule installation of pre-finished and non-painted items, which are to be installed on painted surfaces, after application of final finishes.

1.10 EXTRA MATERIALS

A Supply 5-gallon container of primary interior wall color paint. Supply 1 gallon of other colors and types of paint used on project; store where directed. Containers to be new and unopened.

B. Label each container with color in addition to the manufacturer's label.

PART 2 - PRODUCTS

2.1 LEED™ REQUIREMENTS

A. Requirements: Construction IAQ Management Plan EQc3.1 & EQc3.2 which are the Contractor’s responsibility to identify, coordinate, and document.

1. Low Emitting Materials EQ Credit 4.1: VOC levels of sealants and fillers used during construction inside the building envelope shall not exceed 250 grams per liter.
2. Low Emitting Materials EQ Credit 4.2: VOC levels of paints, coatings, and sealers used during construction inside the building envelope shall conform to Green Seal Standard GS-11, Green Seal Standard GC-03, and South Coast Air Quality Management District Rule 1113.

B. Tinting color shall be the best grade of the type recommended by the manufacturer of paint or stain used on the Project.

2.2 PAINTS AND COATINGS - GENERAL

A. Paint Manufacturers: Subject to compliance with requirements, provide products of one of the following paint manufacturers.

1. Benjamin Moore
2. ICI Dulux
3. Kelly Moore

4. Master Coating Technologies
5. Parker Paint
6. Sherwin-Williams
7. Tnemec
8. Substitutions: Refer to Division 1 of the specifications.

B. Paints and Coatings: Ready-mixed, select products from the MPI Manual Manufacturer's Product List for Manufacturers listed above which installer has used on other projects and are known to provide excellent performance including:

1. A soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating.
2. Good hiding characteristics.
3. Good flow and brushing properties.
4. Good mildew resistance.
5. Capable of drying or curing free of streaks or sags.

C. Certain manufacturer's products may not provide adequate hiding ability with the number of coats specified. The contractor may be required to provide additional coats at no additional cost if products are selected that do not provide adequate hiding ability.

D. Colors: To be selected by Contracting Officer

2.3 ACCESSORY MATERIALS

A. Accessory Materials: Linseed oil, shellac, turpentine, and other painting materials shall be pure, be compatible with other coating materials, bear identifying labels on containers, and be of the highest quality of an approved manufacturer listed in MPI manuals.

B. Patching Material: Latex-based filler.

C. Sealant: Silicon-latex acrylic sealant as specified in Section 07 90 00.

PART 3 - EXECUTION

3.1 COORDINATION

A. Review, coordinate, and accommodate work of other trades that interface with, affect, or are affected by the work of this Section to facilitate the execution of the overall Work of this project in a coordinated and efficient manner.

B. Coordinate selection of paint products to be applied over prime coats applied by others for compatibility and good adhesion.

C. Coordinate inspection of finish gypsum wallboard (GWB) surfaces with Section 09 29 00 before the start of any painting work; identify and mark any defective areas for correction.

D. Schedule work to follow completion of all dust/dirt producing work.

3.2 GWB FINISH INSPECTION WITH SECTION 09 29 00 & PROJECT SUPERINTENDENT

A. Coordinate an inspection walkthrough of all finished GWB surfaces with Section 09 29 00 and project superintendent using a 500-watt lamp aimed from the side; mark any defects in the surface finish.

3.3 EXAMINATION

A. Verify that surfaces are clean and ready to receive paint as required by the product manufacturer.

B. Examine surfaces scheduled to be finished before commencement of work. Report any condition that may potentially affect proper application or performance.

C. Test shop-applied primer/paint for proper adhesion and compatibility with subsequent cover materials. Report in writing to Contracting Officer of conditions that will adversely affect the adhesion of painting and coating work. Do not apply painting and coating systems until such adverse conditions are corrected by the party responsible for the adverse condition.

D. Report defects in substrates that become apparent after application of primer or first finish coat to the Contracting Officer in writing and do not proceed with further work on the defective substrate until such defects are corrected by the party responsible for the defect.

E. Measure moisture content of surfaces. Do not apply finishes unless the moisture content of surfaces conforms to the recommendations of the MPI Manual and paint manufacturer.

F. Do not start paint application until problems with substrate surfaces, GWB finish, and shop-applied primer/paint have been satisfactorily resolved.

G. Start of installation indicates acceptance of substrate, finish, and conditions and responsibility for proper finish and appearance.

3.4 SURFACE PREPARATION

A. Conform to MPI Manual surface preparation recommendations, paint manufacturer’s recommendations, and the following for preparation of each different surface scheduled to be painted, unless instructed differently in Contract Documents. Bring conflicts to the attention of the Contracting Officer in writing.

B. Substrate: Clean substrate surfaces thoroughly before applying any primer or paint following the paint manufacturer’s cleaning recommendations; allow the substrate to dry thoroughly before starting paint application.

C. Fill in minor holes and cracks in wood surfaces to receive paint or stain.

D. Surface Appurtenances: Remove electrical plates, hardware, light fixture trim, escutcheons, and fittings before preparing surfaces or finishing.

E. Marks: Seal with shellac those which may bleed through surface finishes.

F. Mildew: Remove mildew by scrubbing with a solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow the surface to dry.

G. Factory Primed/Painted Items to be painted: Hand sand factory finished surfaces to provide proper tooth for good adhesion of finish coats.

H. Do no exterior painting while the surface is damp unless recommended by the Manufacturer, nor during rainy or frosty weather. Interior surfaces shall be dry before painting. The moisture content of materials to be painted shall be within tolerances acceptable to the Paint Manufacturer

I. Exterior Galvanized Steel, Stainless Steel, and Aluminum: Prepare surfaces to be painted in strict conformance with the paint manufacturer's surface preparation requirements.

1. Minimum Preparation: SSPC-SP1 Solvent Cleaning of all surfaces in strict conformance with SSPC Steel Structures Painting Manual requirements. Acid etch surface as specifically recommended by the paint manufacturer.
2. Application of primer shall follow surface preparation immediately within the same day or surfaces will require repeating the preparation procedure.
3. Surface preparation and prime painting shall be scheduled to coincide with warm, dry weather, minimum of 60 degrees F, and rising.

3.5 PROTECTION

A. Protect all finish surfaces, landscaping, adjacent property, and elements surrounding the work of this Section from overspray, damage, or disfiguration.

B. Maintain subfloor surfaces free from paint and spills using heavy paper or other methods.

C. Protect other finish work and adjacent materials during painting. Do not splatter, drip, or paint surfaces not intended to be painted. These items will not be spelled out but pay special attention to the following:

1. Do not paint finish copper, bronze, chromium plate, nickel, stainless steel, anodized aluminum, or monel metal except as explicitly specified.
2. Keep cones of ceiling speakers completely free of paint. In all cases where the painting of metal speaker grilles is required, paint without grilles mounted to speakers and without grilles on the ceiling.

D. Remove rags and waste used in painting operations from the building each night. Take every precaution to avoid the danger of fire

3.6 APPLICATION

A. Apply exterior concrete stain or paint products following the manufacturer's instructions and the MPI Manual.

B. Apply sufficient wet film thickness to provide good hiding, do not thin the product.

C. Where adjacent sealant is to be painted, do not apply finish coats until the sealant is applied in gaps 3/16 inch and smaller

D. Do not apply finishes to surfaces that are not dry.

E. Touch up suction spots after application of first finish coat.

F. Spread materials smoothly and evenly. Apply coats to not less than wet and dry film thicknesses and at spreading rates for specified products as recommended by the Manufacturer. Allow applied coats to dry completely and surfaces clean before the next coat is applied.

G. In multiple coat paintwork, tint each succeeding coat with a slightly lighter color, but approximating the shade of the final coat, so it is possible to check the application of a specified number of coats. Tint the final coat to the required color. Apply each coat to a uniform appearance.

H. Vacuum clean surfaces of loose particles. Use fine sandpaper between coats as necessary to produce even, smooth surfaces. Remove dust and particles just before applying the next coat.

I. Gypsum Board: After the paint has been sprayed or roller applied to uniform wet film thickness, backroll the entire surface in the same direction to provide uniform texture, reflective value, and appearance, free of roller marks or lines.

3.7 ADJUSTMENT

A. Correct deficiencies in workmanship as required to leave surfaces in conformance with “Properly Painted Surface” as defined in this Section. Correction of “Latent Damage” and “Damage Caused by Others,” as defined in this Section, is not included in the work of this Section.

3.8 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT

A. Remove louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

B. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed before finishing.

3.9 CLEANING

A. Collect waste material that may constitute a fire hazard, place it in closed metal containers, and remove it daily from the site.

B. As work proceeds and upon completion of work of any painting Section, remove paint spots from floors, walls, glass, or other surfaces and leave work clean, orderly, and in acceptable condition.

3.10 BACK-PRIMING

A. Back-prime the following exterior items before installation that are scheduled to be painted:

1. Exterior fascia and trim.

3.11 PAINT COLOR SCHEDULE

A. The number and placement of exterior paint colors and gloss levels shall be Color Level II from MPI Manual, PDCA P3-04 as modified in paragraph 1, following.

1. Several paint colors or gloss levels will be selected for the entire project. However, no more than 1 paint color will be selected for any exterior substrate.
2. Exterior Color Quality Standards – By Contracting Officer

3.12 SURFACES THAT DO NOT REQUIRE PAINT FINISH

A. The Following Work Is Not Field Painted or Finished by This Section:

1. Pavement markings
2. Site furnishings
3. Fire rating labels, equipment serial numbers, and capacity labels.
4. Factory finished sheet metal items except as specifically noted in the next paragraph 3.11.
5. Factory finished coiling and rolling doors
6. Aluminum doors and frames
7. Door hardware
8. Glazing
9. Ceramic tile
10. Acoustical ceiling tile and grid
11. Resilient floor coverings and rubber base
12. FRP panels
13. Toilet partitions
14. Fire extinguisher cabinets
15. Toilet & miscellaneous accessories
16. Factory casework
17. Elevator

3.13 SURFACES THAT REQUIRE PAINT FINISH

A. Paint all materials/surfaces described below under SCHEDULE - PAINT SYSTEMS.

B. Firestopping exposed to view.

C. Factory-finished items that require painting:

1. Access panels/doors

D. Mechanical and Electrical: Use paint systems defined for the substrates to be finished.

1. Mechanical grilles and louvers
2. Paint all insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, and hangers, brackets, collars and supports to match background surfaces, unless otherwise indicated.
3. Paint shop-primed items.
4. Paint interior surfaces of air ducts that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
5. Paint mechanical or electrical equipment on the building exterior.

3.14 SCHEDULE - PAINT SYSTEMS (ALL WORK IS MPI PREMIUM GRADE)

A. All materials/surfaces scheduled hereinafter shall be painted per designated MPI or proprietary Systems and Product requirements.

1. Sheen on finish coats shall be as selected by Contracting Officer from the manufacturer's paint sheen samples.
2. Use the same manufacturer for each coat specified for a given system, do not intermix different manufacturer's products within the same paint system unless specifically approved by the manufacturer(s), and products are known to be compatible for use together.
   a. Where primer is applied by others:
      1) Select a paint system compatible with the primer installed by others.
      2) Test compatibility and adhesion of proposed paint products over primer before application.
   b. Paint failure due to incompatibility between different manufacturers' products is the Contractor's responsibility to correct.

B. Ferrous Metal: Finish all surfaces.

1. Hollow Metal Door Frames (Exterior): Provide paint system specified for Exterior Galvanized Steel.
   a. Application: Spray.
   b. MPI Gloss Level 5

C. Wood:

1. Interior: MPI INT 6.4A
    a. First Coat: Alkyd Primer sealer, MPI Product #45
    b. Second Coat: Interior Latex, MPI Product #52
    c. Third Coat: Interior Latex, MPI Product #52
    d. Application: Spray & back-roll

D. Gypsum Board:

1. Interior: MPI INT 9.2.A.
    a. First Coat: Waterborne primer/sealer, MPI Product #50
    b. Second Coat: Interior latex, MPI Product #43
    c. Third Coat: Interior latex, MPI Product #43
    d. Application: Spray and backroll
    e. MPI Gloss Level: MPI Gloss Level 4 or as selected by Contracting Officer for specific use areas.

E. Cementitious Composition Board (Fiber Cement Siding)

1. Exterior MPI EXT 3.3A
    a. First Coat: Exterior latex low sheen, MPI Product #15
    b. Second Coat: Exterior latex low sheen, MPI Product #15
    c. Third Coat: Exterior latex low sheen, MPI Product #15
    d. Application: Spray and back-roll
    e. MPI Gloss Level: MPI Gloss Level 3 & 4.

END OF SECTION

SECTION 09 96 56

HIGH-PERFORMANCE COATINGS (EPOXY COATINGS)

PART 1 – GENERAL

1.1 SCOPE

A. Applies to sealants and surfacing coating materials applied with a proprietary heated plural component spray system.

B. Uses included in the project:

1. Waterproof corrosion and abrasion-resistant coating for interior surfaces of manholes and wet wells where required by notes on drawings and interior surfaces of water-containing or water-conveying basins, control boxes, or channel ways, as depicted and noted on drawings.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Polyurethane Coating: 100% solids polyurethane coating, free of volatile organic compounds (VOCs), with minimum properties as follows:

PROPERTY	**TEST METHOD**	**VALUE**
Tensile Strength	ASTM D638	7,450 psi
Tensile Modulus	ASTM D638	425,000 psi
Elongation	ASTM D638	4% at break
Abrasion (Taber CS17)	ASTM D4060	17.7 mg loss
Hardness, Shore D	ASTM D2240	90
Adhesion to Concrete	ASTM D4541	Substrate Failure
Density	---	87 lbs/cf
Color	---	Natural color - golden
Application Thickness	---	125 mils
Product Name	---	SprayWall by SprayRoq (or equivalent)
Warranty	---	1 year from date of application

B. Submittals: Provide product data per Section 01 33 00.

PART 3 – EXECUTION

3.1 APPLICATION

A. Coating shall be applied by utilizing a proprietary heated plural component spray system. Coating shall be applied by manufacturer trained and approved appliers only and in strict accordance with the manufacturer's directions for usage and installation.

B. Preparation of concrete surfaces: Pressure-wash, chip visible loose material, apply repair grout where needed to relieve raw-edge conditions. Surfaces must be cleaned of all oil, grease, rusts, scale, deposits, and other debris or contaminants. The surface shall be properly dried and meet the surface temperature requirements of 55 - 122 degrees Fahrenheit.

C. Preparation of steel surfaces: Prepare surface by powered wire brush or equal. Surfaces must be cleaned of all oil, grease, rusts, scale, deposits, and other debris or contaminants. The surface shall be properly dried and meet the surface temperature requirements of 55 - 122 degrees Fahrenheit.

D. Workmanship and soundness: Finished coating stall be free of scuffs, visible material defects, bubbles, voids, or other flaws in continuity.

E. Warranty: One year as defined in General Conditions.

END OF SECTION

SECTION 09 97 13.23

EXTERIOR PAINTED IRON & STEEL

PART 1 - GENERAL

1.1 GENERAL

A. Preparing and painting new exterior un-galvanized iron and steel surfaces with MPI EXT 5.1M Acrylic Finish System, as described in Contract Documents.

B. Related Sections

1. Division 09 Section 09 90 00 - Paints & Coatings.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Use MPI Premium Grade finish requirements for work of this Section.

B. Gloss/Sheen Level Required - Semi-Gloss or Flat

C. Approved Products

1. Primer Coat - MPI Product #107
2. Finish Coats - MPI Product #110

PART 3 - EXECUTION

3.1 APPLICATION

A. General - See appropriate paragraphs of Section 09 90 00 - Paints & Coatings.

B. Clean metal to be painted of rust, mill scale, grease, oil, and welding spatters, burrs, flux, slag, and fume. If all traces of rust cannot be removed, apply rust blocker recommended by Paint Manufacturer before applying primer coat.

3.2 PAINT SCHEDULE

A. Apply to:

1. Ductile Iron Piping
2. Rooftop items are not screened from view with non-factory finishes.
3. Electrical panels and weatherproof electrical outlets.
4. Paint other exterior metalwork items.

B. Colors to be selected by the Contracting Officer.

END OF SECTION

DIVISION 10

SPECIALTIES

SECTION 10 14 00

SIGNAGE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Plastic interior panel signs.

1. Room Identification.
2. Informational Signage.
3. Directory Signage.

B. Plastic exterior panel signs.

1. Room Identification.
2. Informational Signage.
3. Directory Signage.

1.2 RELATED SECTIONS

A. Section 06 20 00 – Interior Finish Carpentry.

1.3 REFERENCES

A. ANSI 117.1 - For Buildings and Facilities.

B. ASTM International (ASTM):

1. ASTM D149 - Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies.
2. ASTM D570 - Standard Test Method for Water Absorption of Plastics.
3. ASTM D638 - Standard Test Method for Tensile Properties of Plastics.
4. ASTM D648 - Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.
5. ASTM D695 - Standard Test Method for Compressive Properties of Rigid Plastics.
6. ASTM D696 - Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30 degrees C and 30 degrees C with a Vitreous Silica Dilatometer.
7. ASTM D732 - Standard Test Method for Shear Strength of Plastics by Punch Tool.
8. ASTM D785 - Standard Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials.
9. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

10. ASTM D792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
11. ASTM D1003 - Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics.
12. ASTM D1929 - Standard Test Method for Determining Ignition Temperature of Plastics.
13. ASTM D2843 - Standard Test Method for Density of Smoke from the Burning or Decomposition of Plastics.
14. ASTM D3418 - Standard Test Method for Transition Temperatures and Enthalpies of Fusion and Crystallization of Polymers by Differential Scanning Calorimetry.
15. ASTM D3763 - Standard Test Method for High-Speed Puncture Properties of Plastics Using Load and Displacement Sensors.
16. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
17. ASTM E2072-04 - Standard Specification for Photoluminescent (Phosphorescent) Safety Marketing.
18. ASTM E2073-02 - Standard Test Method for Photopic Luminance of Photo Luminescent (Phosphorescent) Markings.

C. Underwriters Laboratories (UL):

1. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.
2. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS

A. Submit under provisions of Section 01 33 23 – Submittal Procedures.

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. Shop Drawings: Detail drawings showing sizes, lettering and graphics, construction details of each type of sign, and mounting details with appropriate fasteners for specific project substrates.

D. Manufacturer's Installation Instructions: Printed installation instructions for each signage system.

E. Message List: Signage report indicating signage location, text, and sign type.

F. Selection Samples: For each finished product specified, two complete sets of color chips representing the manufacturer's full range of available colors and available pictograms, characters, and Braille indications.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Minimum two years of documented experience in work of this Section.

B. Installer Qualifications: Minimum two years of documented experience in work of this Section.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in unopened factory packaging.

B. Inspect materials at delivery to verify there are no defects or damage.

C. Store products in the manufacturer's original packaging until ready for installation in the climate-controlled location away from direct sunlight.

D. Store and dispose of solvent-based materials, and materials used with solvent-based materials per requirements of local authorities having jurisdiction.

1.7 PROJECT CONDITIONS

A. Install products in an interior climate-controlled environment.

B. Maintain environmental conditions (temperature, humidity, and ventilation) within the limits recommended by the manufacturer for optimum results. Do not install products under environmental conditions outside the manufacturer's absolute limits.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer or approved equal:

Nova Polymers, Inc.,
8 Evans St. Suite 201
Fairfield, NJ 07004
Toll-Free Tel: 888-484-NOVA (6682)
Email: request info (info@novapolymers.com)
Web:https://www.novapolymers.com

B. Acceptable Fabricators or approved equal

1. Acceptable Fabricator: Kroy Sign Systems, 8221 E Gelding Dr., Scottsdale, AZ 85260. Phone: (800) 950-5769. Email: signs@kroysignsystems.com. Web: www.kroysignsystems.com.

2. Acceptable Fabricator: Neiman & Company, 6842 Valjean Ave., Van Nuys, CA 91406. Phone: (818) 781-8600. Email: signs@neimanandco.com. Web: www.neimanandcompany.com.
3. Acceptable Fabricator: Signtech, 4444 Federal Blvd., San Diego, CA 92102. Phone: (619) 527-6100 ext.117. Email: sales@Signtech.com. Web: www.signtech.com.
4. Acceptable Fabricator: Tube Art Group, 11715 SE 5th Street, Bellevue, WA 98005. Phone: (206) 223-1122 Email: mwoods@tubeart.com. Web: www.tubeartgroup.com

C. Requests for substitutions will be considered following provisions of Section 01 67 00 - PRODUCT REQUIREMENTS.

2.2 PERFORMANCE REQUIREMENTS

A. Provide photopolymer signage that conforms to the requirements of all regulatory agencies holding jurisdiction.

B. Novacryl PETG: Polyethylene terephthalate glycol. A thermoplastic polyester with high chemical resistance, and formability.

1. ADA Compliant.
2. NSF: Listed.
3. FDA: Conforms to food contact regulations.
4. Physical Properties:
   a. Specific Gravity per ASTM D792: 1.27.
   b. Optical Refractive Index per ASTM D542: 1.57.
   c. Light Trans - Total per ASTM D1003: 86 percent.
   d. Light Trans - Haze per ASTM D1003: 1 percent.
   e. Water Absorption by weight per ASTM D570: 0.2 percent.
5. Mechanical Properties:
   a. Tensile Strength per ASTM D638: 7,700 psi.
   b. Tensile Modulus of Elasticity per ASTM D790: 320,300 psi.
   c. Flexural Strength per ASTM D790: 11,200 psi.
   d. Flexural Modulus of Elasticity per ASTM D790: 10,000 psi.
   e. Izod Impact Strength Molded - Milled Notch per ASTM D256: 1.7 Ft-lb per inch Notch.
   f. Rockwell Hardness per ASTM D785: R-115.
   g. Drop Dart Impact per ASTM D3763: 22 ft-lbs.
   h. Shear Strength per ASTM D732: 9,000 psi.
   i. Compressive Strength per ASTM D695: 8,000 psi.
6. Thermal Properties:
   a. Deflection Temperature at 264 psi ASTM D648: 157 degrees F.
   b. Deflection Temperature at 66 psi ASTM D648: 164 degrees F.
   c. Coefficient of Thermal Expansion ASTM D696: 3.8x10 Inches per inch per degree F.
   d. Flammability (Burning Rate) ASTM D635: 0.06 Inches per minute.
   e. Flammability UL 94: HB.
   f. Smoke Density Rating ASTM D2843: 53.8 percent.
   g. Self-Ignition Temp ASTM D1929: 880 degrees F.
   h. Flame Spread Index ASTM E84: 85.
   i. Smoke Development Index ASTM D84: 450.
   j. Glass Transition Temperature ASTM D3418: 178 degrees F.

7. Electrical Properties:
    a. Dielectric Constant at 1KHz ASTM D150: 2.6.
    b. Dielectric Constant at 1MHz ASTM D150: 2.4.
    c. Dielectric Strength ASTM D149: 410 Volts per mil.

2.3 SIGNAGE – GENERAL

A. These specifications intend to establish a sign standard for the Owner including but not limited to, wall-mounted directional signs and primary room identification.

B. Comply with all applicable provisions of the 2010 ADA Standard for Accessible Design codes that apply to the State and Local jurisdiction of the project.

C. If required text and graphics are not indicated in the specification or on drawings, obtain the Owner's instructions as to text and graphics before preparation of shop drawings.

D. Typography: See Drawings. A copy shall be a clean and accurate reproduction of the typeface(s) specified. Upper and lower case and all caps as indicated in Sign Type drawings and Signage Schedule. Letter spacing is to be set by the manufacturer.

E. Arrows, symbols, and pictograms will be provided in style, sizes, colors, and spacing as indicated in drawings for each sign system.

F. Braille:

1. California Braille.

G. Design:

1. Text/Graphics Placement: Centered, or as indicated on contract drawings.
2. Font: As indicated on the Contract Drawings.

2.4 INTERIOR SIGNAGE

A. Panel Material: Novacryl AL Series Photopolymer.

1. Composition: 0.032 inches (0.8 mm) thick moisture resistant interior nylon photopolymer bonded to 0.017 inches (0.4 mm) thick brushed aluminum alloy base.
2. Base thickness: 0.017 inches (0.4 mm) thick brushed aluminum alloy base.
3. Type and Color: To be selected from the manufacturer's full-color range by Contracting Officer.
4. Size: As defined on the drawings.

2.5 EXTERIOR SIGNAGE

A. Panel Material: Novacryl EX Series Photopolymer.

1. Composition: 0.032 inch (0.8 mm) thick exterior-grade photopolymer resin bonded to 0.016 inch (0.4 mm) thick aluminum alloy base.
2. Base thickness: 0.016 inches (0.4 mm) thick brushed aluminum alloy base.
3. Type and Color: To be selected from the manufacturer's full-color range by Architect.
4. Size: As shown on the drawings.

2.6 ACCESSORIES

A. Adhesive:

1. Type recommended by sign manufacturer.

B. Fasteners: Chrome plated screws.

2.7 FABRICATION

A. Fabricate panel material following manufacturer's instructions and approved shop drawings.

B. Fabricate signs by photopolymer process using film negatives to produce characters and graphics in contrasting color, raised. Refer to Signage Schedule.

C. Characters:

1. Height: Refer to Signage Schedule.
2. Style: Refer to Signage Schedule.
3. Width to height ratio: Refer to Signage Schedule.
4. Stroke width to height ratio: Refer to Signage Schedule.

D. Pictograms: Refer to Signage Schedule.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify the Contracting Officer of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly before installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install following manufacturer's instructions.

3.4 PROTECTION

A. Protect installed products until completion of the project.

B. Touch up, repair, or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 10 44 00

FIRE EXTINGUISHERS & BRACKETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including Division 1 Specification Sections, apply to work of this Section.

1.2 SECTION INCLUDES

A. Fire Extinguisher Cabinets

1.3 REFERENCES

A. All references shall be the latest adopted edition.

B. NFPA 10 - Standard for Portable Fire Extinguishers; National Fire Protection Association.

C. UL (FPED) - Fire Protection Equipment Directory; Underwriters Laboratories Inc.; current edition.

1.4 SUBMITTALS

A. Refer to the Purchase Order for submittal procedures.

B. Product Data: Manufacturer's descriptive literature for specified products; indicate compliance to specified requirements.

PART 2 - PRODUCTS

2.2 MANUFACTURERS

A. Available Manufacturers: Subject to conformance with the requirements of this Section, manufacturers offering products that may be provided for this project include, but are not limited to, the following:

1. J.L. Industries, Inc. (specified)
2. Larsen's Manufacturing Company
3. Potter-Roemer
4. The Williams Brothers Corp.
5. Substitutions: Refer to requirements in Section 01 33 23.

2.3 FIRE EXTINGUISHERS

A. Fire Extinguishers: J.L. Industries Cosmic 10E dry chemical, multi-purpose, 10-pound capacity.

1. UL Rating: 4-A:80-B:C; provide at all locations Extinguishers shall be fully charged.

B. Extinguisher Mounting Bracket: Plated steel bracket for mounting either on a wall or in a cabinet, with the quick-release metal retaining strap to hold the extinguisher securely to the bracket. Provide for all extinguishers.

C. Labels: Attach manufacturer's standard metal foil label to the cylinder, with printing and graphics indicating information and instructions required by local authorities having jurisdiction.

PART 3 - EXECUTION

3.1 COORDINATION

A. Review, coordinate, and accommodate work of other trades that interface with, affect, or are affected by the work of this Section to facilitate the execution of the overall Work of this project in a coordinated and efficient manner.

B. Coordinate size and location of recessed openings in framed walls with Sections 06 10 00 - Carpentry and 09 29 00 - Gypsum Board Assemblies.

3.2 EXAMINATION

A. Verify that wall openings are the correct size and in the correct locations.

3.3 INSTALLATION

A. Install cabinets securely to wall framing per manufacturer's instructions and as required by local Code Authority.

1. Install Extinguisher Mounting Bracket centered in the cabinet for each fire extinguisher.

3.4 ADJUSTING

A. Immediately before project completion, ensure extinguishers are fully charged and bear tag recording date of charging and signature of verifying entity.

3.5 PROTECTION

A. Protect exposed finishes of cabinets from damage by subsequent construction activities

B. Repair minor damage to finishes following manufacturer's recommendations; replace components that cannot be repaired to the Owner's satisfaction.

END OF SECTION

DIVISION 12

FURNISHINGS

SECTION 12 30 00

CASEWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including Division 1 Specification Sections, apply to work of this Section.

1.2 SECTION INCLUDES

A. Factory Plastic Laminate Casework

1.3 REFERENCES

A. All references shall be the latest adopted edition.

B. AHA A135.4 - Basic Hardboard; American Hardboard Association.

C. ANSI A208.1 - Wood Particleboard.

D. AWI P-200 - Architectural Woodwork Quality Standards; Architectural Woodwork Institute.

E. NEMA LD 3 - High-Pressure Decorative Laminates; National Electrical Manufacturers Association.

F. PS 1 - Construction and Industrial Plywood.

G. PS 20 - American Softwood Lumber Standard.

1.4 SUBMITTALS

A. Refer to Division 1 of the specifications for submittal procedures.

B. Low Emitting Materials

1. Submit a certification statement on company letterhead specific to products supplied on this project that clearly states the VOC levels of adhesives and sealants used during construction inside the building envelope and that they do not exceed levels per LEED™ as noted below.
2. Submit a certification statement on company letterhead specific to products supplied on this project that clearly states that the casework materials contain no added urea-formaldehyde resins.

C. Product Data: Provide manufacturer's data for casework, hardware, and accessories.

D. Shop Drawings: Provide plan and elevation view of all casework; indicate materials, component profiles and elevations, assembly methods, joint details, fastening methods, accessory listings, hardware location, and schedule of finishes.

1. Counter-Mounted Item (Sinks, appliances, etc.): Show location and size of cutouts for all counter-mounted items, including reinforcing and special requirements. Coordinate rough-in requirements and cut-out dimensions required to accommodate counter-mounted items with trade responsible.
2. Owner Provided Equipment/Appliances: Show location and size of all Owner provided equipment, including reinforcing and special requirements. Coordinate rough-in requirements and dimensions required to accommodate equipment/appliances with the Owner.
3. Coordinate all required dimensions, cutout sizes, and rough-in requirements with the Owner or trade responsible before submission.

E. Samples:

1. Plastic Laminate: Submit two 8" x 11" samples of each different plastic laminate color selected.

1.5 DELIVERY, STORAGE & PROTECTION

A. Protect units from moisture damage.

1.6 ENVIRONMENTAL REQUIREMENTS

A. During and after installation of work of this section, maintain the same temperature and humidity conditions in building spaces as will occur after occupancy.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: The standard of quality and function required for factory casework is AWI Section 400, Custom Grade, Full Overlay Design as further modified by this Section and the Drawings to meet the requirements of this project. Subject to their ability to conform to the requirements of the Drawings and this Section, and to provide custom casework shown on the Drawings using modified standard casework and custom materials/standards specified herein, other manufacturers may be acceptable:

B. Substitutions: Refer to Division 1 of the specification.

2.2 WOOD MATERIALS

A. Softwood Lumber (for use in concealed locations only): NIST PS 20; Graded following AWI P-200 Economy average moisture content of 11 percent.

2.3 PANEL MATERIALS

A. Softwood Plywood: NIST PS-1, APA stamped, exterior grade, five-ply, sanded "A" face on exposed surfaces to receive finish material, "B" or "C" face on concealed surfaces, manufactured with a formaldehyde-free adhesive.

1. Low Emitting Materials Credit EQc4.4: Panels used in the fabrication of the casework shall contain no added urea-formaldehyde resins.

B. Melamine-Faced Monolithic Flakeboard (Particleboard): Industrial Grade Particleboard conforming to ANSI A208.1 manufactured with a formaldehyde-free binder, three-ply, balanced construction of 45 lbs. per cubic foot density, moisture content of 8% or less, with melamine laminate facing in colors selected by Architect.

1. Low Emitting Materials Credit EQc4.4: Panels used in the fabrication of the casework shall contain no added urea-formaldehyde resins.

C. Monolithic Flakeboard (Particleboard): Industrial Grade Particleboard conforming to ANSI A208.1 manufactured with a formaldehyde-free binder, three-ply, balanced construction of 45 lbs. per cubic foot density, moisture content of 8% or less.

1. Low Emitting Materials Credit EQc4.4: Panels used in the fabrication of the casework shall contain no added urea-formaldehyde resins.

D. Hardboard: AHA A135.4; pressed wood fiber, tempered grade, manufactured with a formaldehyde-free binder, exposed face(s) smooth.

1. Low Emitting Materials Credit EQc4.4: Panels used in the fabrication of the casework shall contain no added urea-formaldehyde resins.

E. Moisture Resistant Medium Density Fiberboard (MDF): Industrial Grade Medium Density Fiberboard (MDF), conforming to the requirements of ANSI A208.2-1994, product class MD-EXTERIOR.

1. MDF Manufacturer/Product: SierraPine Medex or similar.
2. Low Emitting Materials Credit EQc4.4: Panels used in the fabrication of the casework shall contain no added urea-formaldehyde resins.

2.4 PLASTIC LAMINATE MATERIALS

A. Manufacturers:

1. Wilsonart
2. Other manufacturers are acceptable subject to compliance with the specifications.

B. High-Pressure Plastic Laminate conforming to NEMA LD 3 and the following:

1. Vertical Applications: GP-33 (0.30 inch thick).
   a. Special: Similar to Wilsonart High-Wear Laminate
2. Horizontal Applications: GP-50 (0.050 inch thick).
   a. Special: Similar to Wilsonart High-Wear Laminate
3. Laminate Backing Sheet: BK20 (0.020 inches thick) backing grade, undecorated plastic laminate.
4. Colors: Refer to Section 01 33 23 for color selections.

2.5 HARDWARE & ACCESSORIES

A. Adhesive: Type recommended by the laminate manufacturer to suit the application.

1. Low Emitting Materials Credit EQc4.1: VOC levels of adhesives and sealants used during construction inside the building envelope shall not exceed levels shown in the Maximum VOC Level Chart included in Section 01 81 13.

B. PVC Edge Banding: Provide Woodtape Accent Edge 3 mm thick PVC edge banding, hot melt glue applied at the factory.

1. Colors: To be selected by Contracting Officer.

C. Hinges: European style, fully concealed

D. Door Catches: Magnetic catches with a minimum 7 lb. pull.

E. Drawer Glides: 75 lb. load rating, concealed, epoxy coated, under-mount, self-closing, self-adjusting.

F. File Drawer Glides: Full extension glide with 150 lb. load rating; similar to Accuride #4032

G. Pulls: 5/16-inch diameter metal wire pull, 4-inch hole spacing, US26D satin chrome finish.

H. Shelf Supports: Nickel-plated steel L-shaped clips with steel pin which fits into 5 mm hole, with security pin for preventing inadvertent shelf removal.

I. Locks: National Lock, type appropriate for application, US26D satin chrome finish, keyed as directed.

J. Countertop Support Brackets: Custom fabricated heavy-duty welded tube steel construction, furniture-quality finish.

1. Size to fit counter depth.
2. Configuration shall allow for code-required ADA accessible knee space under counter.
3. Wall supported, provide appropriate size/number of attachment screws.
4. Capable of 300-pound load applied to the outside edge of the counter without failure or deflection.
5. Powder coated to complementary neutral color with a satin finish.

K. Fasteners: Size and type to suit the application.

L. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit the application.

M. Concealed Joint Fasteners: Threaded steel.

N. Grommets: Plastic material for cut-outs.

2.6 FABRICATION - PLASTIC LAMINATE FACED CASEWORK

A. Verify field conditions and dimensions before starting fabrication.

B. Fabricate casework to conform to the manufacturer's published standard and these specifications.

C. Fabricate in sizes and shapes indicated and as required to fit the spaces and conditions.

D. Provide thermo-fused melamine overlay on all exposed interior faces of particleboard that do not receive the plastic laminate, color as selected.

1. Provide a protective seal on concealed faces.

E. Shop assemble casework for delivery to site in units easily managed and to permit passage through building openings.

F. Cap exposed plastic laminate finish edges with PVC edge banding.

G. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

H. Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners.

I. Apply wood laminate by grain matching adjacent sheets to book matching. Run all wood grain in the same direction.

J. Apply laminate backing sheet to reverse side of a plastic laminate finished surfaces; match liner color where exposed inside of a cabinet or on back of doors and drawer fronts.

K. Shelves over 29 inches shall be 1 inch thick, install PVC edge banding on both long faces of shelves.

L. Provide cutouts for fixtures and fittings. Verify locations of cutouts from on-site dimensions. Seal cut edges.

M. Base: Provide base heights as noted on the Drawings.

N. Light Valance: Construct valance on upper cabinets wherever lighting fixtures are shown on Drawings.

PART 3 - EXECUTION

3.1 COORDINATION

A. Review, coordinate, and accommodate work of other trades that interface with, affect, or are affected by the work of this Section to facilitate the execution of the overall Work of this project in a coordinated and efficient manner.

B. Coordinate backing requirements with Sections 06 10 00 and 09 29 00.

C. Casework installation shall be scheduled to follow painting and installation of ceiling wall angle.

3.2 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify location and sizes of utility rough-in associated with work of this section.

3.3 INSTALLATION - CASEWORK

A. Set and secure casework in place; rigid, plumb, and level per casework manufacturer's installation requirements.

B. Field Joinery: Make joints neatly, with a uniform appearance. Comply with requirements of AWI standard for shop joinery.

C. Use fixture attachments in concealed locations for wall-mounted components.

D. Use concealed joint fasteners to align and secure adjoining cabinet units and countertops.

E. Secure cabinet and counter bases to floor using appropriate angles and anchorages.

F. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood, finish flush with surrounding surfaces.

G. Cut out back of cabinet and backsplash for each plumbing waste, water line, and electrical box individually; make accurate cuts that will be covered completely by escutcheon trim and cover plates.

H. Cut cabinets to accommodate concealed ductwork neatly to fit the size of the duct; do not weaken cabinet or countertop support members.

I. Upper Cabinets inside Corners: Provide matching filler panels at the top and bottom of upper cabinets at inside corners to eliminate void space.

3.4 WORKMANSHIP

A. Casework installation shall be installed using the best workmanship, including the following:

1. No damage to exposed to view finished surfaces.
2. Casework scribed tight to adjacent surfaces.
3. Casework securely attached to wall framing/backing.
4. Accurate cut-outs for plumbing pipes and electrical devices/conduit in the back of the cabinet.
5. Drawers open/close easily.
6. Doors and drawers align properly.
7. Door hinges are not stiff or hard to open.
8. Countertops properly supported and installed level and secured in place.
9. Countertop joints tightly fitted and flush.
10. Edges of plastic laminate not over or under-filed.
11. No exposed fasteners.
12. Consistent gloss and finish appearance on hardwood trim.

3.5 ADJUSTING

A. Test installed work for rigidity and ability to support loads.

B. Adjust moving or operating parts to function smoothly and correctly.

3.6 CLEANING

A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION

DIVISION 13

SPECIAL CONSTRUCTION

SECTION 13 34 18

POST FRAME BUILDING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Engineered wood-framed structures consist of the following components:
   a. Factory-engineered wall columns.
   b. Factory-engineered roof truss.
   c. Factory-engineered metal roofing system.
   d. Prefinished metal trim items.
   e. Prefinished ridge vents and soffits.

1.2 REFERENCES

A. Reference Standards:

1. Preservative Treated Lumber:
   a. American Wood Preservers Association (AWPA).
2. Lumber grading rules and wood species:
   a. National Design Specifications for Wood Construction, the current edition.
   b. Northeastern Lumber Manufacturer's Association, Inc. (NELMA).
   c. Southern Pine Inspection Bureau (SPIB): Southern Pine.
   d. West Coast Lumber Inspection Bureau (WCLIB): Douglas Fir.
   e. Western Wood Products Association (WWPA): Douglas Fir and Ponderosa Pine.
3. MSR Lumber Producers Council (MSR) for machine stress-rated lumber.
4. National Design Specifications for Wood Construction.
5. National Design Standard for Metal Plate Connected Wood Truss Construction (TPI).

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-engineered product. Indicate component materials, dimensions, profiles, and construction and installation details.

1. Include information for specialty accessory products specified for this Project.
2. Include data for wood-preservative treatment from chemical treatment manufacturers and certification by treating plants that treated materials comply with requirements. Indicate the type of preservative used and the net amount of preservative retained.
3. For products receiving waterborne treatment, include a statement that the moisture content of treated materials was reduced to levels specified before shipment to the truss fabricator.
4. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Sizes, stress grades, and species of lumber.
2. Anchor-bolt layout.
3. Structural Framing Drawings: Show complete fabrication of primary and secondary framing. Include provisions for openings and the following information:
   a. Slope or depth, span, and spacing of truss.
   b. Heel bearing height.
   c. Design loading to include:
      1) Top chord live load.
      2) Top chord dead load.
      3) Bottom chord dead load.
      4) Concentrated loads and their points.
   d. Adjustments to lumber and plate design values for conditions of use.
   e. Plate type, thickness of gauge, and size.
   f. Lumber size, species, and grade for each member.
4. Metal Roof Panel Layout Drawings: Show layouts of metal panels including methods of support. Include details of edge conditions, joints, panel profiles, corners, anchorages, trim, flashings, closures, and special details. Indicate the following components:
   a. Roof-mounted items.
5. Submit Shop Drawings that have been engineered and certified by a professional engineer licensed in the State in which Project is located. Include seal and signature of professional engineer on Shop Drawings.

C. Design Data: Truss engineering calculations for loading and stresses, bearing the seal, and signature of a professional engineer licensed in the State in which the Project is located. Include the following calculations:

1. The minimum design shall meet design standards of the latest edition of the International Building Code unless other, more stringent requirements are in force in the Project location.
2. Bending moments and axial forces for each member.
3. Basic plate design values.
4. Design analysis for each joint indicates that proper plates have been used.
5. Provide design calculations for exterior walls, canopies, soffit systems, and lateral bracing walls. Design wind loads and lateral bracing loads are indicated on structural Drawings.
6. Submit design calculations that have been engineered and certified by a professional engineer licensed in the State in which Project is located. Include seal and signature of professional engineer on calculations.

D. Samples for Initial Selection: For units with the factory-applied color finish, color chart of the manufacturer's standard colors.

1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.
2. Engineered wood products.

B. Quality Control Submittals:

1. Test Reports: Certified test reports showing compliance with specified performance characteristics.
2. Certification: Manufacturer's certification that Products furnished meet specified design and performance criteria.

C. Submit written proof of third-party inspection program in force for truss manufacturer used on Project.

D. Certifications: Certify that specified roof and wind load requirements are met.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer with minimum 5 years' documented experience that participates in a recognized quality-assurance program that complies with quality-control procedures and that involves third-party inspection by an independent testing and inspecting agency acceptable to Architect and authorities having jurisdiction.

1. Manufacturers' responsibilities include providing professional engineering services needed to assume engineering responsibility.
2. The manufacturer shall have an engineering department.
3. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

B. Erector Qualifications: An experienced erector who specializes in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to the manufacturer.

C. Source Limitations: Obtain engineered post-frame building components, including primary and secondary framing and metal panel assemblies, from a single source from a single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Handle and store materials per manufacturer's requirements.

B. Handle and store trusses to comply with recommendations in TPI BCSI, "Building Component Safety Information: Guide to Good Practice for Handling, Installing, Restraining, & Bracing Metal Plate Connected Wood Trusses."

1. Store trusses flat, off ground, and adequately supported to prevent lateral bending.
2. Protect trusses from the weather by covering them with waterproof sheeting, securely anchored.
3. Provide for air circulation around stacks and under coverings.
4. Store trusses to avoid contact with other materials that could create staining or discoloration.

C. Inspect trusses upon delivery to the Project site and notify the manufacturer immediately if members have damage from handling or show discoloration, corrosion, or other evidence of deterioration. Discard and replace trusses that are damaged or defective.

1.7 WARRANTY

A. Manufacturer's Special Warranty - Treated Material: The manufacturer agrees to repair, restore, or replace columns that fail in materials within a specified warranty period.

1. Warranty Period: 50 years from the date of Substantial Completion.
2. Manufacturers shall repair treated structural columns that fail because of insect damage or because of decay that occurs under normal conditions and proper use. If the manufacturer is not able to repair structural posts to satisfaction of the Owner, the manufacturer shall replace damaged treated structural columns.

B. Special Warranty on Metal Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within the specified warranty period.

1. Exposed Panel Finish: Deterioration includes the following:
   a. Color fading more than 5 Hunter units when tested per ASTM D2244.
   b. Chalking more than a No. 8 rating when tested per ASTM D4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Finish Warranty Period: From the date of Substantial Completion, 40 years on chalk; 30 years on color change:
3. Warranty Exclusions: The manufacturer will not warrant metal panel finishes damaged due to exposure to atmospheric pollutants including animal waste or other corrosive conditions. Manufacturers will not warrant labor by others.
4. Manufacturers shall repair painted steel roofing or siding panels if the paint peels, cracks, checks, flakes, or blisters to an extent that is apparent by ordinary outdoor visual observation when exposed to normal weather and atmospheric conditions. If the manufacturer is not able to repair steel panels to the satisfaction of the Owner, the manufacturer shall replace damaged steel panels.

PART 2 - PRODUCTS

2.1 PERFORMANCE CRITERIA

A. Design Requirements:

1. Design wood members per formulas published in National Design Specifications (NDS) for Wood Construction.
2. Design light meta-toothed connector plates and joint design in compliance with Truss Plate Institute’s (TPI) National Design Standard for Metal Plate Connected Wood Truss Construction.
3. Include unbalanced roof loads required by ASCE-7, the current edition.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC3b for exterior construction not in contact with the ground and Use Category UC4a for items in contact with the ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
2. For exposed items indicated to receive stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. The maximum moisture content of 19 percent or per appropriate grading rules. Do not use a material that is warped or does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of inspection agency approved by ALSC Board of Review.

D. Application: Treat items indicated on the Drawings, and the following:

1. Laminated columns.
2. Baseboards.
3. Hold down blocks.

2.3 MATERIALS – WOOD

A. Laminated Columns: Factory-fabricated from minimum 3 ply 2 inches by 6-inch #1 or better southern yellow pine.

1. Columns to 20 Feet Lengths: Full-length (unspliced) nail laminated plys. Provide middle ply with short truss support block.
2. Columns over 20 Feet Lengths: Spliced laminated plies per approved Shop Drawings and manufacturer's design.
3. Preservative-Treatment: Treat portions of columns designed to be in contact with the ground to a net retention of 0.60 pounds per cubic foot of CCA per AWPA U1 requirements.

B. Wood Trusses: Factory-fabricated of surfaced lumber.

1. Lumber:
   a. Top and Bottoms Chords: No. 1 or better Southern yellow pine or comparable Spruce- pine-fir.
   b. Webs: No. 2 or better Southern yellow pine or SPF.
2. Metal Connector Plates: Fabricated from ASTM A653; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A); G60 hot-dip galvanizing coating designation.
   a. Plate Thicknesses: 0.036 inches and 0.0556 inches thick.

C. Baseboards: 2-inch by 8-inch No. 2 or better Southern yellow pine, tongue-and-groove.

1. Preservative-Treatment: Treat baseboards for ground contact conditions per AWPA U1 requirements. Preservative shall penetrate 100 percent of sapwood.

D. Wall Girts: 2-inch by 6-inch girts, No. 1 or better Southern yellow pine.

E. Purlins and Truss Ties: 2-inch by 4-inch laid on edge, MSR SPF 1650.

1. Purlins may be installed over the top chord of the truss, flat, or in purling hangers. Where purlins and truss ties are set in hangers, provide 2-inch by 6-inch laid on edge, MSR SPF 1650 or No. 1 or better Southern yellow pine.

F. Overhang Framing: Fabricated rafter frames.

1. Provide factory beveled facia boards, 2-inch by 6-inch Spruce-pine-fir, No. 2.

G. Wind Bracing:

1. inch by 6-inch, No. 2 or better spruce-pine-fir from end wall column to first truss back.
2. inch by 4-inch diagonal in roofline bracing as required by design.

H. Incidental Framing: No.2 or better 2-inch by 4-inch.

2.4 MATERIALS – PREFINISHED MATERIALS

A. General: Factory-formed metal panels, roll-formed in manufacturer's facility, designed to be field assembled by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners inside laps. Include accessories required for a weathertight installation.

B. Metal Panels: Exposed-fastener metal **roof** panels, formed with raised ribs and recesses.

1. Material: Zinc-coated (galvanized) steel sheet, 0.0125-inch nominal thickness.
   a. Exterior Finish: Siliconized polyester.
   b. Color: Selected by Architect from manufacturer's full range.
2. Rib Spacing: 2 major ribs at 9 inches on center. and 2 minor ribs at 3 inches on center between major ribs.
3. Panel Coverage: 36-inch.
4. Panel Height: 3/4 inch.

C. Wainscoting: Not used

D. Metal Trim: Match material and color of metal panels. Provide trim for corners, ridgelines, rakes, eaves, and panel bases in minimum 10-foot lengths.

E. Soffits: Aluminum or steel, vented as required. Colors shall match roof and wall panel colors.

F. Ridge Vent: Manufacturer's standard pre-engineered ridge cap or ridgelite, flashings, and eave and gable trim. Field-fabricate minor flashings as indicated on approved Shop Drawings.

1. Provide manufacturer's standard ridge vents as indicated on the Drawings.

Continuous Vented Ridge	12 square inches per lineal foot Cupola	Total Vent Area
24-inch	250 square inches	
36-inch	560 square inches	
48-inch	990 square inches	

2.5 RELATED MATERIALS

A. Insulation: Not used.

B. Anti-Condensation Felt: Not Used.

C. Walk Doors: Not Used.

D. Windows: Not Used.

E. Closure Strips: Not Used

2.6 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.

1. Where trusses are exposed to weather, in-ground contact, made from pressure-preservative treated wood, or in areas of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153.
2. Exposed Fastener Heads: Match the color of the steel panel.
3. Where steel panels or trim is attached to preservative-treated lumber, provide fasteners of unpainted Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F1667.

1. Framing Lumber: 10d, 16d, and 60d ring shank nails.
2. Machine Bolts: Minimum grade 1, A307.
3. Metal Panels: Minimum 1-1/2 inch No. 10 screw fasteners with EPDM sealing washers bearing on the weather side of metal panels.
   a. Match the color of metal panels.

2.7 FABRICATION

A. Shop-fabricate wood trusses in TPI inspected plant.

B. Cut truss members to accurate lengths, angles, and sizes to produce close-fitting joints.

C. Fabricate metal connector plates to sizes, configurations, thicknesses, and anchorage details required to withstand design loads for types of joint designs indicated.

D. Assemble truss members in design configuration indicated; use jigs or other means to ensure uniformity and accuracy of assembly with joints closely fitted to comply with tolerances in TPI 1. Position members to produce design camber indicated.

1. Fabricate wood trusses within manufacturing tolerances in TPI 1.

E. Connect truss members by metal connector plates located and securely embedded simultaneously in both sides of wood members by air or hydraulic press.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with the erector present, for compliance with requirements for installation tolerances and other conditions affecting the performance of work.

B. Before erection proceeds, survey elevations and locations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments to receive structural framing, with erector present, for compliance with requirements and metal building system manufacturer's tolerances.

1. Engage land surveyor to perform surveying.

C. Verify that mechanical and electrical utilities are in the correct position.

D. Proceed with erection only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep framing secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent framing, connections, and bracing are in place unless indicated otherwise.

3.3 ERECTION OF FRAMING

A. General: Do not use materials that are unsound, warped, improperly finished, or with defective surfaces, sizes, or patterns.

1. Comply with frame manufacturer's approved Shop Drawings for details and building erection.
2. Comply with NFBA document “Accepted Practices for Post-frame Construction Framing Tolerances.”

B. Columns:

1. Auger hole to the depth of diameter indicated on Drawings.
2. Pour ready mix concrete pad in the bottom of each hole per Drawings.
3. Install hold-down blocks at bottom of each column per approved Shop Drawings.
4. Accurately position the column in the hole.
5. Backfill with dry soil compacted in 8-inch lifts.

C. Trusses:

1. Set trusses in place in the center of the column using lifting methods as approved by the manufacturer.
2. When trusses are properly positioned, install 1/2 inch by 5-1/2 inch machine bolt and manufacturer recommended 20d ring shank nails through 2 of column laminates and truss heel.
3. Brace trusses per WTCA guidelines and BCSI Manual.

D. Purlins: Install purlins with fasteners and at spacings per approved Shop Drawings.

E. Truss Ties: Install truss ties at locations recommended by the structure manufacturer and per approved Shop Drawings

1. Run truss ties from end wall to end wall.

F. Incidental Framing: Install 2-inch by 4-inch or 2-inch by 6-inch blocking as required per structure manufacturers' recommendations.

3.4 METAL PANEL INSTALLATION, GENERAL

A. Install metal panels per manufacturer’s established construction procedures.

B. Install metal panels and components plumb, square, straight, and true to lines, and to assure freedom from rattles.

C. Take care when cutting prefinished materials to ensure cuttings do not remain on the finished surface.

D. Properly install fasteners taking care to not under- or overdrive.

3.5 METAL PANEL INSTALLATION

A. Roofing Panels: Install panels perpendicular to supports aligned straight with end fascias and fasten them to purlins. Anchor with fasteners at spacings recommended by manufacturer and design loads.

B. Vented Ridges: Fasten vented ridges to structure as indicated on the Drawings, maintaining the manufacturer's minimum clear throat opening.

C. Soffits: Install soffits to interlock with trim items at top of steel siding and facias.

1. Solid or optional vented soffit shall be used at the end overhang.
2. A combination of solid and perforated soffits shall be provided for balanced ventilation at side overhangs.

D. Trim Items: Install trim items at gables and ridges using no less than 1-inch screw fasteners.

1. Trim items shall be installed at the gables and ridge using appropriate 1-inch screw fasteners.

E. Closure Strips: Provide closure strips at the top and bottom of roofing panels.

END OF SECTION

DIVISION 22

PLUMBING

SECTION 22 00 00

PLUMBING GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. All Plumbing work shall be performed to meet all applicable code requirements by, or under the direct supervision of a plumber licensed in the state of California.

1.2 RELATED SECTIONS

A. Sections that involve plumbing under Division 33 – UTILITIES shall meet the requirements of Section 22 00 00.

END OF SECTION

SECTION 22 05 00

COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Sleeves.
6. Escutcheons.
7. Grout.
8. Plumbing demolition.
9. Equipment installation requirements common to equipment sections.
10. Painting and finishing.
11. Concrete bases.
12. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below the roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Pipe, Tube, and fittings.
2. Joining Materials.
3. Transition fittings.
4. Dielectric fittings.
5. Mechanical sleeve seals.
6. Sleeves.
7. Escutcheons.
8. Grout.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during the progress of construction, to allow for plumbing installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.

2. Full-Face Type: For flat-face, Class 125, cast-iron, and cast-bronze flanges.
3. Narrow-Face Type: For raised-face, Class 250, cast-iron, and steel flanges.
4. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by the piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements for Joining Plastic Piping:

1. ABS Piping: ASTM D 2235.
2. CPVC Piping: ASTM F 493.
3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
4. PVC to ABS Piping Transition: ASTM D 3138.

2.4 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

1. Available Manufacturers:
   a. Cascade Waterworks Mfg. Co.
   b. Dresser Industries, Inc.; DMD Div.
   c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
   d. JCM Industries.
   e. Smith-Blair, Inc.
   f. Viking Johnson.
2. Underground Piping NPS 1-1/2 (DN 40) and Smaller: Manufactured fitting or coupling.
3. Underground Piping NPS 2 (DN 50) and Larger: AWWA C219, metal sleeve-type coupling.
4. Aboveground Pressure Piping: Pipefitting.

B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Available Manufacturers:
   a. Eslon Thermoplastics.

C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Available Manufacturers:
   a. Thompson Plastics, Inc.

D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC PVC CPVC, and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

1. Available Manufacturers:
   a. NIBCO INC.
   b. NIBCO, Inc.; Chemtrol Div.

E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends the same size as piping to be joined, and corrosion-resistant metal band on each end.

1. Available Manufacturers:
   a. Cascade Waterworks Mfg. Co.
   b. Fernco, Inc.
   c. Mission Rubber Company.
   d. Plastic Oddities, Inc.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).

1. Available Manufacturers:
   a. Capitol Manufacturing Co.
   b. Central Plastics Company.
   c. Eclipse, Inc.
   d. Epco Sales, Inc.
   e. Hart Industries, International, Inc.
   f. Watts Industries, Inc.; Water Products Div.
   g. Zurn Industries, Inc.; Wilkins Div.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.

1. Available Manufacturers:
   a. Capitol Manufacturing Co.
   b. Central Plastics Company.
   c. Epco Sales, Inc.
   d. Watts Industries, Inc.; Water Products Div.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Available Manufacturers:
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Central Plastics Company.
   d. Pipeline Seal and Insulator, Inc.
2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig (1035- or 2070-kPa) minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

1. Available Manufacturers:
   a. Calpico, Inc.
   b. Lochinvar Corp.

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

1. Available Manufacturers:
   a. Perfection Corp.
   b. Precision Plumbing Products, Inc.
   c. Sioux Chief Manufacturing Co., Inc.
   d. Victaulic Co. of America.

2.6 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Available Manufacturers:
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Metraflex Co.
   d. Pipeline Seal and Insulator, Inc.
2. Sealing Elements: EPDM interlocking links are shaped to fit the surface of the pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Plastic. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with a corrosion-resistant coating of the length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with the welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe: ASTM D 1785, Schedule 40.

G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.8 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around the pipe, tube, and insulation of insulated piping and an OD that completely covers the opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With a concealed hinge and set screw.

1. Finish: Polished chrome-plated.

E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.

F. Split-Plate, Stamped-Steel Type: With an exposed-rivet hinge, set screw or spring clips, and chrome-plated finish.

G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.9 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, non-corrosive, nongaseous, and recommended for interior and exterior applications.

2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 – EXECUTION

3.1 PLUMBING DEMOLITION

A. Refer to Division 02 Section 02 41 00 for general demolition requirements and procedures.

B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.

1. Piping to be removed: Remove the portion of piping indicated to be removed and cap or plug the remaining piping with the same or compatible piping material.
2. Piping to be abandoned in place: Drain piping and cap or plug piping with the same or compatible piping material.
3. Equipment to be removed: Disconnect and cap services and remove equipment.
4. Equipment to be removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
5. Equipment to be removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment that remains is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace them with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate the general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with a pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:
    a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
    c. Insulated Piping: One-piece, stamped-steel type with spring clips.
    d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
    f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
    g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
    h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
    j. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
    k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with a set screw or spring clips.
    l. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

M. Sleeves are not required for core-drilled holes.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.
    a. Exception: Extend sleeves installed on floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if the ring is specified.
2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
    a. PVC Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).

b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum-board partitions.
c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Refer to 07 62 00 "Sheet Metal Flashing and Trim" for flashing details.
1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for the size, depth, and location of the joint. Refer to 07 92 00 for materials and installation.

Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select the type and number of sealing elements required for pipe material and size. Position pipe in the center of the sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select the type and number of sealing elements required for pipe material and size. Position pipe in the center of the sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

T. Verify final equipment locations for roughing-in.

U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

B. Ream ends of pipes and tubes to remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for the safe-handling practice of cleaners, primers, and solvent cement.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe, and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
5. PVC Nonpressure Piping: Join according to ASTM D 2855.
6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with a clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to the pipe manufacturer's written instructions.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at the final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at the final connection to each piece of equipment.
3. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel, and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at the required slope.

3.6 PAINTING

A. Painting of plumbing systems, equipment, and components is specified in Division 09 Sections for General Painting and Coating Requirements.

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials

3.7 CONCRETE BASES

A. Concrete Bases: Anchor equipment to the concrete base according to the equipment manufacturer's written instructions and according to seismic codes at the project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than the supported unit.
2. Install dowel rods to connect the concrete base to the concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through the concrete base, and anchor into the structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to the anchor-bolt manufacturer's written instructions.
7. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete, and reinforcement as specified in Division 03 Section “Cast-in-Place Concrete.”

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.9 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.

B. Select fastener sizes that will not penetrate members if the opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.10 GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will contact grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during the placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide a smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION

SECTION 22 05 13

COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Basic Motor Requirements
2. Polyphase Motors
3. Single Phase Motors

B. Related Sections:

1. Division 22 Sections for application of motors and reference to specific motor requirements for motor-driven equipment.

1.2 REFERENCES

A. Institute of Electrical and Electronics Engineers (IEEE) Publications:

1. 112 “Standard Test Procedure for Polyphase Induction Motors and Generators”

B. National Electrical Manufacturer’s Association (NEMA) Standards Publications:

1. MG 1 “Motors and Generators”

C. National Fire Protection Association (NFPA) Publications:

1. 70 "National Electric Code"

1.3 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Listing and Labeling: Provide motors specified in this Section that are listed and labeled.

1. Terms "Listed and Labeled": As defined in the National Electrical Code, Article 100.

PART 2 - PRODUCTS

2.1 BASIC MOTOR REQUIREMENTS

A. Basic requirements apply to mechanical equipment motors unless otherwise indicated.

B. Motors 1/2 HP and Larger: Polyphase.

C. Motors smaller than 1/2 HP: Single phase.

D. Frequency Rating: 60 Hz.

E. Voltage Rating: Determined by the voltage of the circuit to which the motor is connected.

F. Service Factor: According to NEMA MG 1, general-purpose continuous duty, design type "B."

G. Capacity and Torque Characteristics: Rated for continuous duty and sufficient to start, accelerate, and operate connected loads at designated speeds, in the indicated environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factors.

H. Enclosure: Open drip-proof, unless otherwise indicated.

I. Efficiency: Motors shall have a higher efficiency rating than industry-standard average motor as delineated in IEEE Standard 112, Test Method 13.

2.2 POLYPHASE MOTORS

A. Description: NEMA MG 1, medium induction motor.

1. Design Characteristics: NEMA MG 1, Design B, unless otherwise indicated.
2. Energy-Efficient Design: Where indicated.
3. Stator: Copper windings, unless otherwise indicated. Multispeed motors have separate winding for each speed.
4. Rotor: Squirrel cage, unless otherwise indicated.
5. Bearings: Double-shielded, pre-lubricated ball bearings suitable for radial and thrust loading.
6. Temperature Rise: Match insulation rating, unless otherwise indicated.
7. Insulation: Class F, unless otherwise indicated.

B. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for the indicated controller, with required motor leads brought to the motor terminal box to suit the control method.

C. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Critical vibration frequencies are not within the operating range of controller output.

2. Temperature Rise: Match rating for Class B insulation.
3. Insulation: Class H, unless otherwise indicated.
4. Thermal Protection: Where indicated, conform to NEMA MG 1 requirements for thermally protected motors.

D. Source Quality Control: Perform the following routine tests according to NEMA MG 1:

1. Measurement of winding resistance.
2. No-load readings of current and speed at rated voltage and frequency.
3. Locked rotor current at rated frequency.
4. High-potential test.
5. Alignment.

2.3 SINGLE-PHASE MOTORS

A. Type: As indicated or selected by the manufacturer from one of the following, to suit starting torque and other requirements of the specific motor application.

1. Permanent-split capacitor.
2. Split-phase start, capacitor run.
3. Capacitor start, capacitor run.

B. Shaded-Pole Motors: Do not use, them unless motors are smaller than 1/20 hp.

C. Thermal Protection: Where indicated or required, internal protection automatically opens the power supply circuit to the motor when the winding temperature exceeds a safe value calibrated to the temperature rating of motor insulation. The thermal protection device automatically resets when the motor temperature returns to the normal range unless otherwise indicated.

D. Bearings: Ball-bearing type for belt-connected motors and other motors with high radial forces on the motor shaft. Sealed, pre-lubricated sleeve bearings for other single-phase motors.

PART 3 - EXECUTION

3.1 ADJUSTING

A. Use adjustable motor mounting bases for belt-driven motors.

B. Align pulleys and install belts.

C. Tension according to manufacturer's written instructions.

END OF SECTION

SECTION 22 05 19

METERS & GAGES FOR PLUMBING PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This section describes the requirements for:

1. Pressure Transducers

1.3 RELATED SECTIONS

A. Section 22 05 00 “Common Work Results for Plumbing

1.4 SUBMITTALS

A. Manufacturer's Literature and Data:

1. Product certificates for each type of meter and gauge
2. Spare parts information.

B. Product Data for magnetic flowmeter in addition to Section 01 33 23 “Submittal Procedures” shall include:

1. magnetic flowmeter pressure rating
2. Certification of magnetic flowmeter material compatibility
3. Installation instructions for magnetic flowmeter straight pipe length requirements.
4. Installation instructions for magnetic flowmeter grounding rings are required for non-metallic pipe installation.

1.5 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American National Standards Institute (ANSI):

1. American Society of Mechanical Engineers (ASME): (Copyrighted Society) B1.20.1 and B40.100.
2. American Water Works Association (AWWA):
   a. AWWA M2 Manual of Practice - Instrumentation and Control

PART 2 – PRODUCTS

2.1 ASH MOUNTAIN LIFT STATION

A. Wastewater Tank Level Transducer

1. Hydrostatic level transducers shall be provided and installed to sense small changes in lift station water levels.
2. The transducer shall measure and record pressure/level, temperature, and time using onboard digital integrated circuitry and silicon strain gauge.
3. The transducer and cable shall be constructed of 316 stainless steel and polypropylene to produce highly accurate readings in rugged and corrosive field conditions.
4. The cable material shall be a 12-m length of polyurethane rubber.
5. The nominal measuring range should be selected based upon the overall depth of the liquid in the tank but should be at least a range of 0-5 m (0 – 16.4 ft).
6. The transducer shall require low power and operate from a 10 to 30 V DC power source.
7. The transducer shall communicate with Modbus RTU (RS485) and SDI-12 interface with a 2-wire 4-20 mA signal.
8. The transducer shall have a diameter and weight that allows the sensor to enter the media and sink easier so it is less prone to turbulence affecting the transmitter.
9. The transducer shall have barometric compensation utilizing a vented cable.
10. The transducer shall have ± 0.05% FSO typical accuracy, resolution of 0.0034% FS, and temperature compensation between 0°C to 40°C.
11. The acceptable manufacturer is Flygt; LTU 601 submersible hydrostatic level transmitter, or equal.

B. Headworks Ultrasonic Flow measurement

1. An ultrasonic transducer provides continuous non-contacting point level monitoring of liquids in flumes.
2. The unit will have a narrow beam of at least 10 degrees.
3. The unit will have an operating range of 0.3 to 8 m (1 to 26 ft) at a maximum operating temperature of 65 degrees centigrade (149 degrees Fahrenheit).
4. The unit shall be self-cleaning and be of otherwise low maintenance.
5. The unit shall have a chemically resistant PFDF copolymer enclosure and CSM rubber face for resistance to methane, caustics, and harsh chemicals.
6. The unit shall be capable of full immersion without altering the sensor reliability.
7. The unit shall be compatible with the SITRANS LUT400 and MultiRanger/HydroRanger controllers
8. The acceptable manufacturer is Siemens; Echomax XRS-5 for flumes and weirs, or equal.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Installation

1. Install equipment per manufacturer's instructions and requirements.
2. Install all components per the plans and specifications. Installation shall include all materials and labor necessary for complete and fully operational transmitters, meters, and gauges.

B. Mag Meter Installation

1. Install magnetic flowmeter grounding rings in application with the non-metallic pipe.
2. Transmitter, Meter, and Gauge wiring shall be installed cleanly and neatly between termination points. Wiring shall be properly supported, hung, and anchored. Excess wiring beyond that necessary for normal operation shall not be permitted.

C. Well Transducer Installation

1. Take particular care with transducers with vented cables. If the cable is accidentally cut or kinked, this will interfere with the barometric compensation. Replace the cable if it is cut.

3.2 FIELD QUALITY CONTROL

A. The transmitter, meter, and gauge assemblies shall all be visually inspected and operationally tested.

3.2 TRAINING

A. Operator training shall be coordinated in advance with Contracting Officer to ensure that Contracting Officer's operation staff can be available for the training session.

END OF SECTION

SECTION 22 05 23

GENERAL DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Bronze ball valves.

B. Related Sections:

1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
3. Division 33 water distribution piping Sections for general-duty and specialty valves for site construction piping.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Non rising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.

1.4 SUBMITTALS

A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from a single source from a single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open positions.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain them at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use a sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Hand lever: For quarter-turn valves NPS 6 (DN 150) and smaller.

E. Valves in Insulated Piping: With 2-inch (50-mm) stem extensions and the following features:

1. Ball Valves: With the extended operating handle of non-thermal-conductive material, and a protective sleeve that allows operation of the valve without breaking the vapor seal or disturbing insulation.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Grooved: With grooves according to AWWA C606.
3. Solder Joint: With sockets according to ASME B16.18.
4. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. American Valve, Inc.
   b. Conbraco Industries, Inc.; Apollo Valves.
   c. Crane Co.; Crane Valve Group; Crane Valves.
   d. Hammond Valve.
   e. Lance Valves; a division of Advanced Thermal Systems, Inc.
   f. Legend Valve.
   g. Milwaukee Valve Company.
   h. NIBCO INC.
   i. Red-White Valve Corporation.
   j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
   a. Standard: MSS SP-110.
   b. SWP Rating: 150 psig (1035 kPa).
   c. CWP Rating: 600 psig (4140 kPa).
   d. Body Design: Two-piece.
   e. Body Material: Bronze.
   f. Ends: Threaded.
   g. Seats: PTFE or TFE.
   h. Stem: Bronze.
   i. Ball: Chrome-plated brass.
   j. Port: Full.

B. Three-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Conbraco Industries, Inc.; Apollo Valves.

b. DynaQuip Controls.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Red-White Valve Corporation.

2. Description:
a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Three-piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Bronze.
i. Ball: Chrome-plated brass.
j. Port: Full.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check the bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace them with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with the stem at or above the center of the pipe.

D. Install valves in position to allow full stem movement.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where the solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where the threaded valve-end option is indicated in valve schedules below.
3. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
4. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where the threaded valve-end option is indicated in valve schedules below.
5. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.
6. For Grooved-End Copper Tubing and Steel Piping: Valve ends may be grooved.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

1. Ball Valves: Two or Three-piece, full port, bronze with bronze trim as described in Section 2.2.

END OF SECTION

SECTION 22 05 29

HANGERS & SUPPORTS FOR PLUMBING PIPING & EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Fiberglass pipe hangers.
4. Metal framing systems.
5. Fiberglass strut systems.
6. Thermal-hanger shield inserts.
7. Fastener systems.
8. Pipe stands.
9. Pipe positioning systems.
10. Equipment supports.

B. Related Sections:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 22 Section "Vibration & Seismic Control for Plumbing Piping & Equipment" for vibration isolation devices.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of the Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting the combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting the combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following: include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Fiberglass strut systems.
4. Pipe stands.
5. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Design Calculations: Calculate requirements for designing trapeze hangers.

D. Welding certificates.

1.6 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 – PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pre-galvanized or hot-dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.

4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Carpenter & Paterson, Inc.
2. Clement Support Services.
3. ERICO International Corporation.
4. National Pipe Hanger Corporation.
5. PHS Industries, Inc.
6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
7. Piping Technology & Products, Inc.
8. Rilco Manufacturing Co., Inc.
9. Value Engineered Products, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover the entire circumference of the pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches (50 mm) beyond the sheet metal shield for piping operating below ambient air temperature.

2.3 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened Portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.4 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon steel shapes.

2.5 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink, and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for the smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricates from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from the building structure.

D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled fiberglass struts.

F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

G. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after the concrete is placed and completely cured. Use operators that are licensed by the powder-actuated tool manufacturer. Install fasteners according to the powder-actuated tool manufacturer's operating manual.

2. Install mechanical expansion anchors in concrete after the concrete is placed and completely cured. Install fasteners according to the manufacturer's written instructions.

H. Pipe Stand Installation:

1. Pipe Stand Types except for Curb-Mounted Type: Assemble components and mount them on the smooth roof surface. Do not penetrate the roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb.

I. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. See Division 22 plumbing fixture Sections for requirements for pipe positioning systems for plumbing fixtures.

J. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

K. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

L. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, permit freedom of movement between pipe anchors, and facilitate the action of expansion joints, expansion loops, expansion bends, and similar units.

M. Install lateral bracing with pipe hangers and supports to prevent swaying.

N. Install building attachments within concrete slabs or attach them to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65), and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

O. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

P. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

Q. Insulated Piping:

1. Attach clamps and spacers to piping.
   a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of the insert.
   c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if the pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with a vapor barrier. Shields shall span an arc of 180 degrees.
    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if the pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
    a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inches (1.22 mm) thick.
    b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inches (1.52 mm) thick.
    c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inches (1.52 mm) thick.
    d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inches (1.91 mm) thick.
    e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inches (2.67 mm) thick.
5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as a protective shield.
6. Thermal-Hanger Shields: Install with insulation the same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above the floor.

B. Grouting: Place grout under supports for equipment and make the bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

3.6 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.7 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have a field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports and attachments for general service applications.

F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

G. Use padded hangers for piping that is subject to scratching.

H. Use thermal-hanger shield inserts for insulated piping and tubing.

I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).

2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F (566 deg C), pipes NPS 4 to NPS 24 (DN 100 to DN 600), requiring up to 4 inches (100 mm) of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36 (DN 20 to DN 900), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 (DN 15 to DN 600) if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4 (DN 15 to DN 100), allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8 (DN 20 to DN 200).
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8 (DN 10 to DN 200).
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3 (DN 10 to DN 80).
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30 (DN 25 to DN 750), from two rods if longitudinal movement caused by expansion and contraction might occur.
15. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 (DN 50 to DN 1050) if longitudinal movement caused by expansion and contraction might occur but the vertical adjustment is not necessary.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F (49 to 232 deg C) piping installations.

L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to the top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to the bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to the center of the bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to the bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For the top of beams if a hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For the bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to the bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to the bottom of steel I-beams for heavy loads, with link extensions.
11, Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using a clip and rod. Use one of the following for indicated loads:
    a. Light (MSS Type 31): 750 lb (340 kg).
    b. Medium (MSS Type 32): 1500 lb (680 kg).
    c. Heavy (MSS Type 33): 3000 lb (1360 kg).
13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to a linear horizontal movement where headroom is limited.

M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by the manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads, if vertical movement does not exceed 1-1/4 inches (32 mm).
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.

4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of the piping system from the hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of the piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of the piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

R. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION

SECTION 22 05 48

VIBRATION & SEISMIC CONTROLS FOR PLUMBING PIPING & EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Isolation pads.
2. Isolation mounts.
3. Restraining braces and cables.

1.3 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: Refer to structural drawings.
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: Refer to structural drawings.
   a. Component Importance Factor: 1.0.
   b. Component Response Modification Factor: 1.5.
   c. Component Amplification Factor: 1.0.
3. Design Spectral Response Acceleration at 1-Second Period.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
    a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
    b. Annotate to indicate application of each product submitted and compliance with requirements.
3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators, seismic restraints, and for designing vibration isolation bases.
2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that the riser system has been examined for excessive stress and that none will exist.
3. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
4. Seismic-Restraint Details:
    a. Design Analysis: To support the selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
    b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
    c. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

C. Coordination Drawings: Show coordination of seismic bracing for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.

D. Welding certificates.

E. Qualification Data: For professional engineers and testing agencies.

F. Field quality-control test reports.

G. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproved by ICC-ES, or preapproved by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 – PRODUCTS

2.1 SEISMIC-RESTRAINT DEVICES

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:

1. Amber/Booth Company, Inc.
2. California Dynamics Corporation.
3. Cooper B-Line, Inc.; a division of Cooper Industries.
4. Hilti, Inc.
5. Kinetics Noise Control.
6. Loos & Co.; Cableware Division.
7. Mason Industries.
8. TOLCO Incorporated; a brand of NIBCO INC.
9. Unistrut; Tyco International, Ltd.

C. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

D. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to the braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

E. Restraint Cables: ASTM A 603 galvanized -steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

F. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

G. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings are designed for rigid equipment mountings and matched to the type and size of anchor bolts and studs.

H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to the type and size of attachment devices used.

I. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

J. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with the strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

K. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with the strength required for anchor and as tested according to ASTM E 488.

2.2 FACTORY FINISHES

A. Finish: Manufacturer's standard prime coat finish ready for field painting.

B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate the capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze members with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment Restraints:

1. Install seismic snubbers on plumbing equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt them to the equipment base and supporting structure.
2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between the anchor and adjacent surface exceeds 0.125 inches (3.2 mm).
3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for the component.

B. Piping Restraints:

1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet (12 m) o.c., and longitudinal supports a maximum of 80 feet (24 m) o.c.
3. Brace a change of direction longer than 12 feet (3.7 m).

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for the component.

E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in the concrete base.

F. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to the wall.

G. Attachment to Structure: If the specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or concrete members.

H. Drilled-in Anchors:

1. Identify the position of reinforcing steel and other embedded items before drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with the sleeve fully engaged in the structural element to which the anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust before installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid the introduction of air pockets in the adhesive.
5. Set anchors to the manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with a connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 22 Section "Domestic Water Piping" for piping flexible connections.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.

2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless post connection testing has been approved), and with at least seven days advance notice.
3. Obtain Architect's approval before transmitting test loads to the structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by the Contracting Officer.
5. Test to 90 percent of the rated proof load of the device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.
9. Air-Mounting System Leak Test: After installation, charge the system and test for leaks. Repair leaks and retest until no leaks exist.
10. Air-Mounting System Operational Test: Test the compressed-air leveling system.
11. Test and adjust air-mounting system controls and safeties.
12. If a device fails a test, modify all installations of the same type and retest until satisfactory results are achieved.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust isolators after the piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust the active height of sprint isolators.

D. Adjust restraints to permit free movement of equipment within the normal mode of operation.

END OF SECTION

SECTION 22 05 53

IDENTIFICATION FOR PLUMBING PIPING & EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Stencils.
5. Valve tags.
6. Warning tags.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 – PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch Stainless steel, 0.025-inch Aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for the name of units if the viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with the label and with the substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and have predrilled holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: White.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for the name of units if the viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with the label and with the substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. The equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and has predrilled holes for attachment hardware.

B. Letter Color: Red.

C. Background Color: White.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for the name of units if the viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with the substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. Do not use pipe labels or plastic tapes for bare pipes conveying fluids at temperatures of 125 deg F (52 deg C) or higher.

B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover the circumference of the pipe and to attach to the pipe without fasteners or adhesive.

D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

E. Pipe Label Contents: Include identification of piping service using the same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as a separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches (38 mm) high.

2.4 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.

1. Stencil Material: Fiberboard or metal.
2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.5 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch (0.8-mm) Stainless steel, 0.025-inch Aluminum, 0.032-inch or anodized aluminum, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link or beaded chain; or S-hook

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with a matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches (75 by 133 mm) minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surface of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified per Section 01 78 23.

B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles, complying with ASME A13.1, on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where the flow pattern is not obvious, mark each pipe at the branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit a view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

D. Pipe Label Color Schedule:

1. Domestic Water Piping:
   a. Background Color: Black.
   b. Letter Color: White.
2. Sanitary Waste Piping:
   a. Background Color: Black.
   b. Letter Color: White.

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:
   a. Cold Water: 1-1/2 inches (38 mm), round.
   b. Hot Water: 1-1/2 inches (38 mm) round.
2. Valve-Tag Color:
   a. Cold Water: Natural.
   b. Hot Water: Natural.
3. Letter Color:
   a. Cold Water: Black.
   b. Hot Water: Black.

3.5 WARNING-TAG INSTALLATION

A. Write a required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

SECTION 22 07 00

PLUMBING INSULATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

Commented [KG1]: Where is this plumbing insultation used? Maybe give general locations where this will be used.

1.2 SUMMARY

A. Section Includes:

1. Insulation Materials:
   a. Flexible elastomeric.
   b. Mineral fiber.
2. Insulating cement.
3. Adhesives.
4. Mastics.
5. Lagging adhesives.
6. Sealants.
7. Factory-applied jackets.
8. Field-applied fabric-reinforcing mesh.
9. Field-applied cloths.
10. Tapes.
11. Securements.
12. Corner angles.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. LEED Submittal:

1. Product Data for Credit EQ 4.1: For adhesives and sealants, including a printed statement of VOC content.

C. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail insulation application at pipe expansion joints for each type of insulation.
3. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
4. Detail removable insulation at piping specialties, equipment connections, and access panels.
5. Detail application of field-applied jackets.
6. Detail application at linkages of control devices.
7. Detail field application for each equipment type.

D. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing the product and intended use. Sample sizes are as follows:

1. Sample Sizes:
   a. Preformed Pipe Insulation Materials: 12 inches long by NPS 2 (DN 50).
   b. Sheet Form Insulation Materials: 12 inches square.
   c. Jacket Materials for Pipe: 12 inches long by NPS 2 (DN 50).
   d. Sheet Jacket Materials: 12 inches square.
   e. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

E. Qualification Data: For qualified Installer.

F. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

G. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by the manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers & Supports for Plumbing Piping & Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation applications may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 – PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that contact stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Aeroflex USA Inc.; Aerocel.
   b. Armacell LLC; AP Armaflex.
   c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in the "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. CertainTeed Corp.; Duct Wrap.
   b. Johns Manville; Microlite.
   c. Knauf Insulation; Duct Wrap.
   d. Manson Insulation Inc.; Alley Wrap.
   e. Owens Corning; All-Service Duct Wrap.

H. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Fibrex Insulations Inc.; Coreplus 1200.
   b. Johns Manville; Micro-Lok.
   c. Knauf Insulation; 1000º Pipe Insulation.
   d. Manson Insulation Inc.; Alley-K.
   e. Owens Corning; Fiberglas Pipe Insulation.
2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with a factory-applied ASJ. Factory-applied jacket requirements are specified in the "Factory-Applied Jackets" Article.

I. Mineral-Fiber, Pipe, and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied FSK jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. The nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in the "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. CertainTeed Corp.; CrimpWrap.
   b. Johns Manville; MicroFlex.
   c. Knauf Insulation; Pipe and Tank Insulation.
   d. Manson Insulation Inc.; AK Flex.
   e. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Insulco, Division of MFS, Inc.; Triple I.
   b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. P. K. Insulation Mfg. Co., Inc.; Thermal-V-Kote.

C. Mineral-Fiber, Hydraulic-Setting Insulating, and Finishing Cement: Comply with ASTM C 449/C 449M.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Insulco, Division of MFS, Inc.; SmoothKote.
   b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
   c. Rock Wool Manufacturing Company; Delta One-Shot.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Aeroflex USA Inc.; Aeroseal.
   b. Armacell LCC; 520 Adhesive.
   c. Foster Products Corporation, H. B. Fuller Company; 85-75.
   d. RBX Corporation; Rubatex Contact Adhesive.
   e. For indoor applications, use the adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Products, Division of ITW; CP-82.
   b. Foster Products Corporation, H. B. Fuller Company; 85-20.
   c. ITW TACC, Division of Illinois Tool Works; S-90/80.
   d. Marathon Industries, Inc.; 225.
   d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Products, Division of ITW; CP-82.
   b. Foster Products Corporation, H. B. Fuller Company; 85-20.
   c. ITW TACC, Division of Illinois Tool Works; S-90/80.
   d. Marathon Industries, Inc.; 225.
   e. Mon-Eco Industries, Inc.; 22-25.
2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

B. Vapor-Barrier Mastic: Water-based; suitable for indoor and outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Products, Division of ITW; CP-35.
   b. Foster Products Corporation, H. B. Fuller Company; 30-90.
   c. ITW TACC, Division of Illinois Tool Works; CB-50.
   d. Marathon Industries, Inc.; 590.
   e. Mon-Eco Industries, Inc.; 55-40.
   f. Vimasco Corporation; 749.
2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perms at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent-based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Products, Division of ITW; CP-30.
   b. Foster Products Corporation, H. B. Fuller Company; 30-35.
   c. ITW TACC, Division of Illinois Tool Works; CB-25.
   d. Marathon Industries, Inc.; 501.
   e. Mon-Eco Industries, Inc.; 55-10.
2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
3. Service Temperature Range: 0 to 180 deg F.
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

D. Vapor-Barrier Mastic: Solvent-based; suitable for outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Products, Division of ITW; Encacel.
   b. Foster Products Corporation, H. B. Fuller Company; 60-95/60-96.
   c. Marathon Industries, Inc.; 570.
   d. Mon-Eco Industries, Inc.; 55-70.
2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F.
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

E. Breather Mastic: Water-based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Products, Division of ITW; CP-10.
   b. Foster Products Corporation, H. B. Fuller Company; 35-00.
   c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
   d. Marathon Industries, Inc.; 550.
   e. Mon-Eco Industries, Inc.; 55-50.
   f. Vimasco Corporation; WC-1/WC-5.
2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 200 deg F.
4. Solids Content: 63 percent by volume and 73 percent by weight.
5. Color: White.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Products, Division of ITW; CP-52.
   b. Foster Products Corporation, H. B. Fuller Company; 81-42.
   c. Marathon Industries, Inc.; 130.
   d. Mon-Eco Industries, Inc.; 11-30.
   e. Vimasco Corporation; 136.
2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment and pipe insulation.
3. Service Temperature Range: Minus 50 to plus 180 deg F.
4. Color: White.

2.6 SEALANTS

A. Joint Sealants:

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Products, Division of ITW; CP-76-8.
   b. Foster Products Corporation, H. B. Fuller Company; 95-44.
   c. Marathon Industries, Inc.; 405.
   d. Mon-Eco Industries, Inc.; 44-05.
   e. Vimasco Corporation; 750.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets for various applications. When factory-applied jackets are indicated, comply with the following:

1. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric for Pipe Insulation: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch for covering pipe and pipe fittings.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Vimasco Corporation; Elastafab 894.

B. Woven Glass-Fiber Fabric for Equipment Insulation: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. inch for covering equipment.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Products, Division of ITW; Chil-Glas No. 5.

C. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch, in a Leno weave, for equipment and pipe.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Foster Products Corporation, H. B. Fuller Company; Mast-A-Fab.
   b. Vimasco Corporation; Elastafab 894.

2.9 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

2.10 TAPES

A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
   b. Compac Corp.; 110 and 111.
   c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
   d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
   b. Compac Corp.; 120.
   c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
   d. Venture Tape; 3520 CW.
2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.11 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Products; Bands.

b. PABCO Metals Corporation; Bands.
c. RPR Products, Inc.; Bands.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 316 304 or Type 316; 0.015 inches thick, 1/2 inch 3/4 inch wide with wing or closed seal.
3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inches thick, 1/2 inch wide with wing or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch diameter shank, length to suit the depth of insulation indicated.
   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      1) AGM Industries, Inc.; CWP-1.
      2) GEMCO; CD.
      3) Midwest Fasteners, Inc.; CD.
      4) Nelson Stud Welding; TPA, TPC, and TPS.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch diameter shank, length to suit the depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      1) AGM Industries, Inc.; CWP-1.
      2) GEMCO; Cupped Head Weld Pin.
      3) Midwest Fasteners, Inc.; Cupped Head.
      4) Nelson Stud Welding; CHP.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in the position indicated when the self-locking washer is in place. Comply with the following requirements:
   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
      2) GEMCO; Perforated Base.
      3) Midwest Fasteners, Inc.; Spindle.
   b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inches thick by 2 inches square.
   c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch diameter shank, length to suit the depth of insulation indicated.
   d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hangers securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that can hold insulation, of thickness indicated, securely in the position indicated when the self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   1) GEMCO; Nylon Hangers.
   2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
b. Baseplate: Perforated, nylon sheet, 0.030 inches thick by 1-1/2 inches in diameter.
d. Spindle: Nylon, 0.106-inch diameter shank, length to suit the depth of insulation indicated, up to 2-1/2 inches.
d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hangers securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in the position indicated when the self-locking washer is in place. Comply with the following requirements:
   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
      2) GEMCO; Press and Peel.
      3) Midwest Fasteners, Inc.; Self Stick.
   b. Baseplate: Galvanized carbon-steel sheet, 0.030 inches thick by 2 inches square.
   c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch diameter shank, length to suit the depth of insulation indicated.
   d. Adhesive-backed base with a peel-off protective cover.
6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick, galvanized steel sheet, with beveled edge sized as required to hold the insulation securely in place but not less than 1-1/2 inches in diameter.
   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      1) AGM Industries, Inc.; RC-150.
      2) GEMCO; R-150.
      3) Midwest Fasteners, Inc.; WA-150.
      4) Nelson Stud Welding; Speed Clips.
   b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of the cap in exposed locations.
7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick nylon sheet, with beveled edge sized as required to hold the insulation securely in place but not less than 1-1/2 inches in diameter.
   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      1) GEMCO.
      2) Midwest Fasteners, Inc.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch wide, stainless steel or Monel.

D. Wire: 0.080-inch nickel-copper alloy.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work including, but are not limited to, the following:
   a. C & F Wire.
   b. Childers Products.

c. PABCO Metals Corporation.
d. RPR Products, Inc.

2.12 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surfaces.

B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005; Temper H-14.

C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 316 304 or 316.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting the performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cement with clean potable water; if insulating cement is to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either a wet or dry state.

D. Install insulation with longitudinal seams at the top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive are recommended by insulation material manufacturers.

I. Install insulation with the least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal end at the attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over the jacket, arranged to protect the jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at the manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips of the same material as the insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of the strip spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of the pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along the edge at 2 inches o.c.
   a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape as recommended by the insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying the same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For the above ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above the roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below the top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through the wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside the wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies.

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from the same material and density as adjacent pipe insulation. Each piece shall be butted tightly against the adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of the same material and thickness as used for the adjacent pipe. Cut sectional pipe insulation to fit. Butt each section close to the next and hold it in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of the same material, density, and thickness as used for the adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of the same material, density, and thickness as used for the adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains the vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure-temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of the same thickness as that on the adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in the same manner as for flanges except divide the two-part section on the vertical centerline of the valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wireframe, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of the valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After the first coat is dry, apply and trowel the second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with the manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to the surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to the outer diameter of the pipe flange.
2. Make the width of the insulation section the same as the overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between the inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of the same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with the manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to the surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with the manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to the surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of the same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to the valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with the manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to the surface being insulated.

3.7 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to the outer diameter of the pipe flange.
2. Make the width of the insulation section the same as the overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between the inner circumference of flange insulation and the outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of the same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of the same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to the valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 FINISHES

A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add the fungicidal agent to render the fabric mildew proof.
   a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After the adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by the Contracting Officer. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect field-insulated equipment, randomly selected by Contracting Officer, by removing field-applied jacket and insulation in layers in reverse order of their installation. The extent of inspection shall be limited to one location for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.

2. Inspect pipe, fittings, strainers, and valves, randomly selected by Contracting Officer, by removing field-applied jacket and insulation in layers in reverse order of their installation. The extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals a noncompliance with requirements.

3.10 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from the materials listed is the Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. NPS 1 (DN 25) and Smaller: Insulation shall be one of the following:
   a. Flexible Elastomeric: 1/2 inch thick.
   b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
2. NPS 1-1/4 (DN 32) and Larger: Insulation shall be one of the following:
   a. Flexible Elastomeric: 1 inch thick.
   b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

B. Domestic Hot and Recirculated Hot Water:

1. NPS 1-1/4 (DN 32) and Smaller: Insulation shall be one of the following:
   a. Flexible Elastomeric: 3/4 inch thick.
   b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
2. NPS 1-1/2 (DN 40) and Larger: Insulation shall be one of the following:
   a. Flexible Elastomeric: 1 inch thick.
   b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

C. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be one of the following:
   a. Flexible Elastomeric: 3/4 inch thick.
   b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

D. Sanitary Waste Piping Where Heat Tracing Is Installed:

1. All Pipe Sizes: Insulation shall be one of the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.

E. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be one of the following:
   a. Flexible Elastomeric: 3/4 inch thick.
   b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

END OF SECTION

SECTION 22 08 00

COMMISSIONING OF PLUMBING SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION

A. The requirements of this Section apply to all sections of Division 22.

B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned are specified in Section 01 91 14 TOTAL BUILDING COMMISSIONING. The commissioning process, which the Contractor is responsible to execute, is also defined in Section 01 91 14. A Commissioning Agent (CxA) appointed by the National Park Service will manage the commissioning process.

1.2 RELATED WORK

A. Section 01 33 23 SUBMITTAL PROCEDURES.

B. Section 01 91 14 TOTAL BUILDING COMMISSIONING.

1.3 SUMMARY

A. This Section includes requirements for commissioning plumbing systems, subsystems, and equipment. This Section supplements the general requirements specified in Section 01 91 14 TOTAL BUILDING COMMISSIONING.

B. Refer to Section 01 91 14 TOTAL BUILDING COMMISSIONING for more specifics regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

1.4 DEFINITIONS

A. Refer to Section 01 91 14 TOTAL BUILDING COMMISSIONING for definitions.

1.5 COMMISSIONED SYSTEMS

A. Commissioning of a system or systems specified in Division 22 is part of the construction process. Documentation and testing of these systems, as well as training of the Operation and Maintenance personnel per the requirements of Section 01 91 14 and Division 22, is required in cooperation with the Commissioning Agent.

B. The Plumbing systems commissioning will include the systems listed in Section 01 91 14.

1.6 SUBMITTALS

A. The commissioning process requires the review of selected Submittals. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the NPS before forwarding it to the Contractor. Refer to Section 01 33 23 SUBMITTAL PROCEDURES for further details.

B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 14 TOTAL BUILDING COMMISSIONING.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 CONSTRUCTION INSPECTIONS

A. Commissioning of the Building Plumbing Systems will require inspection of individual elements of the Plumbing construction throughout the construction period. The Contractor shall coordinate with the Commissioning Agent per Section 01 91 14 and the Commissioning Plan to schedule inspections as required to support the commissioning process.

3.2 PRE-FUNCTIONAL CHECKLISTS

A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the Contracting Officer and the Commissioning Agent for review. The Commissioning Agent may spot-check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to SECTION 01 91 14 TOTAL BUILDING COMMISSIONING for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

3.3 CONTRACTORS TESTS

A. Contractor tests as required by other sections of Division 22 shall be scheduled and documented. All testing shall be incorporated into the project schedule. The contractor shall provide no less than 7 calendar days' notice of testing. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed before scheduling Systems Functional Performance Testing.

3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING:

A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady-state conditions, test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Resident Engineer. The Contractor shall review and comment on the tests before approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 14 TOTAL BUILDING COMMISSIONING, for additional details.

3.5 TRAINING OF PERSONNEL

A. Training of the NPS operation and maintenance personnel is required in cooperation with the Resident Engineer and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The contractor shall submit training agendas and trainer resumes per the requirements of Section 01 91 14. The instruction shall be scheduled in coordination with the Resident Engineer after submission and approval of formal training plans. Refer to Section 01 91 14 TOTAL BUILDING COMMISSIONING and Division 22 Sections for additional Contractor training requirements.

END OF SECTION

SECTION 22 11 00

FACILITY WATER DISTRIBUTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Domestic water systems, including piping, equipment, and all necessary accessories as designated in this section.

1.2 RELATED WORK

A. Section 01 33 23, SUBMITTAL PROCEDURES.

B. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS.

C. Section 01 91 14, TOTAL BUILDING COMMISSIONING.

D. Section 07 84 00, FIRESTOPPING.

E. Section 07 92 00, JOINT SEALANTS.

F. Section 22 07 00, PLUMBING INSULATION.

G. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Society of Mechanical Engineers (ASME):

A13.1-2007 (R2013)	Scheme for Identification of Piping Systems
B16.3-2011	Malleable Iron Threaded Fittings: Classes 150 and 300
B16.9-2012	Factory-Made Wrought Buttwelding Fittings
B16.11-2011	Forged Fittings, Socket-Welding and Threaded
B16.12-2009 (R2014)	Cast Iron Threaded Drainage Fittings
B16.15-2013	Cast Copper Alloy Threaded Fittings: Classes 125 and 250
B16.18-2012	Cast Copper Alloy Solder Joint Pressure Fittings
B16.22-2013	Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
B16.24-2011	Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500
ASME Boiler and Pressure Vessel Code	
BPVC Section IX-2015	Welding, Brazing, and Fusing Qualifications

C. American Society of Sanitary Engineers (ASSE):

1010-2004	Performance Requirements for Water Hammer Arresters

D. American Society for Testing and Materials (ASTM):

A47/A47M-1999 (R2014)	Standard Specification for Ferritic Malleable Iron Castings
A53/A53M-2012	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
A183-2014	Standard Specification for Carbon Steel Track Bolts and Nuts
A269/A269M-2014e1	Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
A312/A312M-2015	Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
A403/A403M-2014	Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings
A536-1984 (R2014)	Standard Specification for Ductile Iron Castings
A733-2013	Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
B32-2008 (R2014)	Standard Specification for Solder Metal
B43-2014	Standard Specification for Seamless Red Brass Pipe, Standard Sizes
B61-2008 (R2013)	Standard Specification for Steam or Valve Bronze Castings
B62-2009	Standard Specification for Composition Bronze or Ounce Metal Castings
B75/B75M-2011	Standard Specification for Seamless Copper Tube
B88-2014	Standard Specification for Seamless Copper Water Tube
B584-2014	Standard Specification for Copper Alloy Sand Castings for General Applications
B687-1999 (R2011)	Standard Specification for Brass, Copper, and Chromium-Plated Pipe Nipples
C919-2012	Standard Practice for Use of Sealants in Acoustical Applications
D1785-2012	Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
D2000-2012	Standard Classification System for Rubber Products in Automotive Applications
D2564-2012	Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems
D2657-2007	Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings
D2855-1996 (R2010)	Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings
D4101-2014	Standard Specification for Polypropylene Injection and Extrusion Materials
E1120-2008	Standard Specification for Liquid Chlorine
E1229-2008	Standard Specification for Calcium Hypochlorite
F2389-2010	Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems

F2620-2013	Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings
F2769-2014	Standard Specification for Polyethylene of Raised Temperature (PE-RT) Plastic Hot and Cold-Water Tubing and Distribution Systems

E. American Water Works Association (AWWA):

C110-2012	Ductile-Iron and Gray-Iron Fittings
C151-2009	Ductile Iron Pipe, Centrifugally Cast
C153-2011	Ductile-Iron Compact Fittings
C203-2008	Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied
C213-2007	Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
C651-2014	Disinfecting Water Mains

F. American Welding Society (AWS):

A5.8M/A5.8-2011-AMD1	Specification for Filler Metals for Brazing and Braze Welding

G. International Code Council (ICC):

IPC-2012	International Plumbing Code

H. Manufacturers Specification Society (MSS):

SP-58-2009	Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation
SP-72-2010a	Ball Valves with Flanged or Butt-Welding Ends for General Service
SP-110-2010	Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

I. NSF International (NSF):

14-2015	Plastics Piping System Components and Related Materials
61-2014a	Drinking Water System Components - Health Effects
372-2011	Drinking Water System Components - Lead Content

J. Plumbing and Drainage Institute (PDI):

PDI-WH 201-2010	Water Hammer Arrestors

K. Department of Veterans Affairs:

H-18-8-2013	Seismic Design Handbook
H-18-10	Plumbing Design Manual

1.4 SUBMITTALS

A. Submittals, including the number of required copies, shall be submitted following Section 01 33 23, SUBMITTAL PROCEDURES.

B. Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 22 11 00, FACILITY WATER DISTRIBUTIONS”, with applicable paragraph identification.

C. Manufacturer's Literature and Data including full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

1. All items listed in Part 2 - Products.

D. Complete operating and maintenance manuals including wiring diagrams, technical datasheets, and information for ordering replacement parts:

1. Include a complete list indicating all components of the systems.
2. Include complete diagrams of the internal wiring for each item of equipment.
3. Diagrams shall have their terminals identified to facilitate installation, operation, and maintenance.

E. Completed System Readiness Checklist provided by the Commissioning Authority (CxA) and completed by the Contractor, signed by a qualified technician, and dated on the date of completion, following the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS and Section 01 91 14.

F. Submit training plans and instructor qualifications following the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

1.5 QUALITY ASSURANCE

A. A certificate shall be submitted before welding steel piping showing the Welder’s certification. The certificate shall be current and no more than one year old. Welder’s qualifications shall be following ASME BPVC Section IX.

B. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be by the same manufacturer as the groove components.

C. All pipe, couplings, fittings, and specialties shall bear the identification of the manufacturer and any markings required by the applicable referenced standards.

D. Bio-Based Materials: For products designated by the USDA’s Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit http://www.biopreferred.gov.

1.6 AS-BUILT DOCUMENTATION

A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.

B. Submit operation and maintenance data updated to include submittal review comments, substitutions, and construction revisions shall be in electronic version on compact disc or DVD inserted into a three-ring binder. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergencies. Notes on all special systems or devices shall be included. A list of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them in Auto-CAD is provided on a compact disk or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.

D. Certification documentation shall be provided to COR 10 working days before submitting the request for a final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and a certificate if applicable that all results of tests were within the limits specified. If a certificate is not available, all documentation shall be on the Certifier's letterhead.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Material or equipment containing a weighted average of greater than 0.25 percent lead is prohibited in any potable water system intended for human consumption and shall be certified following NSF 61 or NSF 372. Endpoint devices used to dispense water for drinking shall meet the requirements of NSF 61, Section 9.

B. Plastic pipe, fittings, and solvent cement shall meet NSF 14 and shall be NSF listed for the service intended.

2.2 UNDERGROUND WATER SERVICE CONNECTIONS TO BUILDINGS

A. From the inside face of the exterior wall to approximately 5 feet outside of the building and underground inside the building, material to be the same for the size specified inside the building.

B. 3 inches Diameter and Greater: Ductile iron, AWWA C151, 350 psig pressure class, exterior bituminous coating, and cement lined. Bio-based materials shall be utilized when possible. Provide flanged and anchored connection to interior piping.

C. Under 3 inches Diameter: Copper tubing, ASTM B88, Type K, seamless, annealed. Fittings are as specified in paragraph "Above Ground (Interior) Water Piping". Use brazing alloys, AWS A5.8M/A5.8, Classification BCuP.

D. Flexible Expansion Joint: Ductile iron with ball joints rated for 250 psig working pressure conforming to AWWA C153, capable of deflecting a minimum of 20 degrees in each direction. Flexible expansion joint size shall match the pipe size it is connected to and shall have the expansion capability designed as an integral part of the ductile iron ball castings. Pressure-containing parts shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of AWWA C213 and shall be factory tested with a 1500-volt spark test. The flexible expansion joint shall have flanged connections conforming to AWWA C110. Bolts and nuts shall be 316 stainless steel and gaskets shall be neoprene. The flexible expansion fitting shall not expand or exert an axial thrust under internal water pressure. Provide piping joint restraints at each mechanical joint end connection and piping restraints at the penetration of the building wall. The restraints shall be provided to address the developed thrust at the change of piping direction.

2.3 ABOVE GROUND (INTERIOR) WATER PIPING

A. Pipe: For pipe less than 6-inches in diameter, Copper tube, ASTM B88, Type K or L, drawn.

B. Fittings for Copper Tube:

1. Wrought copper or bronze castings conforming to ASME B16.18 and B16.22. Unions shall be bronze, MSS SP-72, MSS SP-110, solder or braze joints. Use 95/5 tin and antimony for all soldered joints.
2. Grooved fittings, 2 to 6 inches wrought copper ASTM B75/B75M C12200, 5 to 6 inches bronze casting ASTM B584, C84400. Mechanical grooved couplings, 300 psig minimum ductile iron, ASTM A536 Grade 448-310-12 (Grade 65-45-12), or malleable iron, ASTM A47/A47M Grade 22410 (Grade 32510) housing, with EPDM gasket, steel track head bolts, ASTM A183, coated with copper-colored alkyd enamel.
3. Mechanical press-connect fittings for copper pipe and tube **are prohibited**. See Plumbing Design Manual for additional information.
4. Mechanically formed tee connection: Form mechanically extracted collars in a continuous operation by drilling a pilot hole and drawing out the tube surface to form a collar, having a height of not less than three times the thickness of the tube wall. An adjustable collaring device shall ensure proper tolerance and complete uniformity of the joint. Notch and dimple joining branch tube in a single process to provide free flow where the branch tube penetrates the fitting. Braze joints.
5. Flanged fittings, bronze, class 150, solder-joint ends conforming to ASME B16.24.

C. Adapters: Provide adapters for joining pipe or tubing with dissimilar end connections.

D. Solder: ASTM B32 alloy type Sb5, HA or HB. Provide non-corrosive flux.

E. Brazing alloy: AWS A5.8M/A5.8, brazing filler metals shall be BCuP series for copper to copper joints and BAg series for copper to steel joints.

2.4 EXPOSED WATER PIPING

A. Finished Room: Use full iron pipe size chrome-plated brass piping for exposed water piping connecting fixtures, casework, cabinets, equipment, and reagent racks when not concealed by an apron including those furnished by the Government or specified in other sections.

1. Pipe: ASTM B43, standard weight.
2. Fittings: ASME B16.15 cast bronze threaded fittings with chrome finish.
3. Nipples: ASTM B687, Chromium-plated.
4. Unions: MSS SP-72, MSS SP-110, brass or bronze with chrome finish. Unions 2-1/2 inches and larger shall be flange type with approved gaskets.

B. Unfinished Rooms, Mechanical Rooms, and Kitchens: Chrome-plated brass piping is not required. Paint piping systems as specified in Section 09 91 00, PAINTING.

2.5 STRAINERS

A. Provide on the high-pressure side of pressure reducing valves, on the suction side of pumps, on the inlet side of indicating and control instruments and equipment subject to sediment damage and where shown on drawings. Strainer element shall be removable without disconnection of piping.

B. Water: Basket or "Y" type with easily removable cover and brass strainer basket.

C. Body: Less than 3 inches, brass, or bronze; 3 inches and greater, cast iron or semi-steel.

2.6 DIELECTRIC FITTINGS

A. Provide dielectric couplings or unions between pipes of dissimilar metals.

2.7 STERILIZATION CHEMICALS

A. Hypochlorite: ASTM E1229.

B. Liquid Chlorine: ASTM E1120.

2.8 WATER HAMMER ARRESTER

A. Closed copper tube chamber with permanently sealed 60 psig air charge above a Double O-ring piston. Two high heat Buna-N 0-rings pressure-packed and lubricated with FDA-approved silicone compound. All units shall be designed following ASSE 1010. Access shall be provided where devices are concealed within partitions or above ceilings. Size and install following PDI-WH 201 requirements.

B. Provide water hammer arrestors at:

1. All solenoid valves.
2. All groups of two or more flush valves.
3. All quick opening or closing valves.
4. All medical washing equipment.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with the International Plumbing Code and the following:

1. Install branch piping for water from the piping system and connect it to all fixtures, valves, cocks, outlets, casework, cabinets, and equipment, including those furnished by the Government or specified in other sections.
2. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe, except for plastic and glass, shall be reamed to remove burrs and a clean smooth finish restored to full pipe inside diameter.
3. All pipe runs shall be laid out to avoid interference with other work/trades.
4. Install union and shut-off valve on pressure piping at connections to equipment.
5. Pipe Hangers, Supports, and Accessories:
    a. All piping shall be supported per the IPC, H-18-8 Seismic Design Handbook, MSS SP-58, and SMACNA as required.
    b. Shop Painting and Plating: Hangers, supports, rods, inserts, and accessories used for pipe supports shall be shop coated with zinc chromate primer paint. Electroplated copper hanger rods, hangers, and accessories may be used with copper tubing.
    c. Floor, Wall and Ceiling Plates, Supports, Hangers:
        1) Solid or split un-plated cast iron.
        2) All plates shall be provided with set screws.
        3) Pipe Hangers: Height adjustable clevis type.
        4) Adjustable Floor Rests and Base Flanges: Steel.
        5) Concrete Inserts: "Universal" or continuous slotted type.
        6) Hanger Rods: Mild, low carbon steel, fully threaded or Threaded at each end with two removable nuts for positioning rod and hanger and locking each in place.
        7) Pipe Hangers and Riser Clamps: Malleable iron or carbon steel. Pipe Hangers and riser clamps shall have a copper finish when supporting bare copper pipe or tubing.
        8) Rollers: Cast iron.
        9) Self-drilling type expansion shields shall be "Phillips" type, with case hardened steel expander plugs.
        10) Hangers and supports utilized with insulated pipe and tubing shall have a 180-degree (minimum) metal protection shield centered on and welded to the hanger and support. The shield thickness and length shall be engineered and sized for the distribution of loads to preclude the crushing of insulation without breaking the vapor barrier. The shield shall be sized for the insulation and have flared edges to protect the vapor-retardant jacket facing. To prevent the shield from sliding out of the clevis hanger during pipe movement, center-ribbed shields shall be used.

11) Miscellaneous Materials: As specified, required, directed, or as noted on the drawings for proper installation of hangers, supports, and accessories. If the vertical distance exceeds 20 feet for cast iron pipe additional support shall be provided in the center of that span. Provide all necessary auxiliary steel to provide that support.
12) With the installation of each flexible expansion joint, provide piping restraints for the upstream and downstream sections of the piping at the flexible expansion joint. Provide calculations supporting the restraint length design and type of selected restraints. Restraint calculations shall be based on the criteria from the manufacturer regarding their restraint design.

6. Install chrome-plated cast brass escutcheon with set screw at each wall, floor, and ceiling penetration in exposed finished locations and within cabinets and millwork.
7. Penetrations:
   a. Firestopping: Where pipes pass through fire partitions, firewalls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke, and gases as specified in Section 07 84 00, FIRESTOPPING. Fill and seal clearances between raceways and openings with the firestopping materials.
   b. Waterproofing: At floor penetrations, completely seal clearances around the pipe and make it watertight with sealant as specified in Section 07 92 00, JOINT SEALERS. Bio-based materials shall be utilized when possible.
   c. Acoustical sealant: Where pipes pass through sound-rated walls, seal around the pipe penetration with an acoustical sealant that is compliant with ASTM C919.

B. Domestic Water piping shall conform to the following:

1. Grade all lines to facilitate drainage. Provide drain valves at bottom of risers and all low points in the system. Design domestic hot and cold water circulating lines with no traps.
2. Connect branch lines at bottom of the main serving fixtures below and pitch down so that the main may be drained through the fixture. Connect branch lines to the top of the main serving-only fixtures located on the floor above.

3.2 TESTS

A. General: Test system either in its entirety or in sections. Submit the testing plan to CO 10 working days before the test date.

B. Potable Water System: Test after installation of piping and domestic water heaters, but before piping is concealed, before covering is applied, and before plumbing fixtures are connected. Fill systems with water and maintain hydrostatic pressure of 150 psig gage for two hours. No decrease in pressure is allowed. Provide a pressure gage with a shutoff and bleeder valve at the highest point of the piping being tested. The pressure gauge shall have 1 psig increments.

C. Re-agent Grade Water Systems: Fill system with water and maintain hydrostatic pressure of 200 psig gage during the inspection and prove tight.

D. All Other Piping Tests: Test newly installed piping under 1-1/2 times actual operating conditions and prove tight.

E. The test pressure shall hold for the minimum time duration required by the applicable plumbing code or authority having jurisdiction.

3.3 STERILIZATION

A. After tests have been completed, thoroughly flush and sterilize the interior domestic water distribution system following AWWA C651.

B. Use liquid chlorine or hypochlorite for sterilization.

END OF SECTION

SECTION 22 11 19

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following domestic water piping specialties:

1. Surge Anticipator Valve Assembly
2. Vacuum breakers.
3. Backflow preventers.
4. Temperature-actuated water mixing valves.
5. Strainers.
6. Hose bibbs.
7. Frost Free Yard Hydrants.
8. Drain valves (Hose-end).
9. Water hammer arresters.
10. Air vents.
11. Trap-seal primer valves.
12. Eccentric Reducer Expansion Joint
13. Eyewash / Safety Station

B. Related Sections include the following:

1. Division 22 plumbing piping Sections for general-duty and specialty valves for site construction piping.
2. Division 22 Section "Common Work Results for Plumbing"
3. Division 22 Section "Identification for Plumbing Piping & Equipment."
4. Division 26 Section "Low-Voltage Electrical Power Conductors & Cables."
5. Division 26 Section "Grounding & Bonding for Electrical Systems."

1.3 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for the intended use.

B. NSF Compliance:

1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 – PRODUCTS

2.1 SURGE ANTICIPATOR VALVE ASSEMBLY

A. Main Valve:

1. The valve shall be hydraulically operated, single diaphragm actuated. The diaphragm shall be the only moving part and piston operation shall not be allowed.
2. The valve body shall be cast ductile iron.
3. The diaphragm shall withstand a Mullins Burst test to a minimum of 600 psi and rated for 100,000 cycles.
4. The main valve seat and bearing shall be removable. All internal parts shall be accessible without removing the valve body from the line.

B. Pilot Control Valves:

1. Pressure relief pilot low-pressure pilot shall be adjustable, spring-loaded, normally closed diaphragm control design.
2. The low-pressure pilot shall be adjustable, spring-loaded, normally open diaphragm control design.
3. The pilot system shall contain an adjustable hydraulic limiter to allow separate operations of the two pilots.
4. Pilot pressure adjustment shall be adjustable in the range of 0-450 psi.

C. Approved Products:

1. Approved Manufacturer: CLA-VAL Model 52-01 or project Manager approved equal.

2.2 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers

1. 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:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Ames Co.
   b. Cash Acme.
   c. Conbraco Industries, Inc.
   d. FEBCO; SPX Valves & Controls.
   e. Rain Bird Corporation.
   f. Toro Company (The); Irrigation Div.
   g. Watts Industries, Inc.; Water Products Div.
   h. Zurn Plumbing Products Group; Wilkins Div.
3. Standard: ASSE 1001.
4. Size: NPS 1/4 to NPS 3 (DN 8 to DN 80), as required to match connected piping.
5. Body: Bronze.
6. Inlet and Outlet Connections: Threaded.
7. Finish: Rough bronze.

B. Hose-Connection Vacuum Breakers:

1. 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:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Arrowhead Brass Products, Inc.
   b. Cash Acme.
   c. Conbraco Industries, Inc.
   d. Legend Valve.
   e. MIFAB, Inc.
   f. Prier Products, Inc.
   g. Watts Industries, Inc.; Water Products Div.
   h. Woodford Manufacturing Company.
   i. Zurn Plumbing Products Group; Light Commercial Operation.
   j. Zurn Plumbing Products Group; Wilkins Div.
3. Standard: ASSE 1011.
4. Body: Bronze, nonremovable, with manual drain.
5. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
6. Finish: Rough bronze.

2.3 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principal Backflow Preventers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on the Drawings or a comparable product by one of the following:
   a. Ames Co.
   b. Conbraco Industries, Inc.
   c. FEBCO; SPX Valves & Controls.
   d. Flomatic Corporation.
   e. Watts Industries, Inc.; Water Products Div.
   f. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig (83 kPa) maximum, through middle 1/3 of the flow range.
5. Size: Per drawings.
6. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with 7. AWWA C550 or that is FDA approved steel with interior lining complying with AWWA C550 or that is FDA approved stainless steel for NPS 2-1/2 (DN 65) and larger.
7. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged < for NPS 2-1/2 (DN 65) and larger.
8. Configuration: Designed for horizontal, straight-through flow.
9. Accessories:
   a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 (DN 50) and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 (DN 65) and larger.
   b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

2.4 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Individual-Fixture, Water Tempering Valves:

1. 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:
   a. Cash Acme.
   b. Conbraco Industries, Inc.
   c. Honeywell Water Controls.
   d. Lawler Manufacturing Company, Inc.
   e. Leonard Valve Company.
   f. Powers; a Watts Industries Co.
   g. Watts Industries, Inc.; Water Products Div.
   h. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1016, thermostatically controlled water tempering valve.
3. Pressure Rating: 125 psig (860 kPa) minimum, unless otherwise indicated.
4. Body: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable.
6. Inlets and Outlet: Threaded.
7. Finish: Rough or chrome-plated bronze.
8. Tempered-Water Setting: 110 F (43 deg C).

2.5 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig (860 kPa) minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 (DN 65) and larger.
3. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:
   a. Strainers NPS 2 (DN 50) and Smaller 0.033 inch (0.84 mm.
   b. Strainers NPS 2-1/2 to NPS 4 (DN 65 to DN 100 0.062 inches (1.57 mm).
6. Drain: Factory-installed, hose-end drain valve.

2.6 HOSE BIBBS

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
   a. Acceptable Manufactures:
      1) ZURN Industries (Model: 195XL Series)
      2) Or Approved equal by the Engineer or Contracting Officer
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS /4 (DN 15 or DN 20) threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig (860 kPa).
7. Vacuum Breaker: Integral or field-installation, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, chrome, or nickel-plated.
9. Finish for Service Areas: Rough bronze.
10. Finish for Finished Rooms: Chrome or nickel-plated.
11. Operation for Equipment Rooms: Wheel handles or operating key.
12. Operation for Service Areas: Wheel handle.
13. Operation for Finished Rooms: Wheel handle.

2.7 FROSTPROOF YARD HYDRANTS

A. Yard Hydrants:

1. Body Material: 1.25-inch Galvanized Steel.
   a. Acceptable Manufactures:
      1) Woodford Manufacturing Company (Model: Y1)
      2) Or Approved equal by the Engineer or Contracting Officer.
2. Female Inlet: 1-inch NPT
3. Operating Rod: 3/8-inch Stainless Steel Pipe

4. Drain Hole: Tapped 1/8-inch NPT
5. Removable Nozzle: ¾-inch Brass Male Hose Nozzle
6. Maximum Working Pressure: 125 psig (860 kPa)
7. Maximum Temperature: 120 º F.
8. Packing: Graphite for lubricity and long life.

2.8 DRAIN VALVES (HOSE-END)

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig (2760-kPa) minimum CWP.
3. Size: NPS 3/4 (DN 20).
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.9 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. 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:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AMTROL, Inc.
   b. Josam Company.
   c. MIFAB, Inc.
   d. PPP Inc.
   e. Sioux Chief Manufacturing Company, Inc.
   f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   g. Tyler Pipe; Wade Div.
   h. Watts Drainage Products Inc.
   i. Zurn Plumbing Products Group; Specification Drainage Operation.
3. Standard: ASSE 1010 or PDI-WH 201.
4. Type: Copper tube with a piston.
5. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.10 AIR VENTS (Not Used)

2.11 TRAP-SEAL PRIMER VALVES

A. Supply-Type, Trap-Seal Primer Valves:

1. 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:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. MIFAB, Inc.
   b. PPP Inc.
   c. Sioux Chief Manufacturing Company, Inc.
   d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   e. Watts Industries, Inc.; Water Products Div.
3. Standard: ASSE 1018.
4. Pressure Rating: 125 psig (860 kPa) minimum.
5. Body: Bronze.
6. Inlet and Outlet Connections: NPS 1/2 (DN 15) threaded, union, or solder joint.
7. Gravity Drain Outlet Connection: NPS 1/2 (DN 15) threaded or solder joint.
8. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type, Trap-Seal Primer Valves:

1. 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:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
3. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 (DN 10) minimum, trap makeup connection.
4. Size: NPS 1-1/4 (DN 32) minimum.
5. Material: Chrome-plated, cast brass.

2.12 ECCENTRIC REDUCER EXPANSION JOINT (Not Used)

2.13 EYEWASH/SAFETY STATION

A. The contractor shall provide and install eyewash stations, safety stations, or eyewash and shower combinations in compliance with ANSI Z358.1 “Emergency Eyewash and Shower Equipment.”

B. Showers

1. Showers shall be located so that the water column is provided that is not less than 82 inches nor more than 96 inches in height from the surface on which the user stands.
2. The center of the spray pattern shall be located 32-48” from any obstruction; the spray pattern shall be a minimum diameter of 20” measured 60” from the showerhead.
3. Showers shall be capable of delivering a minimum of 20 gallons per minute at 30 PSI.

5. Manufacturers:
    a. Haws # 8123 or # 8133 series
    b. Guardian # G1643 (horizontal), # G1635 (vertical) or # G-1629 (concealed)

C. Eyewash Stations

1. Eyewash stations shall be positioned with the water nozzles 33 inches to 45 inches from the surface on which the user stands and 6 inches minimum from the wall or nearest obstruction
    a. Manufacturers:
        1) Haws # 7360
        2) Guardian # G1724 or # G1750 Series
        3) Guardian # G1814 Series
2. Deck-mounted (sink mounted) Eyewash Stations: only approved for use in limited circumstances where installation of a wall-mounted eyewash or combination eyewash/shower is impractical.
    a. Manufacturers:
        1) Guardian # G1100 or 1101, or HG1100, or equal
        2) Guardian # G1805 or 1806
        3) Guardian # 1825
3. Floor-Mounted Combination Emergency Shower/Eye Wash Manufacturers:
    a. Manufacturers:
        1) Haws # 8309 series
        2) Guardian# G1902 or HG1902
4. Recessed Wall Mounted Combination Emergency Shower/Eye Wash, With Exposed Shower Head Manufacturers:
    a. Guardian # GBF2172

D. Installation shall include all materials and labor necessary to be complete and fully operational. The faucet and stem lock eyewash shall all be visually inspected and operationally tested.

E. Testing

1. With the unit correctly connected to the water source and the valve(s) closed, visually check the piping for leaks.
2. Remove eyewash filters.
3. Open the valve to the fully open position. The valve shall remain open without requiring further use of the operator’s hands. Flush to ensure all foreign materials from the installation are removed from the piping system.
4. Ensure proper delivered water temperature to eyewashes and showers.
5. After successful testing, reinstall eyewash filters and caps.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in the same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to the floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
3. Do not install bypass piping around backflow preventers.

C. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valves on outlets.

D. Install thermometers and water regulators if specified.

E. Install cabinet-type units recessed in or surface mounted on the wall as specified. Install water hammer arresters in water piping according to PDI-WH 201. Install supply-type, trap-seal primer valves with outlet piping pitched down toward the drain trap a minimum of 1 percent, and connect to the floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate the general arrangement of piping and specialties.

B. Ground equipment according to Division 26 Section "Grounding & Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors & Cables."

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Pressure vacuum breakers.
2. Intermediate atmospheric-vent backflow preventers.
3. Reduced-pressure-principal backflow preventers.
4. Double-check backflow-prevention assemblies.
5. Carbonated-beverage-machine backflow preventers.
6. Dual-check-valve backflow preventers.
7. Reduced-pressure-detector, fire-protection backflow-preventer assemblies.
8. Double-check, detector-assembly backflow preventers.
9. Water pressure-reducing valves.
10. Calibrated balancing valves.

11. Primary, thermostatic, water mixing valves.
12. Manifold, thermostatic, water-mixing-valve assemblies.
13. Photographic-process, thermostatic, water-mixing-valve assemblies.
14. Primary water tempering valves.
15. Outlet boxes.
16. Hose stations.
17. Supply-type, trap-seal primer valves.
18. Trap-seal primer systems.

B. Distinguish among multiple units, inform the operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying units. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping & Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:

1. Test each reduced-pressure-principal backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.5 ADJUSTING

A. Set field-adjustable pressure setpoints of water pressure-reducing valves.

B. Set field-adjustable flow setpoints of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION

SECTION 22 13 13

FACILITY SANITARY SEWERS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But is Not Limited To

1. Perform excavating and backfilling required for work of this Section.
2. Furnish and install sanitary sewage piping as described in the Contract Documents.

B. Related Sections

1. Section 02 05 00 - Common Work Results for Existing Conditions
2. Section 31 23 33 - Utility Excavation & Backfill
3. Section 31 23 33.20 - Restoration of Surfaces

1.2 REFERENCES

A. American Society for Testing and Materials

1. ASTM A 74-98, 'Standard Specification for Cast Iron Soil Pipe and Fittings'
2. ASTM C 564-97, 'Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe & Fittings'.
3. ASTM D 2235-96a, >Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
4. ASTM D 2321-00, >Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
5. ASTM D 2564-96a, >Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
6. ASTM D 2661-97a, >Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings.
7. ASTM D 2665-00, >Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe Fittings.
8. ASTM D 3034-00, >Standard Specification for Type PSM Poly Vinyl Chloride) (PVC) Sewer Pipe & Fittings.
9. ASTM D 3350, >Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
10. ASTM F 656-96a, >Standard Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
11. ASTM F 789-95a, >Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Plastic Gravity Flow Sewer Pipe and Fittings.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements - Install cleanouts and piping per local governing authority and State codes.

1.4 SUBMITTALS

A. Submit product data for materials to be installed or furnished under this section.

B. Submit manufacturer's certification that material meets or exceeds specified requirements including all test results and material identifications

C. Submit manufacturer's installation instructions.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Cast Iron Soil Pipe and Fittings

1. Meet requirements of ASTM A 74, Service Grade.
   a. Cast iron for bell and spigot fittings
   b. Cast iron for no-hub joints.
2. Approved Joint Material and Manufacturers -
   a. For Bell And Spigot Pipe - Rubber gaskets meet the requirements of ASTM C 564 and are compatible with the pipe used.
   b. For No-Hub Pipe -
      1) Approved Products -
         a) Neoprene gaskets with type 304 stainless steel clamp and 24 ga type 304 stainless steel housing by Clamp-All Corp, Haverhill, MA (800) 762-7255 or (978) 372-9010 www.clampall.com
         b) SuperGrip 304 by AB&I - American Brass & Iron, Oakland, CA (800) 468-4766 or (510) 632-3467 www.abifoundry,com
         c) Husky SD 4000 coupling by ANACO, Anaheim, CA (707) 259-0602
         d) MG Coupling by MG Piping Products Co, Stanton, CA (800) 761-8055 or (714) 761-8055 www.mgcoupling.com

B. ABS Schedule 40 solid wall plastic pipe and fittings meeting requirements of ASTM D 2661 joined with pipe cement meeting requirements of ASTM 2235.

C. PVC Schedule 40 solid wall plastic pipe and fittings meeting requirements of ASTM D 2665 joined using cement primer meeting requirements of ASTM F 656 and pipe cement meeting requirements of ASTM D 2564.

D. PVC C900 solid wall plastic pipe and fittings meeting the requirements of ASTM D 1784. Joints shall be elastomeric gasket joints with ASTM F477-02 elastomeric gaskets.

E. Solid Wall High-Density Polyethylene pipe and fittings for iron pipe sizing (IPS) meeting requirements of fusible pipe under ASTM D3350.

F. Solid wall PVC plastic pipe and fittings meeting requirements of ASTM D 3034 with a min. SDR 35 wall thickness. Joints shall be elastomeric gasket joints with ASTM F477-02 elastomeric gaskets.

G. Clean-out Frame and Covers shall be close-grained, gray iron, castings free from blowholes conforming to ASTM A48 Class 20 or better.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before installation, inspect the pipe for defects and cracks. Do not use defective, damaged, or unsound pipes.

3.2 PREPARATION

A. Excavate and backfill as specified in Section 31 23 33 with the following additional requirements

1. Runs shall be as close as possible to those shown on the Drawings.
2. Excavate to required depth and grade to obtain fall required.
3. Bottom of trenches shall be hard. Tamp as required.
4. Remove debris from trench before laying of pipe.
5. Do not cut trenches near footings without consulting Contracting Officer.
6. Excavate trenches so the top of the outside pipe will be 24” minimum below finish grade, or as indicated on the drawings, whichever is deeper.

3.3 INSTALLATION

A. General

1. When work is not in progress, close open ends of pipes and fittings so no trench water, soil, or other substances will enter pipes or fittings.
2. Keep trenches free from water until pipe jointing material has been set. Do not lay pipe when the condition of the trench or weather is unsuitable for such work.
3. Trench width at top of the pipe shall equal the outside diameter of the pipe plus two feet.

B. Placing and Laying of Underground Pipe

1. Deflections from a straight line or grade, as required by vertical curves, horizontal curves, or offsets, shall not exceed 6/D inches per linear foot 12 500/D mm per m of pipe where D represents the nominal diameter of pipe expressed in inches mm.
2. Deflections to be determined between center lines extended of two connecting pipes.
3. If alignment requires deflection more than these limitations, provide special bends or a sufficient number of shorter lengths of pipe to provide angular deflections within limits approved by Contracting Officer.

4. Laying -
    a. Pipe laying shall proceed to upgrade with faucet ends of bell-and-faucet pipe pointing in direction of flow.
    b. Lay each pipe true to line and grade and in such manner as to form a close concentric joint with adjoining pipe and to prevent sudden offsets of the flow line.
    c. As work progresses, the clear interior of pipe of dirt and superfluous materials. Where cleaning after laying is difficult because of the small pipe, keep a suitable swab or drag in the pipe and pull forward past each joint immediately after jointing has been completed.
5. Make joints between cast iron pipe and other types of pipes with standard manufactured cast-iron adapters and fittings.
6. Valve, plug, or cap, as directed by Contracting Officer, where pipe ends are left for future connections.

C. Cast Iron Pipe and Fittings

1. Shape trench bottom to give substantially uniform circumferential support to the lower third of each pipe. Provide depression under the bell of each joint to maintain even bearing of sewer pipe.
2. Connect to street main as required by local authorities.
3. Use jacks to make-up gasketed joints.

D. Thermoplastic Pipe and Fittings

1. Install per Manufacturer's recommendations and ASTM D 2321.
2 Stabilize unstable trench bottoms.
3. Bed pipe true to line and grade with continuous support from a firm base.
    a. Bedding depth – four to six inches (4” – 6”).
    b. Material and compaction to meet ASTM standard noted above.
4. Excavate bell holes into bedding material so the pipe is uniformly supported along its entire length. Blocking to grade pipe is forbidden.
5. Piping and joints shall be clean and installed according to the Manufacturer's recommendations. Break down contaminated joints, clean seats, and gaskets, and reinstall.
6. Do not use a backhoe or power equipment to assemble pipe.
7. Initial backfill shall be twelve inches (12”) 300 mm above the top of the pipe with the material specified in referenced ASTM standard.
8. Minimum cover over the top of the pipe.
    a. 36 inches 900 mm before allowing vehicular traffic over the pipe
    b. 48 inches 1 200 mm before use of compaction equipment other than hand or impact tampers.

E. Clean-outs - General

1. Install per the Manufacturer's recommendations.
2. Place or grind castings, if necessary, to ensure flat, smooth, even, and true surfaces.

3.4 FIELD QUALITY CONTROL

A. Failure to install joints properly shall be cause for rejection and replacement of the piping system.

B. Testing

1. Perform testing in the presence of the Contracting Officer.
2. Gravity sewer piping shall be tested using the following methods:
    a. Visual Inspection - Visually inspect the pipeline between manholes with mirrors or lights after the trench has been backfilled to check alignment and grade, and to check for pipe distortions, leaks, infiltration, and other defects. Verify that the full diameter of the pipe is visible from one manhole to the next. Uncover and repair leaks and defects in the pipeline. Do not reinstall the damaged pipe.
3. Air Pressure Testing
    a. Low-pressure air test lines are 24" and smaller in diameter.
    b. Provide equipment including gauges and instrumentation and calibrate the equipment at the request of the Contracting Officer.
    c. Preliminary and Final Testing:
        1) Preliminary Testing: At the discretion of the Contractor, preliminary testing may be done at any time before the installation of other utilities.
        2) Final Testing: Perform final testing after backfilling and compaction and following the installation of other utilities, but before surface restoration.
    d. Test procedure:
        1) Securely brace plugs to prevent unintentional release of the plug. Prohibit workers from entering a manhole where a plugged pipe is under pressure.
        2) Locate pressure gauges, valves, and instrumentation required for the test and operation of the equipment at the ground surface.
        3) Equip the testing apparatus with a pressure release device such as a rupture disk or pressure relief valve to relieve pressure in the pipe being tested at 6.0 psi.
        4) Pressurize the pipe to 5.0 psi and disconnect the air supply.
        5) Test pressure shall maintain for 6 minutes and show no pressure drop.

C. Pipe Cleaning

1. Before deflection testing and CCTV inspection, clean the completed pipeline with a hydro-cleaner, or other Contracting Officer-approved cleaning equipment, and provide a pipeline free of dirt, mud, rocks, or other material. Leave downstream plugs in place during cleaning and do not introduce foreign material into existing sewer lines. Closed Circuit Television (CCTV) Inspection.

D. Deflection Tests for Flexible Pipe

1. Deflection test all flexible pipelines no sooner than 30 days after trench backfill and compaction are completed. Unless otherwise provided in the contract, the Contractor is to bear costs associated with completing surface repair or other work before all required testing. The maximum allowable deflection is to be 5.0% of the nominal pipe diameter.
2. Provide test mandrels with a diameter of at least 95% of the actual inside diameter (ID) of the pipe. For pipes with controlled outside diameter, calculate the actual ID of the pipe by taking the average outside diameter (OD) as set by the ASTM standard minus 2 times the minimum wall thickness as set by the ASTM standard. For pipes with controlled inside diameter, use the ID set by the ASTM standard.

3. The mandrel shall be constructed of a metal or a rigid plastic material that can withstand 200 psi without being deformed. The mandrel shall have 9 or more "runners" as long as the total number of legs is odd. The length of the mandrel barrel section shall be a minimum of 75% of the inside pipe diameter. A proving ring shall be provided and used for each mandrel size in use.
4. Pull the appropriate mandrel through the pipe using one of the following methods:
    a. Pull the mandrel through the pipe by hand. If the pipe will not allow the mandrel to pass, repeat the test from the opposite direction to determine the limits of failure.
    b. As a part of the CCTV inspection, pull the mandrel through the pipe by connecting it in front of the CCTV camera lens at a distance equal to the camera's focal length. Notify Contracting Officer of time and date of test at least 24 hours before testing to allow for Contracting Officer, at Contracting Officer's discretion, to witness the test. Provide tag line to reverse mandrel and camera should mandrel fail to pass through the line. Perform the test as a separate step from the CCTV inspection thus a separate video record must be made of the mandrel test. Clearly mark video recording identifying project name, mandrel test, and the pipe will not allow the mandrel to pass, repeat the test from the opposite direction to determine the limits of failure.
5. Uncover and, if required by the Contracting Officer, remove, and reinstall new pipe sections for reaches with excessive deflection or re-compact bedding if, in the opinion of the Contracting Officer, the existing pipe is not damaged. Retest pipe after any repair work is completed. Do not reinstall the damaged pipe.
6. Use a "Go-No go" pin gauge instead of a mandrel if "Insta-Tap" tee fittings are used for service connections. Use test diameter per D.2 above.
7. The Government may conduct additional deflection testing before the expiration of the warranty period. Uncover and reinstall sections of the pipe found to have excessive deflection. Do not reinstall the damaged pipe.

E. Pressure sewer piping shall be tested using the following:

1. Pressure Test: Before covering the pipes test system in presence of the Contracting Officer at 1.5 times the pipeline working pressure in psi for 2 hours and show no pressure drop.

END OF SECTION

SECTION 22 13 16

SANITARY WASTE & VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following for soil, waste, and vent piping inside the building:

1. Pipe, tube, and fittings.
2. Special pipe fittings.
3. Encasement for underground metal piping.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

C. LLDPE: Linear, low-density polyethylene plastic.

D. NBR: Acrylonitrile-butadiene rubber.

E. PE: Polyethylene plastic.

F. PVC: Polyvinyl chloride plastic.

G. TPE: Thermoplastic elastomer.

H. HDPE: High-Density Polyethylene plastic

1.4 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.
2. Sanitary Sewer, Force-Main Piping: 50 psig.

B. Seismic Performance: Soil, waste, and vent piping and support and installation shall be capable of withstanding the effects of seismic events determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures."

1.5 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. LEED Submittal:

1. Product Data for Credit EQ 4.1: For solvent cement and adhesive primers, including the printed statement of VOC content.

C. Shop Drawings:

1. Design Calculations: Signed and sealed by a qualified professional engineer for selecting seismic restraints.
2. Solvent Drainage System: Include plans, elevations, sections, and details.

D. Field quality-control inspection and test reports.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear the label, stamp, or other markings of a specified testing agency.

B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where the titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE, AND FITTINGS

A. The pipe and fittings in this Article are available in NPS 2 to NPS 15 (DN 50 to DN 375).

B. Pipe and Fittings: ASTM A 74, Service and Extra-Heavy class(es).

C. Gaskets: ASTM C 564, rubber.

D. Calking Materials: ASTM B 29, pure lead, and oakum or hemp fiber.

2.4 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Sovent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator, and deaerator drainage fittings.

C. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.

1. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
    a. Available Manufacturers:
        1) ANACO.
        2) Fernco, Inc.
        3) Ideal Div.; Stant Corp.
        4) Mission Rubber Co.
        5) Tyler Pipe; Soil Pipe Div.
2. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
    a. Available Manufacturers:
        1) ANACO.
        2) Clamp-All Corp.
        3) Ideal Div.; Stant Corp.
        4) Mission Rubber Co.
        5) Tyler Pipe; Soil Pipe Div.
3. Heavy-Duty, Shielded, Cast-Iron Couplings: ASTM A 48/A 48M, two-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.
    a. Available Manufacturers:
        1) MG Piping Products Co.

D. Rigid, Unshielded Couplings: ASTM C 1461, sleeve-type, reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Available Manufacturers:
   a. ANACO.

2.5 STEEL PIPE AND FITTINGS

A. Pipe in the paragraph below is available in NPS 1/8 to NPS 26 (DN 6 to DN 650).

B. Edit paragraph for specific type or grade, and wall thickness if required.

C. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade A or B, Standard Weight or Schedule 40, galvanized. Include ends matching the joining method.

D. Drainage Fittings: ASME B16.12, galvanized, threaded, cast-iron drainage pattern.

E. Pressure Fittings:

1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized, seamless steel pipe. Include ends matching the joining method.
2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
3. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, galvanized standard pattern.
4. Cast-Iron Flanges: ASME B16.1, Class 125.
5. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125, galvanized.

E. Grooved-Joint Systems:

1. Available Manufacturers:
   a. Anvil International.
   b. Star Pipe Products; Star Fittings Div.
   c. Victaulic Company.
   d. Ward Manufacturing, Inc.
2. Grooved-End, Steel-Piping Fittings: ASTM A 47/A 47M, galvanized, malleable-iron casting; ASTM A 106, galvanized-steel pipe; or ASTM A 536, galvanized, ductile-iron casting; with dimensions matching steel pipe.
3. Grooved-End, Steel-Piping Couplings: AWWA C606, for steel-pipe dimensions. Include ferrous housing sections, a gasket suitable for water, and bolts and nuts.

2.6 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain faucet end, unless grooved or flanged ends are indicated.

1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain faucet end, unless grooved or flanged ends are indicated.

1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Gaskets: AWWA C111, rubber.

C. Grooved-Joint Systems:

1. Available Manufacturers:
   a. Victaulic Company.
2. Grooved-End, Ductile-Iron Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.
3. Grooved-End, Ductile-Iron-Piping Couplings: AWWA C606, for ductile-iron-pipe dimensions. Include ferrous housing sections, a gasket suitable for water, and bolts and nuts.

D. Flanges: ASME 16.1, Class 125, cast iron.

2.7 COPPER TUBE AND FITTINGS

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

B. Hard Copper Tube: ASTM B 88, Types L and M (ASTM B 88M, Types B, and C), water tube, drawn temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
3. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

C. Soft Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B), water tube, annealed temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.

2.8 ABS PIPE AND FITTINGS

A. Solid-Wall ABS Pipe: ASTM D 2661, Schedule 40.

B. Cellular-Core ABS Pipe: ASTM F 628, Schedule 40.

C. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste, and vent patterns.

D. Solvent Cement and Adhesive Primer:

1. Use ABS solvent cement that has a VOC content of 325 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Use an adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.9 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

1. PVC Socket Fittings: ASTM D 2665 or ASTM D 1784, socket type, made to ASTM D 3311, drain, waste, and vent patterns.

B. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.

1. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

C. Cellular-Core, Sewer and Drain Series, PVC Pipe: ASTM F 891, Series PS 100.

1. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Series PS 100 sewer and drainpipe.

D. Solvent Cement and Adhesive Primer:

1. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Use an adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.10 SPECIAL PIPE FITTINGS

A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include a shear ring, ends of the same sizes as piping to be joined, and a corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Available Manufacturers:
   a. Dallas Specialty & Mfg. Co.
   b. Fernco, Inc.
   c. Logan Clay Products Company (The).
   d. Mission Rubber Co.
   e. NDS, Inc.
   f. Plastic Oddities, Inc.

2. Sleeve Materials:
    a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
    b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
    c. For Dissimilar Pipes: ASTM D 5926, PVC, or other material compatible with pipe materials being joined.

B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Available Manufacturers:
    a. Cascade Waterworks Mfg. Co.
    b. Mission Rubber Co.

C. Rigid, Unshielded, Nonpressure Pipe Couplings: ASTM C 1461, sleeve-type reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Available Manufacturers:
    a. ANACO.

D. Pressure Pipe Couplings: AWWA C219 metal, the sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.

1. Available Manufacturers:
    a. Cascade Waterworks Mfg. Co.
    b. Dresser, Inc.; DMD Div.
    c. EBAA Iron Sales, Inc.
    d. Ford Meter Box Company, Inc. (The); Pipe Products Div.
    e. JCM Industries, Inc.
    f. Romac Industries, Inc.
    g. Smith-Blair, Inc.
    h. Viking Johnson.
2. Center-Sleeve Material: Manufacturer's standard.
3. Gasket Material: Natural or synthetic rubber.
4. Metal Component Finish: Corrosion-resistant coating or material.

E. Flexible Ball Joints: Ductile-iron fitting with a combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include gasketed ball-joint section and ductile-iron gland, rubber gasket, and steel bolts.

1. Available Manufacturers:
    a. EBAA Iron Sales, Inc.

F. Expansion Joints: Two or three-piece, a ductile-iron assembly consisting of telescoping sleeve(s) with gaskets and restrained-type, ductile-iron, bell-and-faucet end sections complying with AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

1. Available Manufacturers:
    a. EBAA Iron Sales, Inc.

b. Romac Industries, Inc.
c. Star Pipe Products; Star Fittings Div.

G. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

1. Available Manufacturers:
a. SIGMA Corp.

2.11 ENCASEMENT FOR UNDERGROUND METAL PIPING

A. Description: ASTM A 674 or AWWA C105, high-density, cross-laminated PE film of 0.004-inch (0.10-mm) or LLDPE film of 0.008-inch (0.20-mm) minimum thickness.

B. Form: Sheet or tube.

C. Color: Black or natural.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to Section 31 32 00 for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil, and waste piping NPS 4 (DN 100) and smaller shall be any of the following:

1. Service class, cast-iron soil pipe, fittings; gaskets; and gasketed joints.
2. Hubless cast-iron soil pipe and fittings and rigid, unshielded couplings; and hubless-coupling joints.
3. Steel pipe, drainage fittings, and threaded joints.
4. Stainless steel pipe and fittings, gaskets, and gasketed joints.
5. Copper DWV tube, copper drainage fittings, and soldered joints.
6. Solid-wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
7. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
8. Dissimilar Pipe-Material Couplings: Flexible, nonpressure pipe couplings for joining dissimilar pipe materials with a small difference in OD.

C. Aboveground, vent piping NPS 4 (DN 100) and smaller shall be any of the following:

1. Service class, cast-iron soil pipe, fittings; gaskets; and gasketed joints.

2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel, and rigid, unshielded couplings; and hubless-coupling joints.
3. Steel pipe, drainage fittings, and threaded joints.
4. Stainless steel pipe and fittings gaskets, and gasketed joints.
5. Copper DWV tube, copper drainage fittings, and soldered joints.
    a. Option for Vent Piping, NPS 2-1/2 and NPS 3-1/2 (DN 65 and DN 90): Hard copper tube, Type M (Type C); copper pressure fittings; and soldered joints.
6. Solid-wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
7. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
8. Dissimilar Pipe-Material Couplings: Flexible, nonpressure pipe couplings for joining dissimilar pipe materials with a small difference in OD.

D. Underground, soil, waste, and vent piping NPS 4 (DN 100) and smaller (2 to 4 inches) shall be any of the following:

1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, cast-iron and rigid, unshielded couplings; and hubless-coupling joints.
3. Stainless steel pipe and fittings, gaskets, and gasketed joints.
4. Solid wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
5. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
6. Cellular-core, Sewer, and Drain Series, PVC pipe; PVC socket fittings; and solvent-cemented joints.
7. Dissimilar Pipe-Material Couplings: Flexible, nonpressure pipe couplings for joining dissimilar pipe materials with a small difference in OD.

3.3 PIPING INSTALLATION

A. Sanitary sewer piping outside the building is specified in Section 33 30 00.

B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

C. Install seismic restraints on piping. Seismic-restraint devices are specified in Division 22 Section "Vibration & Seismic Controls for Plumbing Piping & Equipment."

D. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

E. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside the building between wall and floor penetrations and connection to sanitary sewer piping outside the building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.

    1. Install encasement on piping according to ASTM A 674 or AWWA C105.

F. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."

    1. Install encasement on piping according to ASTM A 674 or AWWA C105.

G. Install underground, ductile iron, and special pipe fittings according to AWWA C600.

1. Install encasement on piping according to ASTM A 674 or AWWA C105.

H. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through the foundation wall. A select number of interlocking rubber links are required to make the installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."

I. Install wall-penetration fitting at each service pipe penetration through the foundation wall. Make installation watertight.

J. Install cast-iron soil piping according to CSPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if a change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch, and 1/8-bend fittings if 2 fixtures are installed back-to-back or side by side with a common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change the direction of flow to more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing the size of drainage piping in direction of flow is prohibited.

L. Lay buried building drainage piping beginning at the low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to the manufacturer's written instructions for use of lubricants, cement, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

M. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:

1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
3. Vent Piping: 1 percent down toward vertical fixture vent or vent stack.

N. Install engineered soil and waste drainage and vent piping systems as follows:

1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
2. Sovent Drainage System: Comply with ASSE 1043 and the sovent fitting manufacturer's written installation instructions.
3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.

O. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if the slab is without membrane waterproofing.

P. Install ABS soil and waste drainage and vent piping according to ASTM D 2661.

Q. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.

R. Install underground ABS and PVC soil and waste drainage piping according to ASTM D 2321.

S. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.4 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Join hub-and-faucet, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

C. Join hub-and-faucet, cast-iron soil piping with calked joints according to CSPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.

D. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

E. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

F. Grooved Joints: Assemble joint with keyed coupling, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

G. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.5 VALVE INSTALLATION

A. General valve installation requirements are specified as per manufacturers' requirements.

3.6 HANGER AND SUPPORT INSTALLATION

A. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.

2. Install individual, straight, horizontal piping runs according to the following:
   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on the trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Install supports according to Division 22 Section "Hangers & Supports for Plumbing Piping & Equipment."

D. Support vertical piping and tubing at the base and on each floor.

E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches with 3/8-inch rod.
2. NPS 3 (DN 80): 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches with 5/8-inch rod.
4. NPS 6 (DN 150): 60 inches with 3/4-inch rod.
5. NPS 8 to NPS 12 (DN 200 to DN 300): 60 inches with 7/8-inch rod.

G. Install supports for vertical cast-iron soil piping every 15 feet.

H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 (DN 32): 84 inches with 3/8-inch rod.
2. NPS 1-1/2 (DN 40): 108 inches with 3/8-inch rod.
3. NPS 2 (DN 50): 10 feet with 3/8-inch rod.
4. NPS 2-1/2 (DN 65): 11 feet with 1/2-inch rod.
5. NPS 3 (DN 80): 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet with 5/8-inch rod.
7. NPS 6 (DN 150): 12 feet with 3/4-inch rod.
8. NPS 8 to NPS 12 (DN 200 to DN 300): 12 feet with 7/8-inch rod.

I. Install supports for vertical steel piping every 15 feet.

J. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 2 (DN 50): 84 inches with 3/8-inch rod.
2. NPS 3 (DN 80): 96 inches with 1/2-inch rod.
3. NPS 4 (DN 100): 108 inches with 1/2-inch rod.
4. NPS 6 (DN 150): 10 feet with 5/8-inch rod.

K. Install supports for vertical stainless-steel piping every 10 feet.

L. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 (DN 32): 72 inches with 3/8-inch rod.
2. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches with 3/8-inch rod.
3. NPS 2-1/2 (DN 65): 108 inches with 1/2-inch rod.
4. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet with 1/2-inch rod.
5. NPS 6 (DN 150): 10 feet with 5/8-inch rod.
6. NPS 8 (DN 200): 10 feet with 3/4-inch rod.

M. Install supports for vertical copper tubing every 10 feet.

N. Install hangers for ABS and PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches with 3/8-inch rod.
2. NPS 3 (DN 80): 48 inches with 1/2-inch rod.
3. NPS 4 and 5 (DN 100 and 125): 48 inches with 5/8-inch rod.
4. NPS 6 (DN 150): 48 inches with 3/4-inch rod.
5. NPS 8 to NPS 12 (DN 200 to DN 300): 48 inches with 7/8-inch rod.

O. Install supports for vertical ABS and PVC piping every 48 inches.

P. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate the general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by the plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by the plumbing code.
4. Equipment: Connect drainage piping as indicated. Provide a shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger.

D. Connect force-main piping to the following:

1. Sanitary Sewer: To exterior force main or sanitary manhole.

3.8 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of a portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in the piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to the completion of the inspection, the water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on the roof and building drain where they leave the building. Introduce air into piping system equal to the pressure of 1-inch wg (250 Pa). Use a U-tube or manometer inserted in the trap of the water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout the inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
2. Cap and subject piping to static-water pressure of 50 psig (345 kPa) above operating pressure, without exceeding the pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

3.9 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during the remainder of the construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in the ends of uncompleted piping at end of the day and when work stops.

3.10 PROTECTION

A. Exposed ABS and PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

END OF SECTION

SECTION 22 13 19

SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following sanitary drainage piping specialties:

1. Cleanouts.
2. Floor drains.
3. Roof flashing assemblies.
4. Miscellaneous sanitary drainage piping specialties.
5. Flashing materials.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FOG: Fats, oils, and greases.

C. FRP: Fiberglass-reinforced plastic.

D. HDPE: High-density polyethylene plastic.

E. PE: Polyethylene plastic.

F. PP: Polypropylene plastic.

G. PVC: Polyvinyl chloride plastic.

1.4 QUALITY ASSURANCE

A. Drainage piping specialties shall bear the label, stamp, or other markings of a specified testing agency.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, C. Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for the intended use.

C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.5 COORDINATION

A. Coordinate the size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 GENERAL

A. Subject to compliance with requirements, provide the product indicated on the Drawings or a comparable product from the alternates listed on the Drawings except noted below.

2.2 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, the positive air gap between the installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening on top of the body.
4. Outlet: Larger than the inlet.
5. Size: Same as connected waste piping and with an inlet large enough for associated indirect waste piping.

2.3 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper-bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.

B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:

1. General Applications: 12 oz./sq. ft.
2. Vent Pipe Flashing: 8 oz./sq. ft.

C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 (Z275) hot-dip galvanized, mill-phosphatized finish for painting if indicated.

D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

E. Fasteners: Metal compatible with material and substrate being fastened.

F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with the material being installed.

G. Solder: ASTM B 32, lead-free alloy.

H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless a larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
4. Locate at the base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with the top flush with the finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with the finished wall.

E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below the elevation of the surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
   a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
   b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
   c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
3. Install floor-drain flashing collar or flange so no leakage occurs between the drain and adjoining flooring. Maintain the integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

F. Install flashing fittings on sanitary stack vents and vent stacks that extend through the roof.

G. Install floor drain, and trap-seal primer fittings on the inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if the trap has a trap-seal primer connection.
2. Size: Same as floor drain inlet.

H. Install air-gap fittings on draining-type backflow preventers and indirect-waste piping discharge into the sanitary drainage system.

I. Install wood-blocking reinforcement for wall-mounting-type specialties.

J. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless the trap is indicated.

K. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. FOG Disposal Systems: Connect inlet and outlet to the unit, connect flow-control fitting and fresh-air inlet piping to unit inlet piping, and connect vent piping between trap and media chamber. Connect electrical power.

D. Grease Interceptors: Connect inlet and outlet to unit and connect flow-control fitting and vent to unit inlet piping. Install valve on outlet of the automatic draw-off-type unit.

E. Grease Removal Devices: Connect controls, electrical power, factory-furnished accessories, and inlet, outlet, and vent piping to the unit.

F. Oil Interceptors: Connect inlet, outlet, vent, and gravity draw-off piping to the unit; flow-control fitting and vent to unit inlet piping; and gravity draw-off and suction piping to oil storage tank.

G. Ground equipment according to Division 26 Section "Grounding & Bonding for Electrical Systems."

H. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors & Cables."

3.3 FLASHING INSTALLATION

A. Fabricate flashing from a single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with a minimum length of 10 inches, and skirt or flange extending at least 8 inches around the pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around the sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around the specialty.

C. Set flashing on floors and roofs in the solid coating of bituminous cement.

D. Secure flashing into the sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing & Trim."

F. Extend flashing up vent pipe passing through roofs and turn down into the pipe, or secure flashing into a cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. FOG disposal systems.
2. Grease interceptors.
3. Grease removal devices.
4. Oil interceptors.
5. Solids interceptors.

B. Distinguish among multiple units, inform the operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying units. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping & Equipment."

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Leak Test: After installation, charge the system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.6 PROTECTION

A. Protect drains during the remainder of the construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs at the ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 22 13 29

SANITARY SEWERAGE PUMPS

Commented [KG1]: Delete this section? Pumps called out in Section 33 32 13

PART 1 GENERAL

1.1 SUMMARY

A. This section includes the work necessary for the installation of lift station submersible pumps at the Grant Grove Wastewater Treatment Plant. Lift stations include Pine Camp, Sunset Camp, and Swale Camp.

Commented [KG2]: Change to Ash Mountain?
Also this spec is mainly for sump pumps, the way it looks.

B. Furnish and provide all supervision, labor, materials, tools, equipment, and perform all operations as specified herein or as indicated on the Drawings for the complete installation, start-up, and testing of the equipment.

1.2 REFERENCES

A. ABMA American Bearing Manufacturers Association

B. ASTM A48 Standard Specification for Gray Iron Castings

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Domestic water piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.4 WARRANTY FOR LIFT STATION AND PUMPS

A. The wastewater pump lift station system shall be completely serviceable, with easy access to pumps. The pumps shall be designed for removal without requiring confined space entry into the wet well.

B. The manufacturer's standard five (5) year warranty on the pump and motor shall apply.

1.5 SUBMITTALS

A. Lift Station Sump Pumps:

1. The following specific sump pump manufacturer submittal information shall be provided consistent with Submittals - Section 01 33 00 and including:
   a. Printed Warranty for sump pumps

b. Certifications and testing consistent with Contractor Quality Control - Section 01 40 00 and including:
   1) Certification that products used to meet standards referenced
c. Exceptions taken sheet, listing detail, each exception taken to the Engineer's specifications, and the value-added by that exception. An exceptions sheet shall be provided in all cases even if no exceptions are necessary.
d. Submit the recommended procedure for exercising pumps where infrequent use of the submersible pumps might be characteristic of their operation.

PART 2 PRODUCTS

2.1 PUMPS

A. For ease of serviceability, all pumps supplied on the project for an application shall be of like horsepower and by one manufacturer.

Commented [KG3]: What pumps are basis of design? Need to list here.

2.2 SUMP PUMPS

A. Sump Pump: Contractor shall provide and install submersible non-clog wastewater sump pump(s) with an integrated electric motor, and all appurtenant materials and work, complete and operable. The pumps shall be designed for continuous operating service and constructed to meet the intended service of conveying raw sanitary waste.

2.3 SUMP PUMP EQUIPMENT

A. Major pump components shall be of grey cast iron, ASTM A-48, Class 35B, with smooth surfaces devoid of blow holes or other irregularities. All exposed nuts or bolts shall be AISI type 304 stainless steel construction. All exterior metal surfaces in contact with the pumpage, other than stainless steel or brass, shall be protected by a factory-applied spray coating of acrylic dispersion zinc phosphate and a polyester resin enamel finish.

B. All O-rings shall be of Nitrile or Viton rubber. The lifting handle shall be stainless steel. Sealing shall be accomplished by the proper fitting of the parts and not by compression or special torque requirements. All external screws and fasteners shall be made of stainless steel.

C. The pump shaft shall rotate on two single-row ball bearings. Motor bearings shall be permanently grease lubricated. The upper bearing shall be a single deep groove ball bearing. The lower bearing shall be a two-row angular contact bearing to compensate for axial thrust and radial forces.

D. The ball bearings shall be rated at an L-10 'minimum expected bearing life' of 17,500 hours at design point loads following the ABMA.

E. Each pump shall be provided with a tandem mechanical shaft seal system consisting of two independent seal assemblies. The seals shall operate in a lubricant reservoir that hydrodynamically lubricates the lapped seal faces at a constant rate. The lower, primary seal shall be silicon carbide/silicon carbide. The upper seal shall be carbon/ceramic. The seals shall require neither maintenance nor adjustment nor DEPEND ON DIRECTION OF ROTATION FOR SEALING.

1. The positively driven seal faces shall be held in place by individual independent springs or snap rings. The seals shall require neither routine maintenance nor adjustment and shall not be damaged when the pump is run dry. When required, seal oil inspection shall be achieved without disassembly of the pump. The seal shall not require the pumped liquid as a lubricant.
2. Seal lubricant shall be non-hazardous.
3. The pump and motor shaft shall be the same unit, extra heavy, and of high strength design. The shaft shall be of ANSI 416 high chrome stainless steel shafting with high tensile strength.
4. The pump shaft is an extension of the motor shaft; couplings shall not be acceptable.
5. The Impeller(s) shall be resistant to corrosion, dynamically balanced, closed two-vane non-clogging design having a long throughlet without acute turns.
6. Pump volute(s) shall be single-piece grey cast iron, Class 35B, non-concentric design with smooth passages large enough to pass any solids that may enter the impeller. Wear rings shall not be required. Minimum inlet and discharge size shall be as specified. The volute shall have a centerline discharge.

2.4 SUMP PUMP CONTROL PANEL

A. Control Panel Features

1. 100:5 CTs (Sunset LS) and 50:5 CTs (Swale &Pine LS)
2. 24VDC Power Supply, 2.5A
3. Transient Voltage Surge Suppressor
4. Hand-Off-Remote Switch for Each Pump *
5. Run Light for Each Pump*
6. Fail Light for Each Pump *
7. Elapsed Time Meters for Each Pump *
8. Alarm Reset Pushbutton for Each Pump *
9. Alarm Light & Horn w/ Silence Button
10. Phase Monitor
11. Intrinsically Safe Barriers for Digital & Analog Level Sensors
12. Terminal Blocks as Required
13. Control Relays as Required
14. Wires Labeled and Engraved Labels
15. Panels shall be listed: UL698 (A)

B. Acceptable Manufacturer: Orenco Controls provided by Xylem Flygt specifically for lift station pump applications, MultiSmart, 3MP2

2.5 SUMP PUMP MOTOR

A. Motors are sufficiently cooled by the surrounding environment or pumped media. A water-cooling jacket is not required. The pump is intended for wet pit application and is not intended for dry pit installations.

B. A JUNCTION BOX SHALL BE COMPLETELY SEALED OFF FROM THE PUMPED MEDIA. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.

C. The pump motor shall be induction type with a squirrel cage rotor, shell-type design, housed in an air-filled, watertight chamber, NEMA B type or equal.

D. The stator windings and leads shall be insulated with moisture-resistant Class F insulation rated for 311°F. The stator shall be dipped and baked three times in Class F varnish and shall be heat-shrink fitted into the stator housing. The use of bolts, pins, or other fastening devices requiring penetration of the stator housing is not acceptable. The motor shall be designed for continuous duty handling pumped media of 104°F and capable of no less than 15 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of cast aluminum. The motor and pump shall be designed and assembled by the same manufacturer.

1. Thermal switches set to open at 260°F shall be embedded in the stator end coils to monitor the temperature of motor windings for the FM-approved (explosion-proof) variant.
2. Thermal switches shall also be available in the pump's standard configuration. These thermal switches shall be used in conjunction with and supplemental to the external motor overload protection. Each phase of the motor shall contain a bimetallic electro-mechanical temperature monitor embedded in the motor windings. The monitors shall be connected in series and coupled to the control circuit of the pump control panel to shut the pump down should any one of the monitors detect high temperature. The temperature setting of the temperature monitors shall be 140 deg C +/- 5 deg C and shall automatically reset once the stator temperature returns to normal.
3. The combined service factor (combined effect of voltage, frequency, and specific gravity) shall be a minimum of 1.15. The motor shall have a voltage tolerance of plus or minus 10%. The motor shall be designed for operation up to 104°F ambient and with a temperature rise not to exceed 178°F. A performance chart shall be provided showing curves for torque, current, power factor, input/output kW, and efficiency. This chart shall also include data on starting and no-load characteristics.
4. The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need for any splices. The outer jacket of the cable shall be oil-resistant chlorinated polyethylene rubber. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater.

5. The cable entry seal design shall preclude specific torque requirements to ensure a watertight and submersible seal. The cable entry shall consist of a single cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain relief function, separate from the function of sealing the cable. The assembly shall provide ease of changing the cable when necessary, using the same entry seal. The power cable and assembly shall be designed to prevent the wicking of moisture through the cable assembly even when the cable jacket has been punctured.
6. The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.

2.6 SUMP PUMP PERFORMANCE

A. Performance Description:

1. Quantity 2 at each of the three applications.
2. Discharge Connection Pull-up type pump.
3. The design point shall be between 75% and 115% of the pump BEP.
4. The head capacity curve shall rise continuously to shut off.
5. Small sump pump motor requirements do not include variable frequency operation.
6. Length of Pump Column 6” from the bottom of the tank.
7. Control Panel: Shall be following the Division 26 Electrical sections.

B. Sump Pump Factory Testing - Each completed and assembled pump/motor unit shall undergo the following factory tests at the manufacturer’s plant before shipment:

1. Minimum 3-point hydraulic performance test.
2. No-Leak seal integrity test.
3. Electrical integrity test.

2.7 ACCEPTABLE SUMP PUMP MANUFACTURERS:

A. Xylem Flygt Corporation.

B. Or equal.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that electrical power and protection are available and of the correct characteristics.

3.2 INSTALLATION - GENERAL

A. Install all components per the Design Drawings and manufacturer's recommendations.

B. Install electrical power, control panel, and equipotential bonding per the manufacturer's recommendations.

C. Provide all accessories as required to install all system components per the manufacturer's instructions.

D. All pump equipment shall operate without sound or vibration which is abnormal for the type of equipment.

END OF SECTION

SECTION 22 40 00
PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following conventional plumbing fixtures and related components:

1. Faucets for lavatories showers and sinks.
2. Laminar-flow faucet-spout outlets.
3. Protective shielding guards.
4. Fixture supports.
5. Kitchen sinks.

B. Related Sections include the following:

1. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. Accessible Fixture: Plumbing fixtures that can be approached, entered, and used by people with disabilities.

C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.

D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.

E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

F. FRP: Fiberglass-reinforced plastic.

G. PMMA: Polymethylmethacrylate (acrylic) plastic.

H. PVC: Polyvinyl chloride plastic.

I. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.4 SUBMITTALS

A. Product Data: For each type of plumbing fixture indicated in the drawings. include selected fixtures and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

B. LEED Submittal:

1. Product Data for Credit WE 2, 3.1, and 3.2: Documentation indicating flow and water consumption requirements.

C. Shop Drawings: Diagram power, signal, and control wiring.

D. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.

E. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.

1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for the intended use.

C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:

1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
2. Plastic Lavatories: ANSI Z124.3.
3. Plastic Mop-Service Basins: ANSI Z124.6.
4. Plastic Shower Enclosures: ANSI Z124.2.
5. Plastic Sinks: ANSI Z124.6.
6. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
7. Slip-Resistant Bathing Surfaces: ASTM F 462.
8. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
9. Stainless-Steel Residential Sinks: ASME A112.19.3.
10. Vitreous-China Fixtures: ASME A112.19.2M.
11. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.

H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:

1. Faucets: ASME A112.18.1.
2. Hose-Connection Vacuum Breakers: ASSE 1011.
3. Hose-Coupling Threads: ASME B1.20.7.
4. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
5. NSF Potable-Water Materials: NSF 61.
6. Pipe Threads: ASME B1.20.1.
7. Supply Fittings: ASME A112.18.1.
8. Brass Waste Fittings: ASME A112.18.2.

I. Comply with the following applicable standards and other requirements specified for shower faucets:

1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
2. Combination, Pressure-Equalizing, and Thermostatic-Control Anti-scald Faucets: ASSE 1016.
3. Faucets: ASME A112.18.1.
4. Hand-Held Showers: ASSE 1014.
5. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
6. Hose-Coupling Threads: ASME B1.20.7.
7. Pipe Threads: ASME B1.20.1.
8. Pressure-Equalizing-Control Anti-scald Faucets: ASTM F 444 and ASSE 1016.
9. Sensor-Actuated Faucets and Electrical Devices: UL 1951.

J. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:

1. Atmospheric Vacuum Breakers: ASSE 1001.
2. Brass and Copper Supplies: ASME A112.18.1.
3. Dishwasher Air-Gap Fittings: ASSE 1021.
4. Plastic Tubular Fittings: ASTM F 409.
5. Brass Waste Fittings: ASME A112.18.2.

K. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Dishwasher Air-Gap Fittings: ASSE 1021.
2. Flexible Water Connectors: ASME A112.18.6.
3. Floor Drains: ASME A112.6.3.
4. Grab Bars: ASTM F 446.
5. Hose-Coupling Threads: ASME B1.20.7.
6. Off-Floor Fixture Supports: ASME A112.6.1M.
7. Pipe Threads: ASME B1.20.1.
8. Plastic Toilet Seats: ANSI Z124.5.
9. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 WARRANTY

A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools that fail in materials or workmanship within the specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures of the unit shell.
   b. Faulty operation of controls, blowers, pumps, heaters, and timers.
   c. Deterioration of metals, metal finishes, and other materials beyond normal use.
2. Warranty Period for Commercial Applications: Three years from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. 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:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Engineered Brass Co.
   b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
   c. McGuire Manufacturing Co., Inc.
   d. Plumberex Specialty Products Inc.
   e. TCI Products.
   f. TRUEBRO, Inc.
   g. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.
3. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.

1. Use carrier supports with waste fitting and seals for back-outlet fixtures.
2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.

D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

E. Install wall-mounting fixtures with tubular waste piping attached to supports.

F. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.

G. Install counter-mounting fixtures in and attached to casework.

H. Install fixtures level and plumb according to roughing-in drawings.

I. Install water-supply piping with a stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

1. Exception: Use a ball, gate, or globe valves if supply stops are not specified with the fixture.

J. Install trap and tubular waste piping on the drain outlet of each fixture to be directly connected to the sanitary drainage system.

K. Install tubular waste piping on the drain outlet of each fixture to be indirectly connected to the drainage system.

L. Install flushometer valves for accessible water closets and urinals with handle mounted on the wide side of the compartment. Install other actuators in locations that are easy for people with disabilities to reach.

M. Install tanks for accessible, tank-type water closets with lever handle mounted on the wide side of the compartment.

N. Install toilet seats on water closets.

O. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with the required rates and patterns. Include adapters if required.

P. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.

Q. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with the required rates and patterns. Include adapters if required.

R. Install shower flow-control fittings with specified maximum flow rates in shower arms.

S. Install traps on fixture outlets.

1. Exception: Omit trap on fixtures with integral traps.
2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

T. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."

U. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies stop risers, and traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Division 26 Section "Grounding & Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors & Cables."

3.4 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat the procedure until units operate properly.

E. Install fresh batteries in sensor-operated mechanisms.

3.5 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow and stream.

C. Replace washers and seals of leaking and dripping faucets and stops.

D. Install fresh batteries in sensor-operated mechanisms.

3.6 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:

1. Remove faucet spouts and strainers, remove sediment and debris and reinstall strainers and spouts.
2. Remove sediment and debris from drains.

B. After completing the installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow the use of plumbing fixtures for temporary facilities unless approved in writing by the Owner.

END OF SECTION

DIVISION 23

HVAC

SECTION 23 05 00

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Sleeves.
6. Escutcheons.
7. Grout.
8. HVAC demolition.
9. Equipment installation requirements common to equipment sections.
10. Painting and finishing.
11. Concrete bases.
12. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below the roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above the ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. CPVC: Chlorinated polyvinyl chloride plastic.
2. PE: Polyethylene plastic.
3. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Piping materials
2. Joining Materials
3. Transition fittings
4. Dielectric fittings.
5. Mechanical sleeve seals.
6. Sleeves
7. Escutcheons.
8. Grout

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code-Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during the progress of construction, to allow for HVAC installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section 08 31 00 "Access Doors & Panels."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
   a. Full-Face Type: For flat-face, Class 125, cast-iron, and cast-bronze flanges.
   b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by the piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements for Joining Plastic Piping:

1. CPVC Piping: ASTM F 493.
2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

I. Fiberglass Pipe Adhesive: As furnished or recommended by the pipe manufacturer.

2.4 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Available Manufacturers:
   a. Eslon Thermoplastics.

B. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Available Manufacturers:
   a. Thompson Plastics, Inc.

C. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC, and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

1. Available Manufacturers:
   a. NIBCO INC.
   b. NIBCO, Inc.; Chemtrol Div.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

1. Available Manufacturers:
   a. Capitol Manufacturing Co.
   b. Central Plastics Company.
   c. Eclipse, Inc.
   d. Epco Sales, Inc.
   e. Hart Industries, International, Inc.
   f. Watts Industries, Inc.; Water Products Div.
   g. Zurn Industries, Inc.; Wilkins Div.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

1. Available Manufacturers:
   a. Capitol Manufacturing Co.
   b. Central Plastics Company.
   c. Epco Sales, Inc.
   d. Watts Industries, Inc.; Water Products Div.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Available Manufacturers:
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Central Plastics Company.
   d. Pipeline Seal and Insulator, Inc.
2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

1. Available Manufacturers:
   a. Calpico, Inc.
   b. Lochinvar Corp.

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

1. Available Manufacturers:
   a. Perfection Corp.
   b. Precision Plumbing Products, Inc.
   c. Sioux Chief Manufacturing Co., Inc.
   d. Victaulic Co. of America.

2.6 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Available Manufacturers:
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Metraflex Co.
   d. Pipeline Seal and Insulator, Inc.
2. Sealing Elements: EPDM interlocking links are shaped to fit the surface of the pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length is required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with the welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral water stop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe: ASTM D 1785, Schedule 40.

G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.8 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around the pipe, tube, and insulation of insulated piping and an OD that completely covers the opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome plated.

D. Split-Casting, Cast-Brass Type: With a concealed hinge and set screw.

1. Finish: Polished chrome plated.

E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.

F. Split-Plate, Stamped-Steel Type: With an exposed-rivet hinge, set screw or spring clips, and chrome-plated finish.

G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.9 GROUT

A. Description: ASTM C 1107, Grade B, non-shrink, and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, non-staining, non-corrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate the general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with a pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:
    a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
    c. Insulated Piping: One-piece, stamped-steel type with spring clips.
    d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
    f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting], cast-brass type with polished chrome-plated finish.
    g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
    h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
    j. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
    k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with screw or spring clips.
    l. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
2. Existing Piping: Use the following:
    a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
    b. Insulated Piping: Split-plate, stamped-steel type with concealed or exposed-rivet hinge and spring clips.
    c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
    d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.
    e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
    f. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
    g. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with polished chrome-plated finish.
    h. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed or exposed rivet, hinge, and set screw or spring clips.
    i. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
    j. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with a set screw or spring clips.
    k. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

M. Sleeves are not required for core-drilled holes.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.
    a. Exception: Extend sleeves installed on floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if the ring is specified.
2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
    a. PVC Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
    b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum-board partitions.
    c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing & Trim" for flashing.
        1) Seal space outside of sleeve fittings with grout.
4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for the size, depth, and location of the joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select the type and number of sealing elements required for pipe material and size. Position pipe in the center of the sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select the type and number of sealing elements required for pipe material and size. Position pipe in the center of the sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

T. Verify final equipment locations for roughing-in.

U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove the burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for the safe-handling practice of cleaners, primers, and solvent cement.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe, and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
4. PVC Nonpressure Piping: Join according to ASTM D 2855.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with a clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to the pipe manufacturer's written instructions.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at the final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at the final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel, and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at the required slope.

3.5 PAINTING

A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections.

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match the original factory finish.

3.6 CONCRETE BASES

A. Concrete Bases: Anchor equipment to the concrete base according to the equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than the supported unit.
2. Install dowel rods to connect the concrete base to the concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through the concrete base, and anchor into the structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to the anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.

B. Select fastener sizes that will not penetrate members if the opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.9 GROUTING

A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will contact grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during the placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide a smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION

SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 – GENERAL

1.1 SCOPE

A. This section includes requirements for single and three-phase motors that are used with the equipment specified in other sections.

1.2 RELATED WORK

A. Section 01 91 14 – Total Building Commissioning

B. Division 26 00 00 - Electrical

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this section.

B. Section 23 05 00 – Common Work Results for HVAC Equipment.

1.4 REERENCE STANDARDS

A. ANSI/IEEE 112 - Test Procedure for Polyphase Induction Motors and Generators

B. ANSI/NEMA MG-1 - Motors and Generators

C. AFBMA 9 – Load Ratings and Fatigue Life for Ball Bearings.

D. AFBMA 11 – Load Ratings and Fatigue Life for Roller Bearings

E. ANSI/NFPA 70 - National Electrical Code

F. NEMA Standard ICS 2 – Industrial Control Devices, Controllers, and Assemblies.

G. NEMA Standard 250 – Enclosures for Electrical Equipment.

H. NEMA Standard KS 1 – Enclosed Switches.

1.5 QUALITY ASSURANCE

A. Refer to Division 1, General Conditions, Quality Requirements.

B. Electrical components and materials shall be UL labeled and listed.

1.6 SHOP DRAWINGS

A. Refer to Division 1, General Conditions, Submittal Procedures.

B. No separate submittal is required. Submit product data with the equipment which the motor drives the following motor information: motor manufacturer, horsepower, voltage, phase, hertz, rpm, full load efficiency. Include project wiring diagrams prepared by the contractor specifically for this work.

1.7 OPERATION AND MAINTENACE DATA

A. All operations and maintenance data shall comply with the submission and content requirements specified under Division 1.

B. In addition to the general content specified under Division 1, supply the following additional documentation:

1. Lubrication instructions, including list/frequency of lubrication
2. Table noting full load power factor, service factor, NEMA design designation, insulation class, and frame type for each motor provided

1.8 ELECTRICAL COORDINATION

A. All starters, overload relay heater coils, disconnect switches and fuses, relays, wire, conduit, pushbuttons, pilot lights, and other devices required for the control of motors or electrical equipment are furnished and installed by the Electrical Contractor, except as specifically noted elsewhere in this division of specifications.

B. Electrical drawings and/or specifications show the number and horsepower rating of all motors furnished by this Contractor, together with their actuating devices if these devices are furnished by the Electrical Contractor.

1. Should any discrepancy in size, horsepower rating, electrical characteristics, or means of control be found for any motor or other electrical equipment after contracts are awarded, the Contractor is to immediately notify the Contracting Officer and Engineer of such discrepancy.
2. Costs involved in any changes required due to equipment substitutions initiated by this contractor will be the responsibility of this contractor.

C. The electrical Contractor will provide all power wiring and control wiring, except temperature control wiring.

D. Furnish project-specific wiring diagrams to Electrical Contractor for all equipment and devices furnished by this Contractor and indicated to be wired by the Electrical Contractor.

1.9 PRODUCT CRITERIA

A. Motors to conform to all applicable requirements of NEMA, IEEE, ANSI, and NEC standards and shall be listed by U.L. for the service specified.

B. Select motors for conditions in which they will be required to perform, i.e., general-purpose, splashproof, explosion-proof, standard duty, high torque, or any other special type as required by the equipment or motor manufacturer's recommendations.

C. Furnish motors for starting per utility requirements and are compatible with starters as specified.

PART 2 – PRODUCTS

2.1 MOTORS

A. The following are basic requirements for simple or common motors. For special motors, more detailed and specific requirements are specified in the individual equipment specifications.

1. Torque characteristics shall be sufficient to satisfactorily accelerate the driven loads.
2. Motor sizes shall be large enough so that the driven load will not require the motor to operate in the service factor range. Minimum service factors shall be as follows:

Motor Service Factor Schedule		
Horsepower:	**3600 RPM:**	**1800 RPM:**
1/6 – 1/3	1.35	1.35
1/2	1.25	1.25
3/4	1.25	1.25
1 – 1.25	1.25	1.15
1.5 - 150	1.15	1.15

3. Temperature Rating: Rated for 40 deg. C environment with a maximum of 50 deg. C temperature rise for continuous duty at full load (Class A Insulation).
4. Starting capability: Frequency of starts as indicated by an automatic control system, and not less than 5 evenly timed starts per hour for manually controlled motors.

5. Motor Construction: NEMA Standard MG 1, general-purpose, continuous duty, Design "B", except "C" where required for high starting torque.
    a. Frames: NEMA Standard No. 48 or 54; use driven equipment manufacturer's standards to suit each specific application.
    b. Bearings: Ball or roller bearings with inner and outer shaft seals; re greasable; designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in the motor; for fractional horsepower, light-duty motors, sleeve type bearings are permitted.
    c. Enclosure Type: Unless otherwise noted, use open drip-proof motors where satisfactorily housed or remotely located during operation; guarded drip-proof motors where exposed to contact by employees or building occupants; weather-protected Type I for outdoor use, Type II where not housed.
    d. Overload protection: Built-in thermal overload protection (following NEC requirements) and, where indicated, an internal sensing device suitable for signaling and stopping the motor at the starter.
6. Noise rating: "Quiet"
7. Efficiency: "Premium efficiency" motors, as defined in NEMA MG 1, most recent edition.
8. Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, special features, and similar information.
9. All three-phase motors shall be inverter duty type.
10. Motors Used for Wet or Corrosive Duty: Severe duty with a cast-iron frame, epoxy finish, stainless steel nameplate, polymer shaft seal, corrosion-resistant fasteners and fan, moisture-resistant windings, and non-wicking leads.

2.2 THREE-PHASE, SINGLE-SPEED MOTORS

A. Use NEMA rated 230 volt, three-phase, 60-hertz motors for all motors 1/2 HP and larger unless specifically indicated.

B. Use NEMA general-purpose, continuous duty, Design B, normal starting torque, T-frame or U-frame motors with Class B or better insulation unless the manufacturer of the equipment on which the motor is being used has different requirements. Use open drip-proof motors unless totally enclosed fan-cooled, totally enclosed non-ventilated, explosion-proof, or encapsulated motors are specified in the equipment sections.

C. Use grease-lubricated anti-friction ball bearings with housings equipped with plugged/capped provision for relubrication, rated for minimum AFBMA 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt centerline at the end of NEMA standard shaft extension. Stamp bearing sizes on the nameplate.

D. All open drip-proof motors have a 1.15 service factor. Other motor types may have a minimum of 1.0 service factors.

E. All motors 1 HP and larger, except specially wound motors and inline pump motors 56 frame and smaller, to be high-efficiency design with full load efficiencies which meet or exceed the values listed below when tested following NEMA MG 1.

FULL LOAD NOMINAL MOTOR EFFICIENCY BY MOTOR SIZE AND SPEED			
	-----Open Drip-Proof Motors------ -------Nominal Motor Speed-------		
MOTOR HP	**1200 rpm**	**1800 rpm**	**3600 rpm**
1	82.5	85.5	77.0
1-1/2	86.5	86.5	84.0
2	87.5	86.5	85.5
3	88.5	89.5	85.5
5	89.5	89.5	86.5
7-1/2	90.2	91.0	88.5
10	91.7	91.7	89.5
15	91.7	93.0	90.2
20	92.4	93.0	91.0
25	93.0	93.6	91.7
30	93.6	94.1	91.7
40	94.1	94.1	92.4
50	94.1	94.5	93.0
60	94.5	95.0	93.6

FULL LOAD NOMINAL MOTOR EFFICIENCY BY MOTOR SIZE AND SPEED			
	-----Totally Enclosed Fan-Cooled------ -------Nominal Motor Speed-------		
MOTOR HP	**1200 rpm**	**1800 rpm**	**3600 rpm**
1	82.5	85.5	77.0
1-1/2	87.5	86.5	84.0
2	88.5	86.5	85.5
3	89.5	89.5	86.5
5	89.5	89.5	88.5
7-1/2	91.0	91.7	89.5
10	91.0	91.7	90.2
15	91.7	92.4	91.0
20	91.7	93.0	91.0
25	93.0	93.6	91.7
30	93.0	93.6	91.7
40	94.1	94.1	92.4
50	94.1	94.5	93.0
60	94.5	95.0	93.6

2.3 SINGLE-PHASE, SINGLE-SPEED MOTORS

A. Use NEMA-rated 115 volts, single phase, 60-hertz motors for all motors 1/3 HP and smaller.

B. Use permanent split capacitor or capacitor start, induction run motors equipped with permanently lubricated and sealed ball or sleeve bearings and Class A insulation. Service factor to be not less than 1.35.

2.4 TWO-SPEED MOTORS

A. Unless otherwise indicated, three-phase two-speed motors to be two winding, variable torque, and single-phase motors to be capacitor start capacitor run type having two capacitors in parallel with run capacitor remaining in the circuit at operating speeds.

B. Two-speed starters shall be located at the motor location unless otherwise noted.

2.5 MOTORS USED FOR REDUCED VOLTAGE STARTING

A. Furnish motors compatible with reduced voltage starting for the following motors:

2.6 MOTORS USED ON VARIABLE FREQUENCY DRIVES

A. In addition to the requirements specified above, the motor must be suitable for use with the drive, including but not limited to motor cooling. Ratings, characteristics, and features are coordinated with and approved by the drive manufacturer.

B. Motor shall comply with NEMA MG1 Part 31 to provide windings capable to withstand up to 1600 peak Volts with a rise time of 0.1 µs.

C. Provide brush-style bearing protection to bleed current from the motor shaft to the motor casing to suit the motor application. Brushes shall be field replaceable.

D. Motor shall be designed with critical vibration frequencies outside the operating range of the drive output and shall be suitable for use throughout the speed range without overheating.

E. All motors served by VFDs must have an internal factory-installed shaft grounding assembly or external field-installed shaft grounding assembly. Acceptable Manufacturers: Shaft Grounding Systems (SGS), Helwig Carbon Bearing Protection Kits (BPK), or equal.

2.7 SHEAVES

A. All sheaves shall conform to NEMA Standard MG1-14.42, which lists minimum diameters and maximum overhangs. Locate motors to minimize overhang.

B. When replacing sheaves, use sheaves of at least the originally supplied sizes.

C. The contractor shall be responsible for replacement sheaves required to achieve specified performance. Coordinate testing and balancing of the equipment.

2.8 STARTERS, ELECTRICAL DEVICES, AND WIRING

A. Motor-Starter Characteristics: Motor starters shall be compatible with the equipment they serve. In general, motor starter characteristics shall meet the requirements of Division 26 specification sections and as outlined as follows:

B. Motor Connections

1. Provide connections to motors per the requirements listed in the electrical specifications.
2. See Division 26 for the use of lugs for motor connections.

C. Capacitors

1. Capacitor features shall include:
   a. Individual unit cells.
   b. All welded steel housing.
   c. Each capacitor shall be internally fused.
   d. Nonflammable synthetic liquid impregnate.
   e. Craft tissue insulation.
   f. Aluminum foil electrodes

PART 3 – EXECUTION

3.1 INSTALLATION

A. Mount motors on a rigid base designed to accept a motor, using shims if required under each mounting foot to get a secure installation.

B. When the motor will be flexibly coupled to the driven device, mount coupling to the shafts per the coupling manufacturer's recommendations.

1. Using a dial indicator, check the angular misalignment of the two shafts; adjust motor position as necessary so that the angular misalignment of the shafts does not exceed 0.002 inches per inch diameter of the coupling hub.
2. Again using the dial indicator, check the shaft for run-out to assure concentricity of the shafts; adjust as necessary so that run-out does not exceed 0.002 inches.

C. When the motor will be connected to the driven device utilizing a belt drive, mount sheaves on the appropriate shafts per the manufacturer's instructions.

1. Use a straight edge to check the alignment of the sheaves; reposition the sheaves as necessary so that the straight edge contacts both sheave faces squarely.

2. After sheaves are aligned, loosen the adjustable motor base so that the belt(s) can be added and tighten the base so that the belt tension is per the drive manufacturer's recommendations.
3. Frequently recheck belt tension and adjust if necessary during the first day of operation and again after 80 hours of operation as recommended.

D. Verify the proper rotation of each three-phase motor as it is being wired or before the motor is energized for any reason.

E. Lubricate all motors requiring lubrication. Record lubrication material used and the frequency of use. Include this information in the maintenance manuals.

3.2 CONTRACTOR COORDINATION

A. A general contractor is responsible for the coordination of all subcontractors and associated scopes of work.

B. Unless otherwise indicated on drawings, all motors, equipment, controls, etc. shall be furnished, set in place, and wired per this specification section

END OF SECTION

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING & EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nameplates.
2. Tags.
3. Stencils.
4. Pipe markers.
5. Ceiling tacks.
6. Labels.
7. Lockout devices.
8. Warning Signs & Labels.

1.2 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's catalog literature for each product required.

B. Samples.

C. Shop Drawings: Submit a list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

PART 2 - PRODUCTS

2.1 NAMEPLATES

A. Manufacturers:

1. Craftmark Pipe Markers.
2. Seton Identification Products / Tricor Direct / Brady Corporation.
3. Kolbi Pipe Marker Company.

B. Product Description: Laminated three-layer plastic with engraved black letters on a light contrasting background color.Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for the name of units if the viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets.
5. Adhesive: Contact-type permanent adhesive, compatible with the label and with the substrate.

2.2 TAGS

A. Plastic Tags:

1. Manufacturers:
   a. Seton Identification Products / Tricor Direct / Brady Corporation.
   b. Brady Worldwide, Inc.
   c. Kolbi Pipe Marker Company.
2. Laminated three-layer plastic with engraved black letters on a light contrasting background color. Tag size minimum 1-1/2 inches diameter square.

B. Metal Tags:

1. Manufacturers:
   a. Seton Identification Products / Tricor Direct / Brady Corporation.
   b. Brady Worldwide, Inc.
   c. Kolbi Pipe Marker Company.
2. Aluminum with stamped letters; tag size minimum 1-1/2 inches diameter with finished edges.

C. Tag Chart: Typewritten letter-size list of applied tags and location in anodized aluminum frame plastic laminated.

2.3 STENCILS

A. Manufacturers:

1. Seton Identification Products / Tricor Direct / Brady Corporation.
2. Brady Worldwide, Inc.
3. Kolbi Pipe Marker Company.

B. Stencils: With clean-cut symbols and letters of the following size:

1. Up to 2 inches Outside Diameter of Insulation or Pipe: 1/2 inch high letters.2-1/2 to 6 inches Outside Diameter of Insulation or Pipe: 1-inch high letters.
2. Over 6 inches Outside Diameter of Insulation or Pipe: 1-3/4 inches high letters.
3. Ductwork and Equipment: 1-3/4 inches high letters.

C. Stencil Paint: Semi-gloss enamel.

2.4 PIPE MARKERS

A. Plastic Pipe Markers:
1. Manufacturers:
   a. Seton Identification Products / Tricor Direct / Brady Corporation.
   b. Brady Worldwide, Inc.
   c. Kolbi Pipe Marker Company.
2. Factory fabricated flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with a spring fastener.

B. Plastic Tape Pipe Markers:

1. Manufacturers:
   a. Seton Identification Products / Tricor Direct / Brady Corporation.
   b. Brady Worldwide, Inc.
   c. Kolbi Pipe Marker Company.
2. Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.

2.5 CEILING TACKS

A. Manufacturers:

1. Seton Identification Products / Tricor Direct / Brady Corporation.
2. Brady Worldwide, Inc.
3. Kolbi Pipe Marker Company.

B. Description: Steel with 3/4 inch diameter color-coded head.

C. The color code is as follows:

1. HVAC equipment: Yellow.
2. Fire dampers/smoke dampers: Red.
3. Plumbing valves: Green.
4. Heating/cooling valves: Blue.

2.6 LABELS

A. Manufacturers:

1. Seton Identification Products / Tricor Direct / Brady Corporation.Brady Worldwide, Inc.
2. Kolbi Pipe Marker Company.

B. Description: Aluminum, size 1.9 x 0.75 inches, adhesive-backed with printed identification.

C. Pipe Labels:

1. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
2. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover the circumference of the pipe and to attach to the pipe without fasteners or adhesive.
   a. NPS 5 (DN 125) and smaller: Attach to the pipe without fasteners or adhesive.
   b. NPS 6 (DN 150) and larger: Attach to pipe with stainless steel spring fasteners.
3. Pipe Label Contents: Include identification of piping service using the same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
   a. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as a separate unit on each pipe label to indicate flow direction.
   b. Lettering Size: At least 1-1/2 inches high.
4. Maximum Temperature: Able to withstand temperatures up to 180 deg F (83 deg C).

D. Duct Labels:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and have predrilled holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: Blue.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for the name of units if the viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets.
8. Adhesive: Contact-type permanent adhesive, compatible with the label and with the substrate.
9. Duct Label Contents: Include identification of duct service using the same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
   a. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as a separate unit on each duct label to indicate flow direction.
   b. Lettering Size: At least 1-1/2 inches high.

2.7 LOCKOUT DEVICES

A. Lockout Hasps:

1. Manufacturers:
   a. Seton Identification Products / Tricor Direct / Brady Corporation.
   b. Brady Worldwide, Inc.
   c. Kolbi Pipe Marker Company.
2. Anodized aluminum hasp with erasable label surface; size minimum 7-1/4 x 3 inches.

B. Valve Lockout Devices:

1. Manufacturers:
   a. Seton Identification Products / Tricor Direct / Brady Corporation.
   b. Brady Worldwide, Inc.
   c. Kolbi Pipe Marker Company.
2. Steel device preventing access to valve operator, accepting lock shackle.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces for stencil painting.

3.2 INSTALLATION

A. Apply stencil painting.

B. Install identifying devices after completion of coverings and painting.

C. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.

D. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.

E. Install tags using corrosion resistant chain. Number tags consecutively by location.

END OF SECTION

SECTION 23 34 23

HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Ceiling-mounting ventilators.

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on actual Project site elevations.

B. Operating Limits: Classify according to AMCA 99.

1.4 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness and finishes, including color charts.
5. Dampers, including housings, linkages, and operators.
6. Roof curbs.
7. Fan speed controllers.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.
2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and support equipment. Include auxiliary motor slides and rails, and base weights.

C. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Roof framing and support members relative to duct penetrations.
2. Ceiling suspension assembly members.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for the intended use.

B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

D. UL Standard: Power ventilators shall comply with UL 705.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver fans as a factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.

B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

1.7 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate the size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.1 WALL-MOUNTED VENTILATORS

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.

C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on the Drawings or a comparable product by one of the following:

1. Panasonic
2. Carnes Company HVAC.
3. Dayton Electric Manufacturing Co.; a division of W. W. Grainger, Inc.
4. FloAire.
5. Greenheck.
6. Loren Cook Company.
7. NuTone Inc.
8. Penn Ventilation.

D. Description: Centrifugal fans designed for installation in a wall or concealed in-line applications.

E. Housing: Steel, lined with acoustical insulation.

F. Fan Wheel: Centrifugal wheels directly mounted on the motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.

G. Grille: Plastic, louvered grille with a flange on intake and thumbscrew attachment to fan housing.

H. Electrical Requirements: Junction box for electrical connection on housing and receptacle for the motor plug-in.

I. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Manual Starter Switch: Single-pole rocker switch assembly with cover and pilot light.
3. Time-Delay Switch: Assembly with single-pole rocker switch, timer, and cover plate.
4. Motion Sensor: Motion detector with adjustable shutoff timer.
5. Filter: Washable aluminum to fit between fan and grille.
6. Isolation: Rubber-in-shear vibration isolators.
7. Manufacturer's standard roof jack or wall cap, and transition fittings.

J. Capacities and Characteristics:

1. Refer to Schedules in the drawings.

2.2 MOTORS

A. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

B. Enclosure Type: Totally enclosed, fan-cooled.

2.7 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install power ventilators level and plumb.

B. Wall Units: Suspend units from structure; use steel wire or metal straps.

C. Install units with clearances for service and maintenance.

D. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping & Equipment."

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors.

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Division 26 Section "Grounding & Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors & Cables."

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from the motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in the fully open position.
9. Disable automatic temperature-control operators, energize the motor and adjust the fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut the unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Refer to the Manufacturer's literature for the HVAC testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

END OF SECTION

SECTION 23 82 39

UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Wall and ceiling heaters with propeller fans and electric-resistance heating coils.

1.3 DEFINITIONS

A. BAS: Building automation system.

B. CWP: Cold working pressure.

C. PTFE: Polytetrafluoroethylene plastic.

D. TFE: Tetrafluoroethylene plastic.

1.4 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.

B. LEED Submittal:

1. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with ASHRAE 62.1-2004, Section 5 - "Systems and Equipment."

C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Plans, elevations, sections, and details.
2. Location and size of each field connection.
3. Details of anchorages and attachments to structure and support equipment.
4. Equipment schedules to include rated capacities, operating characteristics, furnished specialties, and accessories.

5. Location and arrangement of piping valves and specialties.
6. Location and arrangement of integral controls.
7. Wiring Diagrams: Power, signal, and control wiring.

D. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which unit heaters will be attached.
3. Method of attaching hangers to the building structure.
4. Size and location of initial access modules for acoustical tile.
5. Items penetrating finished ceiling, including the following:
   a. Lighting fixtures.
   b. Air outlets and inlets.
   c. Speakers.
   d. Sprinklers.
   e. Access panels.
6. Perimeter moldings for exposed or partially exposed cabinets.

E. Samples for Initial Selection: Finish colors for units with factory-applied color finishes.

F. Samples for Verification: Finish colors for each type of cabinet unit heater and wall and ceiling heaters indicated with factory-applied color finishes.

G. Manufacturer Seismic Qualification Certification: Submit certification that cabinet unit heaters, accessories, and components will withstand seismic forces.

1. Basis for Certification: Indicate whether withstand certification is based on an actual test of assembled components or calculation.
   a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
   b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. Dimensioned Outline Drawings of Equipment Unit: Identity center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

H. Field quality-control test reports.

I. Operation and Maintenance Data: For unit heaters to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for the intended use.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

PART 2 - PRODUCTS

2.1 WALL AND UNIT HEATERS

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:

C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on the Drawings or a comparable product by one of the following:

1. Berko Electric Heating; a division of Marley Engineered Products.
2. Chromalox, Inc.; a division of Emerson Electric Company.
3. Indeeco.
4. Marley Electric Heating; a division of Marley Engineered Products.
5. CADET.
6. QMark Electric Heating; a division of Marley Engineered Products.
7. TPI.

D. Description: An assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.

E. Cabinet:

1. Front Panel: Extruded aluminum bar grille, with removable panels fastened with tamperproof fasteners.
2. Finish: Baked enamel over the baked-on primer with manufacturer's standard color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.
3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

F. Surface-Mounting Cabinet Enclosure: Steel with a finish to match the cabinet.

G. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, embedded in magnesium oxide refractory and sealed in the corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high-temperature protection. Provide integral circuit breaker for overcurrent protection.

H. Fan: Aluminum propeller directly connected to the motor.

1. Motor: Permanently lubricated. Comply with requirements in Division 23 Section "Common Work Results for HVAC."

I. Controls: the unit-mounted thermostat. Low-voltage relay with transformer kit.

J. Electrical Connection: Factory wire motors and controls for a single field connection with a disconnect switch.

K. Capacities and Characteristics:

1. Refer to Schedules

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for electrical connections to verify actual locations before unit heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall boxes in the finished wall assembly, seal, and weatherproof. Joint-sealant materials and applications are specified in Division 07 Section "Joint Sealants."

B. Install propeller unit heaters level and plumb.

C. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify the location of thermostats and other exposed control sensors with Drawings and room details before installation.

D. Install new filters in each fan-coil unit within two weeks of Substantial Completion.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to the machine to allow service and maintenance.

C. Connect piping to cabinet unit heater's factory, hot-water piping package. Install the piping package if shipped loose.

D. Connect supply and return ducts to cabinet unit heaters with flexible duct connectors.

E. Comply with safety requirements in UL 1995.

F. Ground equipment according to Division 26 Section "Grounding & Bonding for Electrical Systems."

G. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors & Cables."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

3.5 ADJUSTING

A. Adjust initial temperature set points.

B. Occupancy Adjustments: When requested within 12 months of the date of Substantial Completion, provide on-site assistance in adjusting the system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train the Owner's maintenance personnel to adjust, operate, and maintain cabinet unit heaters. Refer to Division 01 Section 01 79 00- "Demonstration & Training."

END OF SECTION

DIVISION 26

ELECTRICAL

SECTION 26 00 00

ELECTRICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section applies to all sections of Division 26.

B. Furnish and install electrical wiring, systems, equipment, and accessories in accordance with the specifications and drawings. Capacities and ratings of motors, transformers, cable, switchboards, switchgear, panelboards, motor control centers, generators, automatic transfer switches, and other items and arrangements for the specified items are shown on drawings.

C. Wiring ampacities specified or shown on the drawings are based on copper conductors, with the conduit and raceways accordingly sized. Aluminum conductors are prohibited.

1.2 MINIMUM REQUIREMENTS

A. References to the International Building Code (IBC), National Electrical Code (NEC), Underwriters Laboratories, Inc. (UL) and National Fire Protection Association (NFPA) are minimum installation requirement standards.

1.3 TEST STANDARDS

A. All materials and equipment shall be listed, labeled or certified by a nationally recognized testing laboratory to meet Underwriters Laboratories, Inc., standards where test standards have been established. Equipment and materials which are not covered by UL Standards will be accepted provided equipment and material is listed, labeled, certified or otherwise determined to meet safety requirements of a nationally recognized testing laboratory. Equipment of a class which no nationally recognized testing laboratory accepts, certifies, lists, labels, or determines to be safe, will be considered if inspected or tested in accordance with national industrial standards, such as NEMA, or ANSI. Evidence of compliance shall include certified test reports and definitive shop drawings.

B. Definitions:

1. Listed: Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production or listed equipment or materials or periodic evaluation of services, and whose listing states that the equipment, material, or services either meets appropriate designated standards or has been tested and found suitable for a specified purpose.
2. Labeled: Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

3. Certified: equipment or product which:

a. Has been tested and found by a nationally recognized testing laboratory to meet nationally recognized standards or to be safe for use in a specified manner.

b. Production of equipment or product is periodically inspected by a nationally recognized testing laboratory.

c. Bears a label, tag, or other record of certification.

4. Nationally recognized testing laboratory: laboratory which is approved, in accordance with OSHA regulations, by the Secretary of Labor.

1.4 QUALIFICATIONS (PRODUCTS AND SERVICES)

A. Manufacturer’s Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least three years.

B. Product Qualification:

1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three (3) years.

2. The Government reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.

C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.5 APPLICABLE PUBLICATIONS

Applicable publications listed in all Sections of Division 26 are the latest issue, unless otherwise noted.

1.6 MANUFACTURED PRODUCTS

A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts shall be available.

B. When more than one unit of the same class or type of equipment is required, such units shall be the product of a single manufacturer.

C. Equipment Assemblies and Components:

1. Components of an assembled unit need not be products of the same manufacturer.

2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.

3. Components shall be compatible with each other and with the total assembly for the intended service.

4. Constituent parts which are similar shall be the product of a single manufacturer.

D. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.

E. When Factory Testing Is Specified:

1. The Government shall have the option of witnessing factory tests. The contractor shall notify the Contracting Officer a minimum of 15 working days prior to the manufacturers making the factory tests.
2. Four copies of certified test reports containing all test data shall be furnished to the Contracting Officer prior to final inspection and not more than 90 days after completion of the tests.
3. When equipment fails to meet factory test and re-inspection is required, the Contractor shall be liable for all additional expenses, including expenses of the Government.

1.7 EQUIPMENT REQUIREMENTS

Where variations from the contract requirements are requested, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.

1.8 EQUIPMENT PROTECTION

A. Equipment and materials shall be protected during shipment and storage against physical damage, vermin, dirt, corrosive substances, fumes, moisture, cold and rain.

1. Store equipment indoors in clean dry space with uniform temperature to prevent condensation. Equipment shall include but not be limited to switchgear, switchboards, panelboards, transformers, motor control centers, motor controllers, uninterruptible power systems, enclosures, controllers, circuit protective devices, cables, wire, light fixtures, electronic equipment, and accessories.
2. During installation, equipment shall be protected against entry of foreign matter; and be vacuum cleaned both inside and outside before testing and operating. Compressed air shall not be used to clean equipment. Remove loose packing and flammable materials from inside equipment.
3. Damaged equipment shall be, as determined by the Contracting Officer placed in first class operating condition or be returned to the source of supply for repair or replacement.
4. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.
5. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

1.9 WORK PERFORMANCE

A. All electrical work must comply with the requirements of NFPA 70 (NEC), NFPA 70B, NFPA 70E, OSHA Part 1910 subpart J, OSHA Part 1910 subpart S and OSHA Part 1910 subpart K in addition to other references required by contract.

B. All electrical work shall be performed by, or under the direct supervision of an electrician licensed in the state of California.

C. Job site safety and worker safety is the responsibility of the Contractor.

D. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished in this manner for the required work, the following requirements are mandatory:

1. Electricians must use full protective equipment (i.e., certified and tested insulating material to cover exposed energized electrical components, certified and tested insulated tools, etc.) while working on energized systems in accordance with NFPA 70E.

2. Electricians must wear personal protective equipment while working on energized systems in accordance with NFPA 70E.
3. Work on energized circuits or equipment cannot begin until prior written approval is obtained from the Contracting Officer.

E. New work shall be installed and connected to existing work neatly, safely and professionally. Disturbed or damaged work shall be replaced or repaired to its prior conditions.

F. Coordinate location of equipment and conduit with other trades to minimize interferences.

1.10 EQUIPMENT INSTALLATION AND REQUIREMENTS

A. Equipment location shall be as close as practical to locations shown on the drawings.

B. Working spaces shall not be less than specified in the NEC for all voltages specified.

C. Inaccessible Equipment:

1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Government.
2. "Conveniently accessible" is defined as being capable of being reached quickly for operation, maintenance, or inspections without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

1.11 SUBMITTALS

A. Submit in accordance with Section 01 33 23.

1.12 SINGULAR NUMBER

Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

END OF SECTION

SECTION 26 04 00

CONDUCTOR INSULATION TESTING

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Section 26 00 00 Electrical General

1.02 SUMMARY

A. Section Includes:

1. Procedures, Criteria, and Report format for conductor and outlet tests to be performed.

1.03 SUBMITTALS

A. Test Equipment:

1. Submit specification data and the NIST certificate for all test equipment to be used for testing. Certificate must indicate the listed laboratory where calibration was performed and the expiration date for the calibration.
   a. Ground Test
   b. Insulation Test
   c. Continuity Test
   d. Outlet Test
   e. Amperage Readings
   f. Voltage Readings

B. Test Report Forms:

1. Submit a copy for approval of the proposed tabular data sheet to be used for each required test. Type column and heading titles on sheets. Submit data sheets for approval a minimum of 30 days before each test. Divide sheets into columns and rows with appropriate rulings and titles. Enter test data on tabular forms during tests by hand; do not recopy.
2. Furnish data in tabular form listing required test data, name of tested device, location, serial number, type and name of measurement instrument with scale settings.

1.04 QUALITY ASSURANCE

A. Use test equipment that has been calibrated in accordance with NIST and holds a current calibration.

B. Comply with ANSI/NETA ATS

C. Comply with NFPA 70.

D. Use IEEE 525 for guidance.

1.05 PROJECT CONDITIONS

A. Testing is to be performed when exposed conductors can be kept dry during testing. Ambient temperature should be above dew point to ensure accurate readings.

1.06 COORDINATION

A. Coordinate with other crafts and CO to ensure all personnel are clear of conductors to be tested. For insulation tests, signage indicating max test equipment voltage shall be applied at the area or enclosure for the non-test equipment end (i.e. “Insulation Testing in progress, up to 1000V max voltages may be present”)

PART 2. - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, use test equipment by one of the following:

1. Fluke, Inc.
2. Tektronics
3. AEMC
4. Hewlett-Packard (now Agilent)
5. Or as specified in this section
6. Or as approved by CO

PART 3. - EXECUTION

3.01 EXAMINATION

A. Examination of the wiring should include checking for cuts and abrasions in insulation, knicks in strands or missing strands, and other issues that might impact the performance and craftsmanship of the finished product.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PRELIMINARY TESTING

A. Ground System Tests: See Section 26 05 26 Grounding & Bonding for field quality-control testing for grounding system.

B. Insulation Resistance: Conform to the following:

1. Lighting circuits that have not been modified do not require testing.
2. All new conductors installed shall be tested.

3. All underground wiring, new and re-used shall be tested.
4. Measure resistance between all insulated conductors (including neutral and isolated ground) and ground as well as each other. Coordinate testing with CO so that tests can be witnessed if desired.
5. For conductors with 600 V rated insulation, make insulation resistance measurements on each power distribution and control panel, main feeder and each branch circuit and all control circuits. Make all measurements with loads disconnected and after all wiring and associated equipment is in place. Perform tests with Megohm meter having a minimum 5,000 megohm scale range and apply 1000 VDC. Minimum resistance shall be 500 megohms within 30 seconds of application of test voltage.
6. For circuits with less than 600 V rated insulation, test conductors using 500 VDC. Conductor insulation resistance as installed shall not be less than 200 megohms to ground within 30 seconds of application of test voltage. This does not apply to telephone or control cable. Perform tests with Megohm meter and apply DC voltage that does not exceed limit set by cable manufacturer.
7. Perform testing after all wiring is in place, with loads disconnected. All electronic devices must be disconnected to avoid damage. This includes electronic switches and outlets (GFI's). GFI breakers in branch panels must be disconnected. Other breakers rated in excess of the test voltage can remain connected and in the “off” position.
8. Connect Megohm meter to phase, neutral, ground and isolated ground busses in the combinations shown in the following table. The neutral and isolated ground must be disconnected from ground at the main service switchgear in order to test the feeders.
9. The following table can be used to record readings:

TEST LOCATION_____ CIRCUIT ID _____ TEST VDC_____

	L1	L2	N	G	IG
L1	n/a				
L2		n/a			
N			n/a		
G				n/a	

10. Exception. Outlet and associated circuits may be tested as low as 250 VDC if arcing/failure occurs at the higher voltage test. If this happens, reduce the voltage to a lesser value and record the megohm value. Note test voltage in the test report.

C. Continuity Test (Feeders 4/0 and above)

1. Test is to be performed once insulation resistance test has been performed satisfactorily.
2. Test is to be performed with conductors disconnected from panels and equipment.
3. Test is to be performed using a milliohm meter with a minimum scale of 0.1 milliohms or less.

4. At non-test equipment end of feeder, short L1 & L2 together and N&G conductors together.
5. At test equipment end of feeder, measure the resistance of each conductor back through the conductor it is shorted to.
6. Passing criteria shall be less than the computed value using R = L * R/Ft Where: R=Resistance in milliohms, L=Length in Feet (times 2 for both conductors), R/Ft is as shown in the following table:

Size (Copper Coated / Stranded)	Milliohms per foot (R/Ft)
750	0.0163
600	0.0207
500	0.0246
400	0.0307
350	0.0355
300	0.0414
250	0.0497
4/0	0.0581
3/0	0.0740
2/0	0.0938
1/0	0.1179
1	0.1485
2	0.1866
3	0.2358
4	0.2980
6	0.4734

(Table is derived from NEC Table 8, adjusted for 80F, plus 10% to account for variances.)

7. Test Report format should be as follows:

Location_____ Circuit Tested _____

Conductor	Size	Length per conductor	R/Ft (mOhms)	Computed mOhms L*2*R/Ft	Tested Resistance
L1 – L2					
N-G					

D. Continuity Test (Control Panels Only) Perform at each control panel continuity tests on power and control circuits after connection of external controlled and pilot devices and sensors before connecting to power and control panels. Actuate all pilot devices (float switches, etc.) manually to check proper operation and electrical continuity.

1. Identify circuits in report
2. Record the value of the loop resistance for each pair of conductors for each continuity test.

3.03 FINAL TESTING

A. Motor and other Load Current: Actual motor and all other equipment load current on each ungrounded conductor at maximum load conditions must be equal to or less than nameplate rated full load motor current at a service factor of 1.0. For equipment such as duct heaters, furnaces, or any other equipment that is controlled in stages, sequence the controllers for each piece of equipment and record load current in each phase as each stage is energized, and at full load nameplate current. Verify that the staging is proper with load at each stage point. Coordinate with equipment and control supplier to ensure that all equipment safety interlocks and control actions are proper and equipment is being operated properly.

B. Power Distribution Panels and Motor Control Panels: Submit the following information:

1. No load and full load voltage, L1 to L2, and each leg to ground in each panel main feeder at highest system load conditions.
2. Full load current on each branch circuit or motor circuit in each panel at maximum system load conditions.
3. Full load current on each main supply conductor to each panel and all feeders at maximum system load conditions.
4. Unbalanced neutral current in each panel. The above measurements are for worst case maximum load for each phase.
5. Demonstration of trip action on each GFI breaker and GFCI receptacle by connection of a 15,000 ohm + 5% resistor between the "hot" line and ground on each receptacle connected to GFI breaker. An outlet ground loop tester may be used for this test.
6. Suggested format for the report is to use the panelboard schedule with supplemental load/no load voltages added for the feeder main data. Alternate formats shall be submitted to CO for approval prior to the start of final testing.

C. Final Control System Tests (Control Panels for Motor Control, HVAC, Fire, Intrusion, PA, Lighting control, BMS, Special purpose systems not defined elsewhere in specifications):

1. Final operational preliminary tests of the control systems will be performed under the supervision of the control systems manufacturer's Field Engineer in the presence of the CO. Supply all labor and material required for testing.
2. Normal Operation Test: Test each control panel to demonstrate normal operation of the system including all pilot devices and sensors, (level flow, float and pressure switches, all instrumentation and monitoring), level probes, time delays, lights, indicator gages, controllers, etc., for correct operating sequence. All controlled devices will be connected and operating under normal load for tests. Final adjustment of all operating set points and other adjustments shall be permanently marked by etching a mark on control adjustment device and marking with red paint.
3. Provide complete operational sequence checkout to verify all modes of operation both normal and alarm for each system.
4. Test all control systems that interact with each other as a complete system to demonstrate that all interconnections and interactions are correct and that all interwiring is functional.
5. Calibration of Equipment: Calibrate all equipment requiring calibration such as such as power supplies, instrumentation transmitters, pressure switches, flow switches, pressure gauges, and all sensors. Provide all calibrators and instruments for this calibration. Provide each sensor with the appropriate input over its full operating range to test sensor output, such as, pressure, flow, level, temperature, %RH, etc. to

demonstrate the sensors output (4-20 mA) for example is linear and corresponds to the physical variable measured. Provide certified, calibrated test instruments that read these variables measuring the same media as the sensor.

6. Failure and Alarm Tests: Test all safety protection devices and circuits, indicator lights, sonalert, etc., to demonstrate each separate type of failure and proper circuit operation for each condition.
7. Show actual operation of all protective and normal operation sensors. Shorting around or opening of circuits to simulate activation will not be allowed on either normal operation tests above or failure tests.
8. Test Failure: Failure of any phase of the operation tests shall constitute failure of the system. Correct failures and retest system. Repeat until the system is operating to required specifications.

D. Provide a Motor test report and motor nameplate data in a tabular list of nameplate rated currents, motor service factors, temperature derating multipliers, service factor derating multipliers and measured current for all motors to verify against overload trip ratings. The control panel manufacturer will supply overload heaters if different ones are required.

E. POLARITY AND GROUND LOOP IMPEDANCE TEST FOR OUTLETS

1. Test all 15 & 20A 120VAC receptacles for ground loop impedance with an electronic tester for the following items:
   a. Polarity
   b. Voltage drop at 15A
   c. GFCI testing
   d. AFCI testing
   e. Ground loop impedance L-N, H-N L-G. Results shall be less than two ohms.
   f. Use an Ideal 61-615 circuit analyzer or approved equal for outlet testing.
   g. Use this instrument to test all GFCI trip levels.

3.04 INSTALLATION

A. Install according to manufacturers' instructions.

3.05 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems".

END OF SECTION

SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 – GENERAL

1.1 SUMMARY

A. Related Documents:

1. Drawings and general provisions of the Subcontract apply to this Section.
2. Review these documents for coordination with additional requirements and information that apply to work under this Section.

B. Section Includes:

1. The contractor shall furnish services, skilled labor, and apparatus and materials required for the complete installation as shown and within the intent of the drawings and these Specifications.
2. Work includes, but not limited to, the following and shall be completed in accordance with the project construction drawings and specifications:

Ash Mountain Site:

1) Electrical demolition from the existing utility power feed on the secondary side of the SCE 200A power pedestal to the existing control building at the Ash Mountain Site.
2) Demolition of all electrical components mounted on the inside of and on the exterior of the existing control building.
3) Demolition of the existing propane generator (and associated 250-gallon propane tank) at the existing control building.
4) Demolition of the existing motor control center and all existing exterior electrical components at the head works area.
5) Demolition of power to the aeration pumps at both existing retention ponds.
6) New feeder from the secondary side of the 200A circuit breaker in the SCE power pedestal to the new control building at the Ash Mountain Site.
7) New electrical service and equipment in the new control building.
8) New disconnecting means and panel at the headworks equipment.
9) New 40 kW propane generator in the control building (generator room) with new ATS, propane tank, generator vaporizer, and new start controls.
10) New 200A, 208/120V pin-and-sleeve connection for standby generator.
11) New readouts (2); one each for magmeter and ultrasonic flow meters.
12) New power devices and circuitry in the new control building.
13) New interior and exterior lighting circuitry, lighting fixtures, and lighting controls in the new control building.
14) New 200A, 208/120V, three-phasee manual transfer switch (MTS).
15) New 200A/3P service disconnect, in NEMA 3R enclosure, proximate to the point where service enters the building.

16) New pump control panel(s) and associated treatment plant controls in the new control building.
17) Two new exhaust fans in the new control building.
18) External GFCI weatherproof receptacle at control building.
19) At the Ash Mountain spray field pump house: electrical demolition of existing 40 hp pump, pump starter, meter enclosure, main panel P-1, panel LA-1, 5 kVA transformer X-1, and light(s).
20) At the Ash Mountain spray field pump house: install two (2) new 50 hp pumps, duplex starters, disconnects, panel (with necessary circuit breakers), and new step-down transformer. Replace old meter enclosure and main panel (P-1) and panel LA-1.
21) At the Ash Mountain spray field pump house: install new 200A, 480/277V, three-phase manual transfer switch (MTS). Install 200A, 480/277V, three-phase pin-and-sleeve connector for standby generator.
22) At Ash Mountain spray field pump house: install external GFCI weatherproof receptacle.
23) At the Ash Mountain spray field pump house: replace light.
24) At the Ash Mountain spray field pump house: replace ball valve on incoming fluid pipe. Install flow meter on outgoing fluid pipe. Install flow meter readout in pump house building.

Buckeye Housing Site:

1) Remove the weathered, worn, and in disrepair interior-mounted power panels, sub-panels, disconnects, and starters associated with the lift station.
2) Relocate and replace operating control with NEMA 3R versions of power panels, sub-panels, disconnects, and starters as necessary, as well as a new flowmeter. Pump equipment will be mounted on the outside of the treatment building adjacent to the new lift station.
3) Replace existing lift station pumps.
4) Install a new 240/120V, 100A three phase pin and sleeve connector with an associated 240/120V, 100A, three phase manual transfer switch (MTS) for connecting a portable generator.
5) Connect the magnetic flowmeter to a remote readout display mounted adjacent to the new pump operating panels.
6) Remove old blowers and blower assembly, blower starters and disconnects, comminutor and comminutor disconnect, timer(s), O2 readout, gutter, and old panel M. Diconnect Panel A from service. Install new Panel M indoors.
7) Remove single phase service from building. Coordinate removal with utility company (SCE).
8) Install new LED lighting in building, along with vacancy sensor. Install new exterior lighting on building.
9) Install new GFCI outlets where necessary.
10) Install new GFCI weatherproof outlet to building's exterior.

B. Related Sections:

1. Division 01 Section "General Requirements."
2. Division 01 Section "Special Procedures."
3. This section applies to Division 26 Sections.

1.2 REFERENCES

A. General:

1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.
3. Refer to Division 01 Section "General Requirements" for the list of applicable regulatory requirements.

B. ANSI/NFPA 70 - National Electrical Code.

C. ANSI - American National Standards Institute

D. Illuminating Engineering Society of North America (IES)

E. LBNL Facilities Department Lateral Force Design Criteria.

F. NFPA 70 - National Electrical Code

G. IEEE, National Electrical Safety Code (NESC)

H. NFPA – National Fire Protection Association:

1. Standard for Electrical Safety in the Workplace (NFPA 70E)

I. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

J. UL – Underwriter’s laboratories

1.3 SUBMITTALS

A. Submit under provisions of Division 01 Section "General Requirements" Paragraph1.8. E, Submittals, and Division 01 Section "Special Procedures" Paragraph1.6, Drawings and Specifications and as required by other sections of the Specifications.

B. Shop Drawings: The Subcontractor shall submit for approval Shop Drawings prepared in accordance with Division 01 Section "General Requirements," Paragraph1.8.E and as required by other sections of the Specifications.

1.4 QUALITY ASSURANCE

A. Inspections: Refer to Division 01 Section "Special Procedures" Paragraph1.3 - Inspections.

B. Quality Control: Refer to Division 01 Section "Special Procedures" Paragraph1.12.

C. Materials and Equipment: Refer to Division 01 Section "General Requirements" Paragraph1.12, Paragraph1.8.D.

D. If the Drawings or Specifications may not appear clear or definite, the Subcontractor shall request the Project Manager through 'Request for Information' (RFI) process for an interpretation and decision of same and shall have such questions decided before proceeding with the Work.

E. Manufacturer's Directions: Follow manufacturer's directions covering points not shown on the drawings or specified herein. Manufacturer's directions do not take precedence over drawings and Specifications. Where these are in conflict with the Drawings and Specifications, notify the Project Manager for clarification before installing the work.

F. Protection of Equipment:

1. Care shall be exercised during construction to avoid damage or disfigurement. Equipment shall be protected from dust and moisture prior to and during construction. The Subcontractor is cautioned that concrete finishing, painting, etc. in electrical rooms shall not proceed if unprotected equipment is installed.
2. Where required or directed, construct temporary protection for equipment and installations so as to protect same from dust and debris caused by construction.
3. All protection shall be substantially constructed with the use of clean canvas, heavy plastic, Visqueen and plywood as required, and made tight and dust proof as directed.
4. The Subcontractor shall repair by spray or brush painting, after properly preparing the surface, scratches or defects in the finish of the equipment. Only identical paint furnished by the equipment manufacturer shall be used for such purposes.
5. Failure of the Subcontractor to protect the equipment as outlined herein shall be grounds for rejection of the equipment and its installation.

G. Removed Equipment and Material: Refer to Division 01 Section "Special Procedures" Paragraph 1.3 - U.S. Government and/or University Property - Materials to Be Removed.

H. Shutdown: Refer to Division 01 Section "Special Procedures" Paragraph1.5.

I. Cleaning: Refer to Division 01 Section "Special Procedures" Paragraph 3.5.

J. Qualifications and License Requirements:

1. Prime, Sub, or Sub-Sub contractor performing electrical construction work on the project shall have C-10 Electrical Construction License from the State of California, USA.
2. Subcontractor performing electrical construction work shall provide details of the project experience addresses and references with names and phone numbers.
3. Certified electricians shall have evidence of certification in their possession at all times. Non-certified personnel shall perform electrical work under the continuous supervision of a certified electrician.

K. Materials and Equipment: Materials and equipment shall be new. Materials and equipment for which tests have been established by Underwriter's Laboratories, Inc. shall be approved by that body and shall bear its label of approval, or the label of an OSHA approved nationally recognized testing laboratory (NRTL).

1. All equipment shall bear a label or listing by Underwriter's Laboratories, Inc. or NRTL.

2. Unless otherwise approved by the Contracting Officer, the materials to be furnished under this Specification shall be the standard products of manufacturers regularly engaged in the production of such equipment equal to or superior to material specified and shall be the manufacturer's latest standard design that complies with the Specification requirements.

L. Approval of Materials:

1. Refer to Division 01 Section "General Requirements" Paragraph 1.8.E.
2. A complete list of materials and equipment proposed shall be submitted to the Project Manager for approval. The list shall include for each item: the manufacturer, the manufacturer's catalog number, type or class, the rating, capacity, size, etc.
3. The Subcontractor shall submit a brochure containing catalog cuts or drawings and data for, but not limited to, the following items:
4. Before installation of the equipment, the Subcontractor shall submit for approval detailed construction drawings for each item of fabricated equipment required for the electrical installation. Drawings shall be to scale and fully dimensioned and shall provide sufficient detail to clearly indicate the arrangement of equipment and its components.
5. Installation of approved substituted equipment is the Subcontractor's responsibility, and changes required to work included under other divisions for installations of approved substituted equipment must be made to the satisfaction of the Contracting Officer and without change in contract price. Approval by the Contracting Officer of substituted equipment and/or dimension drawings does not waive these requirements.

1.5 COORDINATION

A. Refer to Division 01 Section "General Requirements" Paragraph1.7.

1.6 MAINTENANCE

A. Maintenance and Operating Instructions:

1. See Division 01 Section "General Requirements," Paragraph1.8. G.
2. At time of occupancy, arrange for manufacturer's representatives to instruct building, operating and maintenance personnel in the use of equipment requiring operating and maintenance. Arrange for personnel to be instructed at one time. Pay the costs for such service.
3. Maintenance and operating instructions and training for equipment will be provided by the equipment vendor. The Subcontractor shall be responsible for all other equipment.

1.7 WARRANTY

A. Refer to Division 01 Section "General Requirements", Paragraph1.8.H - Guarantee.

PART 2 – PRODUCTS

2.1 GENERAL

A. In addition to material and equipment specified, the Subcontractor shall also provide incidental materials required to effect a complete installation. Such incidental materials include solders, tapes, caulking, mastics, gaskets, and similar items that are approved for the purpose.

B. Materials and equipment shall be uniform throughout the installation. Equipment of the same type shall be of the same manufacturer. Materials and equipment shall be new. Materials and equipment for which tests have been established by the Underwriter's Laboratories, Inc. shall have been approved by that body, or an equivalent testing firm (see Paragraph 1.4.C) and shall bear its label of approval.

PART 3 – EXECUTION

3.1 TESTS

A. Upon completion of the electrical construction work, perform tests and provide test reports as specified in this and other sections.

B. Tests shall be made in the presence of the Contracting Officer. The application or interruption of power shall be programmed and directed by the Contracting Officer.

C. The Subcontractor shall submit to the Project Manager three (3) copies of test results, certified in writing, witnessed, signed and dated, immediately upon completion of work. Unsatisfactory condition revealed by these test results, or unsatisfactory methods of tests and/or testing apparatus and instruments, shall be corrected by the Subcontractor to the satisfaction of the Contracting Officer.

D. The Contracting Officer reserves the right to require that the Subcontractor perform and repeat tests that are deemed necessary to complete or check the tests or the certified records of the Subcontractor at any time during the course of the work. The Subcontractor shall correct unsatisfactory portion of his work that is revealed by the tests or that may be due to progressive deterioration during this period, unless the item in question was a direct specification.

3.2 ARC FLASH HAZARD WARNING LABELING

A. Switchgear, switchboards, panelboards, industrial control panels, motor control centers, and meter panels/enclosures shall be labeled to warn qualified persons of potential electric shock and/or

B. Labels shall, as a minimum, display the following:

1. Incident energy in calories/cm^2at the working distance.
2. Flash hazard boundary distance.
3. Personal protective equipment (PPE) category per NFPA 70E.
4. Shock hazard voltage when covers are removed.

5. Glove class with leather protectors.
6. Limited approach boundary.
7. Restricted approach boundary.

3.3 EQUIPMENT IDENTIFICATION

A. Transformers: Transformers shall be identified by one-inch-high white stenciled-on characters giving bank number and circuit feeding the transformer in agreement with the Drawings.

B. Panelboards: Panel boards shall be identified by circuit number, voltage, phase, and wire as shown on drawings or specified elsewhere in these Specifications.

C. Schedules: Panelboards shall be furnished with a complete 8-1/2" x 11" typewritten schedule mounted on the inside of the inner door. If field changes are necessary, new schedules shall be provided by the Subcontractor. Forms will be provided by the Project Manager.

D. Receptacles and Light Switches: Receptacles and light switches shall be identified by a circuit number as indicated on the drawings with 1/4 inches (6 mm) high white characters on 1/2 inch (12 mm) wide dark contrasting stick-on embossing tape placed directly above the device.

E. Equipment: Properly identify circuit breakers and other devices on switchboards, motor disconnect switches, starters, time clocks, and other apparatus used for operation of, or control of circuits, appliances, or equipment by means of 3/32-inch-thick black laminated phenolic nameplate with white core. For switchboards and panelboards, fed by standby or emergency power sources, use 3/32-inch-thick yellow laminated phenolic nameplate with black core. Engrave characters a minimum of 1/2 inch size for device numbers, except that transformer bank identification shall use a minimum size of 1-1/2-inch character height and 15kV switchgear shall use 1 inch character height, Helvetica style font. Attach nameplates with No. 4-36 RH nickel-plated brass machine screws.

F. Conductors: The main incoming power will be delivered to the building site with the A phase, B phase, C phase and Neutral phase (if applicable) cables positively identified. The phase sequence rotation shall be A-B-C clockwise.

1. Conductors shall be identified using plastic or metal labels, factory-colored wires or by using color bands or tape intended for the purpose and approved for wet, outdoor applications at terminations, junctions and wherever the conductors are accessible in pull boxes. Conductors are not color coded, but identified as "A Phase", "B Phase", and "C Phase".
2. For color coding of low voltage conductors, see Division 26 Section "600 Volt Conductors and Cable", Paragraph 2.1.
3. Feeder circuit cables shall be identified with embossed metal or plastic labels with 1/2" characters permanently attached to the feeder circuit cables. Feeder circuits shall be identified with the circuit number per the drawings.
4. Branch circuit identification shall be by use of wrap-around labels such as manufactured by Brady, Thomas and Betts, or equal. Labels shall be placed on conductors at outlets (switch, receptacle, fixture, etc.), panelboards, junction boxes, relays, disconnect switches, motor starters, and controls. Branch circuit conductors shall be identified with the circuit number.

3.4 NOISE AND VIBRATION

A. The Subcontractor shall cooperate in reducing objectionable noise or vibration. If noise or vibration is a result of improper material or installation, these conditions shall be corrected at no cost to the University.

3.5 GENERAL INSTALLATION METHODS

A. Carpentry, Cutting, Patching, and Core Drilling:

1. Provide carpentry, cutting, patching, and core drilling required for installation of material and equipment specified in the scope of work.
2. Do not cut, core, or drill structural members without consent of the Contracting Officer.
3. Seismic Mounting: Electrical material and equipment, including floor mounted equipment, suspended raceways and light fixtures, shall be installed with bracing, cabling, or anchoring to comply with the latest edition of the CBC and Standard and Division 01 Section “Lateral Force Provisions.” See 031500 – Concrete Accessories for approved anchors.

B. Waterproof Construction:

1. Maintain waterproof integrity of penetrations of materials intended to be waterproof. Provide flashings at exterior roof penetrations. Caulk penetrations of foundation walls and floors watertight. Provide membrane clamps at penetrations of waterproof membranes.
2. Provide waterproof NEMA 3R enclosures for equipment or devices mounted outside or otherwise exposed to the weather.

C. Painting of Electrical Equipment and Hardware:

1. Provide moisture resistant paint for exterior painting.
2. Colors shall be as shown on the drawings unless specified.
3. Refer to individual Sections and Construction Drawings for painting requirements of electrical equipment.
4. Exposed conduits, raceways and gutters inside and outside the building shall be painted to match the wall color.

D. Equipment Concrete Pads:

1. Equipment located on concrete floors inside the building or on grade outside the building, shall be mounted on a concrete base. The concrete base shall be four inches high and shall extend six inches beyond the edge of equipment base unless indicated otherwise on drawings.
2. Coordinate concrete bases: Concrete bases indicated on Architectural or Structural drawings are specified in other Divisions. Concrete bases not on Architectural or Structural drawings are requirements of this Division.

E. Seismic Anchorage:

1. Seismic anchorage of electrical equipment shall be in accordance with Division 01 Section "Lateral Force Procedures". See 03 15 00 – Concrete Accessories for approved anchors.

F. Demolition and Removal:

1. Refer to construction documents for demolition and removal details.
2. Contracting Officer approval shall be obtained prior to disposal of electrical equipment and materials.
3. Disconnected wiring shall be removed from raceway systems, panels, enclosures pull boxes, junction boxes etc. irrespective of whether the removal is specified in the construction documents or not. The empty raceway systems shall be tagged spare on both ends of each termination.

3.6 ARC FLASH ANALYSIS

A. Credentials, Software, Parameters.

1. Proposed equipment and materials to be used for the project or as built equipment and materials, as applies to the submittal.
2. Data entry and system one-line modeling in Current version of SKM software.
3. Model verification.
4. Short Circuit study.
5. Protective device coordination study.
6. Arc flash hazard study.
7. Detailed report and findings of the analysis.
8. Electronic copies of the Project Report and the System Modeling file.
9. Hard copies of the project report (note all printing, postage, etc.) shall be included in proposed project.

END OF SECTION

SECTION 26 05 11

REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

PART 1 – GENERAL

1.1 DESCRIPTION

A. This section applies to all sections of Division 26.

B. Furnish and install electrical wiring, systems, equipment, and accessories in accordance with the specifications and drawings. Capacities and ratings of motors, transformers, cable, switchboards, switchgear, panelboards, motor control centers, generators, automatic transfer switches, and other items and arrangements for the specified items are shown on drawings.

D. Wiring ampacities specified or shown on the drawings are based on copper conductors, with the conduit and raceways accordingly sized. Aluminum conductors are prohibited.

1.2 MINIMUM REQUIREMENTS

A. References to the International Building Code (IBC), National Electrical Code (NEC), Underwriters Laboratories, Inc. (UL) and National Fire Protection Association (NFPA) are minimum installation requirement standards.

B. Drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the above standards.

1.3 TEST STANDARDS

A. All materials and equipment shall be listed, labeled or certified by a nationally recognized testing laboratory to meet Underwriters Laboratories, Inc., standards where test standards have been established. Equipment and materials which are not covered by UL Standards will be accepted provided equipment and material is listed, labeled, certified or otherwise determined to meet safety requirements of a nationally recognized testing laboratory. Equipment of a class which no nationally recognized testing laboratory accepts, certifies, lists, labels, or determines to be safe, will be considered if inspected or tested in accordance with national industrial standards, such as NEMA, or ANSI. Evidence of compliance shall include certified test reports and definitive shop drawings.

B. Definitions:

1. Listed: Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production or listed equipment or materials or periodic evaluation of services, and whose listing states that the equipment, material, or services either meets appropriate designated standards or has been tested and found suitable for a specified purpose.
2. Labeled: Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or

materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

3. Certified: equipment or product which:

a. Has been tested and found by a nationally recognized testing laboratory to meet nationally recognized standards or to be safe for use in a specified manner.

b. Production of equipment or product is periodically inspected by a nationally recognized testing laboratory.

c. Bears a label, tag, or other record of certification.

4. Nationally recognized testing laboratory: laboratory which is approved, in accordance with OSHA regulations, by the Secretary of Labor.

1.4 QUALIFICATIONS (PRODUCTS AND SERVICES)

A. Manufacturer’s Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least three years.

B. Product Qualification:

1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three (3) years.

2. The Government reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.

C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.5 APPLICABLE PUBLICATIONS

A. Applicable publications listed in all Sections of Division 26 are the latest issue, unless otherwise noted.

1.6 MANUFACTURED PRODUCTS

A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts shall be available.

B. When more than one unit of the same class or type of equipment is required, such units shall be the product of a single manufacturer.

C. Equipment Assemblies and Components:

1. Components of an assembled unit need not be products of the same manufacturer.

2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.

3. Components shall be compatible with each other and with the total assembly for the intended service.

4. Constituent parts which are similar shall be the product of a single manufacturer.

D. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.

E. When Factory Testing Is Specified:

1. The Government shall have the option of witnessing factory tests. The contractor shall notify the Contracting Officer a minimum of 15 working days prior to the manufacturers making the factory tests.
2. Four copies of certified test reports containing all test data shall be furnished to the Contracting Officer prior to final inspection and not more than 90 days after completion of the tests.
3. When equipment fails to meet factory test and re-inspection is required, the Contractor shall be liable for all additional expenses, including expenses of the Government.

1.7 EQUIPMENT REQUIREMENTS

Where variations from the contract requirements are requested in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.

1.8 EQUIPMENT PROTECTION

A. Equipment and materials shall be protected during shipment and storage against physical damage, vermin, dirt, corrosive substances, fumes, moisture, cold and rain.

1. Store equipment indoors in clean dry space with uniform temperature to prevent condensation. Equipment shall include but not be limited to switchgear, switchboards, panelboards, transformers, motor control centers, motor controllers, uninterruptible power systems, enclosures, controllers, circuit protective devices, cables, wire, light fixtures, electronic equipment, and accessories.
2. During installation, equipment shall be protected against entry of foreign matter; and be vacuum cleaned both inside and outside before testing and operating. Compressed air shall not be used to clean equipment. Remove loose packing and flammable materials from inside equipment.
3. Damaged equipment shall be, as determined by the Contracting Officer placed in first class operating condition or be returned to the source of supply for repair or replacement.
4. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.
5. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

1.9 WORK PERFORMANCE

A. All electrical work must comply with the requirements of NFPA 70 (NEC), NFPA 70B, NFPA 70E, OSHA Part 1910 subpart J, OSHA Part 1910 subpart S and OSHA Part 1910 subpart K in addition to other references required by contract.

B. Job site safety and worker safety is the responsibility of the Contractor.

C. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished in this manner for the required work, the following requirements are mandatory:

1. Electricians must use full protective equipment (i.e., certified and tested insulating material to cover exposed energized electrical components, certified and tested insulated tools, etc.) while working on energized systems in accordance with NFPA 70E.

2. Electricians must wear personal protective equipment while working on energized systems in accordance with NFPA 70E.
3. Work on energized circuits or equipment cannot begin until prior written approval is obtained from the Contracting Officer.

D. For work on existing stations, arrange, phase and perform work to assure electrical service for other buildings at all times. Refer to Article OPERATIONS AND STORAGE AREAS under Section 01 00 00, GENERAL REQUIREMENTS.

E. New work shall be installed and connected to existing work neatly, safely and professionally. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.

F. Coordinate location of equipment and conduit with other trades to minimize interferences.

1.10 EQUIPMENT INSTALLATION AND REQUIREMENTS

A. Equipment location shall be as close as practical to locations shown on the drawings.

B. Working spaces shall not be less than specified in the NEC for all voltages specified.

C. Inaccessible Equipment:

1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Government.
2. "Conveniently accessible" is defined as being capable of being reached quickly for operation, maintenance, or inspections without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

1.11 EQUIPMENT IDENTIFICATION

A. In addition to the requirements of the NEC, install an identification sign which clearly indicates information required for use and maintenance of items such as switchboards and switchgear, panelboards, cabinets, motor controllers (starters), fused and unfused safety switches, automatic transfer switches, separately enclosed circuit breakers, individual breakers and controllers in switchboards, switchgear and motor control assemblies, control devices and other significant equipment.

B. Nameplates for Normal Power System equipment shall be laminated black phenolic resin with a white core with engraved lettering. Nameplates for Essential Electrical System (EES) equipment, as defined in the NEC, shall be laminated red phenolic resin with a white core with engraved lettering. Lettering shall be a minimum of 1/2 inch (12mm) high. Nameplates shall indicate equipment designation, rated bus amperage, voltage, number of phases, number of wires, and type of EES power branch as applicable. Secure nameplates with screws.

C. Install adhesive arc flash warning labels on all equipment as required by NFPA 70E. Label shall indicate the arc hazard boundary (inches), working distance (inches), arc flash incident energy at the working distance (calories/cm2), required PPE category and description including the glove rating, voltage rating of the equipment, limited approach distance (inches), restricted approach distance (inches), prohibited approach distance (inches), equipment/bus name, date prepared, and manufacturer name and address.

1.12 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. The Government's approval shall be obtained for all equipment and material before delivery to the job site. Delivery, storage or installation of equipment or material which has not had prior approval will not be permitted at the job site.

C. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings and other data necessary for the Government to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted.

D. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.

1. Mark the submittals, "SUBMITTED UNDER SECTION_____".
2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
3. Submit each section separately.

E. The submittals shall include the following:

1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required.
3. Elementary and interconnection wiring diagrams for communication and signal systems, control systems and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
4. Parts list which shall include those replacement parts recommended by the equipment manufacturer.

F. Manuals: Submit in accordance with Section 01 00 00, GENERAL REQUIREMENTS.

1. Maintenance and Operation Manuals: Submit as required for systems and equipment specified in the technical sections. Furnish four copies, bound in hardback binders, (manufacturer's standard binders) or an approved equivalent. Furnish one complete manual as specified in the technical section but in no case later than prior to performance of systems or equipment test and furnish the remaining manuals prior to contract completion.
2. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, equipment, building, name of Contractor, and contract number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment.
3. Provide a "Table of Contents" and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.
4. The manuals shall include:

a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
b. A control sequence describing start-up, operation, and shutdown.
c. Description of the function of each principal item of equipment.
d. Installation instructions.
e. Safety precautions for operation and maintenance.
f. Diagrams and illustrations.
g. Periodic maintenance and testing procedures and frequencies, including replacement parts numbers and replacement frequencies.
h. Performance data.
i. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.
j. List of factory-approved or qualified permanent servicing organizations for equipment repair and periodic testing and maintenance, including addresses and factory certification qualifications.

G. Approvals will be based on complete submission of manuals together with shop drawings.

H. After approval and prior to installation, furnish the Contracting Officer with one sample of each of the following:

1. A 300 mm (12 inch) length of each type and size of wire and cable along with the tag from the coils of reels from which the samples were taken.
2. Each type of conduit coupling, bushing and termination fitting.
3. Conduit hangers, clamps and supports.
4. Duct sealing compound.
5. Each type of receptacle, toggle switch, occupancy sensor, outlet box, manual motor starter, device wall plate, engraved nameplate, wire and cable splicing and terminating material, and branch circuit single pole molded case circuit breaker.

1.13 SINGULAR NUMBER

Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

END OF SECTION

SECTION 26 05 19

LOW VOLTAGE ELECTRICAL POWER CONDUCTORS & CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Building wires and cables rated six hundred volts (600 V) and less.
2. Connectors, splices, and terminations rated six hundred volts (600 V) and less.
3. Sleeves and sleeve seals for cables.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.6 COORDINATION

A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

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:

1. Alcan Products Corporation; Alcan Cable Division.
2. American Insulated Wire Corp.; a Leviton Company.
3. General Cable Corporation.
4. Senator Wire & Cable Company.
5. Southwire Company.
6. Honeywell.

B. Copper Conductors: Comply with NEMA WC 70.

C. Conductor Insulation: Comply with NEMA WC 70 for Types THW, THHN-THWN and XHHW.

2.2 CONNECTORS AND SPLICES

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:

1. AFC Cable Systems, Inc.
2. Hubbell Power Systems, Inc.
3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.
5. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SLEEVES FOR CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

2.4 SLEEVE SEALS

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:

1. Advance Products & Systems, Inc.

2. Calpico, Inc.
3. Metraflex Co.
4. Pipeline Seal and Insulator, Inc.

B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.

1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
2. Pressure Plates: Stainless steel. Include two for each sealing element.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTI-CONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN-THWN, single conductors in raceway.

B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

E. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway. Type THWN-XHHW for underground.

F. Class 1 Control Circuits: Type THHN-THWN, in raceway.

G. Class 2 Control Circuits: Type THHN-THWN, in raceway.

H. Phone wire, Cat 6 (min.), weatherproof suitable for direct burial.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

B. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.

C. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

D. Support cables according to Division 26 Section "Hangers & Supports for Electrical Systems."

E. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

F. Neutral conductors shall be installed in accordance with the National Electric Code (NEC). Separate neutral conductors are required for all 120V circuits. Multiple individual 120V circuits **may not** be ganged under a common handle tie (multi-phase breaker) to reduce the quantity of neutral conductors.

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than un-spliced conductors.

1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least six (6) inches of slack.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Coordinate sleeve selection and application with selection and application of penetration.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Rectangular Sleeve Minimum Metal Thickness:

1. For sleeve rectangle perimeter less than fifty inches (50”) and no side greater than sixteen inches (16”), thickness shall be 0.052 inch.
2. For sleeve rectangle perimeter equal to, or greater than, fifty inches (50”) and one (1) or more sides equal to, or greater than, sixteen inches (16”), thickness shall be 0.138 inch.

E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

F. Size pipe sleeves to provide one-fourth inch (1/4”) annular clear space between sleeve and cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.

G. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

H. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.

I. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for one inch (1”) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

J. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for one inch (1”) annular clear space between cable and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

A. Install to seal underground exterior-wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.7 INSPECTION AND TESTS

A. Tests shall be made in the presence of the NPS Contracting Officer.

B. The electrical installation shall be inspected and tested to ensure safety for operating personnel and conformity to Code authorities and subcontract documents. Field tests shall be performed in conformance with the National Electrical Testing Association (NETA) Standards.

C. Measure and record insulation resistance of all power, lighting and control wiring installed by or altered by the Subcontractor including insulation resistance of all equipment, supplied by either the University or the Subcontractor. The Subcontractor shall not be responsible for defective insulation in equipment that has been supplied by to the Subcontractor, unless such damage is due to negligence or incorrect handling or installation workmanship of the Subcontractor.

1. The insulation resistance of each main feeder conductor and phase-to-ground shall be measured. For circuits rated less than 600 volts, the resistance shall not be less than one mega-ohm.

2. Systems rated above 240 volts shall be tested with a 1000-volt Megohmeter. Main feeders for 240 volts and below shall be tested with a 500-volt Megohmeter. The D.C. potential shall be applied for thirty (30) seconds.

D. Measure ground grid ground resistance using a ground fall of potential meter as described in IEEE Standards 81. Report the results in writing to NPS Contracting Officer for acceptance/approval.

E. Using a calibrated torque wrench, test and record values at all feeder terminations.

F. The Subcontractor shall submit to the contracting officer five (5) copies of test results, certified in writing, witnessed, signed and dated, immediately upon completion of work for review and acceptance by the NPS. An unsatisfactory condition revealed by these test results, or unsatisfactory methods of tests and/or testing apparatus and instruments, shall be brought to the attention of the Contracting Officer. Corrections by the Subcontractor shall be validated by re-tests to the satisfaction of the Contracting Officer.

G. The Contracting Officer reserves the right to require that the Subcontractor perform and repeat tests that are deemed necessary to complete or check the tests or the certified records of the Subcontractor at any time during the course of the work. The Subcontractor shall correct any unsatisfactory portion of his work that is revealed by the tests or that may be due to progressive deterioration during this period, unless the item in question was a direct specification.

END OF SECTION

SECTION 26 05 23

CONTROL VOLTAGE ELECTRICAL CABLES

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Low-voltage control cabling.
2. Control-circuit conductors.
3. Identification products.

B. Related Sections:

1. The Contract Documents are a single integrated document, and as such all Divisions and Sections apply. It is the responsibility of the CONTRACTOR and its Sub-Contractors to review all sections to insure a complete and coordinated project.

C. Cabinets and enclosures to house electrical controls, instruments, terminal blocks, and similar equipment.

1.2 DEFINITIONS

A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control reports.

C. Maintenance data.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inspect cables upon receipt at Project site.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Belden.
2. Carol.
3. Or approved equal.

2.2 LOW-VOLTAGE CABLES

A. Analog type control circuits shall be wired with Multi-Conductor – Shielded Twisted Pair cable.

1. One pair, twisted, No. 18 AWG, stranded tinned-copper conductors
2. 300V minimum operating voltage
3. Overall Shield with No. 20 AWG stranded tinned copper drain wire.
4. PVC jacket.
5. Outdoor rated.

2.3 CONTROL-CIRCUIT CONDUCTORS

A. Class 1, 2 and 3 Control Circuits: Stranded copper, Type THHN-THWN, in raceway, complying with UL 83.

2.4 IDENTIFICATION PRODUCTS

A. Manufacturers: Subject to compliance with requirements.

1. Brady Corporation.
2. Kroy LLC.
3. Panduit Corp.
4. Or approved equal.

B. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

PART 3 – EXECUTION

3.1 INSTALLATION OF PATHWAYS

A. Comply with NEC for pull-box sizing and length of conduit and number of bends between pull points.

B. Comply with requirements in "Raceways" Specification Section for raceway selection and installation requirements for boxes, conduits, and wireways as supplemented or modified in this Section.

1. Flexible conduit shall be metallic liquid tight only and shall not be used for lengths over 5ft.

C. Pathway Installation in Equipment Rooms:

1. Install cable trays to route cables if conduits cannot be located in these positions.
2. Extend conduits 3 inches above finished floor.
3. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

3.2 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1 and NFPA 70.

B. General Requirements for Cabling:

1. All cabling and wiring shall be in conduit as required by code.
2. Cables may not be spliced.
3. Secure and support conduit at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
4. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii.
5. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
6. Cold-Weather Installation: Bring cable to room temperature before dereeling. Do not use heat lamps for heating.
7. Pulling Cable: Per manufacturer’s recommendations.
8. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.

C. Installation of Control-Circuit Conductors:

1. Install wiring in raceways. Comply with requirements specified in “Raceway” Specification Section.

D. Separation from EMI Sources:

1. Provide separation of control conductors and data communications cable from potential EMI sources including electrical power lines and equipment.

E. Separate Power circuits from Control circuits

1. Power circuits and Control circuits shall be run in separate conduits.

3.3 CONTROL-CIRCUIT CONDUCTORS

A. Minimum Conductor Sizes:

1. Class 1 remote-control and signal circuits, No 14 AWG.
2. Class 2 low-energy, remote-control, and signal circuits, No. 16 AWG.
3. Class 3 low-energy, remote-control, alarm, and signal circuits, No 18 AWG.

3.4 IDENTIFICATION

A. Identify all field installed control wiring, and cabling according. Comply with requirements for identification specified in Division 26 Section “Identification for Electrical Systems.”

1. Identify cable and conductor source and wire label per Process Control Panel Shop Drawings.

B. Identify data and communications system components, wiring, and cabling according to TIA-606-A; label printers shall use label stocks, laminating adhesives, and inks complying with UL 969.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Visually inspect cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments and inspect cabling connections to confirm compliance with TIA-568-C.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test cabling for direct-current loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination, but not after cross-connection.

a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in its "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in its "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

B. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide or transfer the data from the instrument to the computer, save as text files, print, and submit.

C. End-to-end cabling will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION

SECTION 26 05 26

GROUNDING & BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes methods and materials for grounding systems and equipment.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for the intended use.

B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for six hundred volts (600V) unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Conductor: Sized as indicated on drawings, stranded copper conductor.
5. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

2.2 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two (2) bolts.

1. Pipe Connectors: Clamp type, sized for the pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by the kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING SYSTEM DEVICES

1. Ground Rods: Copper-clad, Zinc-coated Stainless steel, sectional type; five-eighths by ninety-six inches (5/8” x 96”). Ground Rods: Grade 40HS, cone-pointed, copper-encased steel, 3/4-inch (19 mm) diameter, minimum length 10 feet. Copper shall have a minimum wall thickness of 0.013 inch (0.33 mm) at any point on the rod.
2. Ground Rod Connectors: Accessible; Burndy, Copperweld, or equal.
3. Cable Connectors: Accessible; O.Z./Gedney, Burndy, or equal.
4. Ground Rod and Cable Connectors: Not Accessible; Cadweld, Thermoweld, or equal.
5. Grounding Bushings: O.Z. Type BL, Burndy, or equal.
6. Pipe Connectors: O.Z. Type ABG, Burndy, or equal.
7. Enclosure Connectors: O.Z. Type QG or KG, Burndy, or equal.
8. Feedthrough Lug: Burndy Type Q2B, O.Z./Gedney, or equal.
9. Concrete Ground Box: Brooks Concrete Products 3-RT, or equal.
10. Copper Mechanical Grounding Connector for Copper Cable to Flat Bus Bar: Burndy Type KC Servit Post, or equal.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 18 AWG and smaller, and stranded conductors for No. 16 AWG and larger, unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper conductor, No. 6 AWG minimum.

1. Bury at least twenty-four inches (24”) (600 mm) below grade.

C. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are two inches (2") (50 mm) below finished floor or final grade, unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
2. For grounding electrode system, install at least two (2) rods spaced at least one (1) rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to the basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

3.4 TESTING

A. Testing: Perform the following field quality-control testing:

1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
2. Test completed grounding system at each location where a maximum ground-resistance level is indicated and at service disconnect enclosure grounding terminal. Measure ground resistance not less than two (2) full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests, by the fall-of-potential method according to IEEE 81. Drive additional rods if the reading is greater than twenty-five (25) Ohms.

END OF SECTION

SECTION 26 05 29

HANGERS & SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.
2. Nonmetallic slotted support systems.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. 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:
   a. Allied Tube & Conduit.
   b. Cooper B-Line, Inc.; a division of Cooper Industries.
   c. ERICO International Corporation.

d. GS Metals Corp.
e. Thomas & Betts Corporation.
f. Unistrut; Tyco International, Ltd.
g. Wesanco, Inc.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
5. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Hilti Inc.
      2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      3) MKT Fastening, LLC.
      4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc coated or stainless steel, for use in hardened Portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
   a. 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:
      1) Cooper B-Line, Inc.; a division of Cooper Industries.
      2) Empire Tool and Manufacturing Co., Inc.
      3) Hilti Inc.
      4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      5) MKT Fastening, LLC.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.

6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, RMC, EMT, IMC, RMC, and MC (where approved by local jurisdiction) may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69 Spring-tension clamps.

7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

B. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 26 05 33

RACEWAYS & BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. FMC: Flexible metal conduit.

C. IMC: Intermediate metal conduit.

D. LFMC: Liquid-tight flexible metal conduit.

E. LFNC: Liquid-tight flexible nonmetallic conduit.

F. RNC: Rigid nonmetallic conduit.

G. RMC: Rigid metal conduit.

1.4 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.

1. Custom enclosures and cabinets.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for the intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.
2. Alflex Inc.
3. Allied Tube & Conduit; a Tyco International Ltd. Co.
4. Anamet Electrical, Inc.; Anaconda Metal Hose.
5. Electri-Flex Co.
6. Manhattan/CDT/Cole-Flex.
7. Maverick Tube Corporation.
8. O-Z Gedney; a unit of General Signal.
9. Wheatland Tube Company.

B. Rigid Steel Conduit: ANSI C80.1.

C. Aluminum Rigid Conduit: ANSI C80.5.

D. IMC: ANSI C80.6.

E. EMT: ANSI C80.3.

F. FMC: Zinc-coated steel or aluminum.

G. LFMC: Flexible steel conduit with PVC jacket.

H. RMC: PVC coated.

I. Fittings for Conduit (including all Types and Flexible and Liquid-tight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
2. Fittings for EMT: Steel, set-screw, or compression type.

2.2 NONMETALLIC CONDUIT AND TUBING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.
2. Anamet Electrical, Inc.; Anaconda Metal Hose.
3. Arnco Corporation.
4. CANTEX Inc.
5. CertainTeed Corp.; Pipe & Plastics Group.
6. Condux International, Inc.
7. ElecSYS, Inc.

8. Electri-Flex Co.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT/Cole-Flex.
11. RACO; a Hubbell Company.
12. Thomas & Betts Corporation.

B. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.

C. LFNC: UL 1660.

D. Fittings for RNC: NEMA TC 3; match to conduit or tubing type and material.

E. Fittings for LFNC: UL 514B.

2.3 METAL WIREWAYS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.
2. Hoffman.
3. Square D; Schneider Electric.

B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, 12, 3R, unless otherwise indicated.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for a complete system.

D. Wireway Covers: Hinged type or Screw-cover type.

E. Finish: Manufacturer's standard enamel finish.

2.4 BOXES, ENCLOSURES, AND CABINETS

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:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. EGS/Appleton Electric.
3. Erickson Electrical Equipment Company
4. Hoffman.
5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
6. O-Z/Gedney; a unit of General Signal.
7. RACO; a Hubbell Company.
8. Robroy Industries, Inc.; Enclosure Division.
9. Scott Fetzer Co.; Adalet Division.
10. Spring City Electrical Manufacturing Company.
11. Thomas & Betts Corporation.

12. Walker Systems, Inc.; Wiremold Company (The).
13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, aluminum, Type FD, with gasketed cover.

D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

F. For outdoor environments: NEMA 3R

G. For corrosive environments: NEMA 4X.

H. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic**,** finished inside with radio-frequency-resistant paint.

I. Cabinets:

1. NEMA 250, Type 1, galvanized-steel box with the removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. A hinged door in the front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: Rigid steel conduit, IMC, RNC.
2. Concealed Conduit, Aboveground: Rigid steel conduit, IMC, EMT.
3. Underground Conduit: Sch 80 -PVC, direct buried.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R, and (if corrosive environment) 4X.
6. Conduit in Hazardous areas: Rigid steel conduit.

B. Minimum Raceway Size: 3/4-inch (16-mm) trade size.

C. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.

3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Support raceways as specified in Division 26 Section "Hangers & Supports for Electrical Systems."

E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

F. Install no more than the equivalent of three (3) ninety-degree (90°) bends in any conduit run except for communications conduits, for which fewer bends are allowed.

G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

H. Raceways Embedded in Slabs:

1. Run conduit larger than ½ -inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Change from RNC to rigid steel conduit, or IMC before rising above the floor.

I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

K. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of the pull wire.

L. Flexible Conduit Connections: Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed and semi-recessed lighting fixtures**,** equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC in damp or wet locations not subject to severe physical damage.

M. Recessed Boxes in Masonry Walls: Saw-cut opening for the box in the center of the cell of masonry block and install box flush with the surface of the wall.

N. Set metal floor boxes level and flush with the finished floor surface.

O. Set nonmetallic floor boxes level. Trim after installation to fit flush with the finished floor surface.

3.3 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by the manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by the manufacturer.

END OF SECTION

SECTION 26 05 48

VIBRATION & SEISMIC REQUIREMENTS FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 SUMMARY

A. This section includes performance-based design requirements for Seismic Restraints, Equipment Operability Requirements, and Vibration Isolation for electrical systems.

B. Contractor is to engage the services of a Professional Engineer licensed in the state of California to design necessary seismic restraints as necessary to comply with all applicable National and Local Codes and requirements of Authority Having Jurisdiction.

C. This Section includes requirements for the following materials:

1. Channel support systems
2. Anchorage bushings and washers

D. Related Sections include the following:

1. Division 26 Section "Common Work Results for Electrical" for commonly used electrical supports and installation requirements.

1.2 RELATED DOCUMENTS

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

1.3 DEFINITIONS

A. IBC: International Building Code, latest edition.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

D. ASCE 07 American Society of Civil Engineers

E. 2007 California Building Code

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Design Criteria:

1. Seismic Design Parameters:
   a. Building Occupancy Category: II
   b. Site Class: D
   c. Mapped Spectral Response Acceleration at Short Period (SS): 0.658

d. Design Spectral Response Acceleration at Short Period (SDS): 0.56
e. Mapped Spectral Response Acceleration at 1-Second Period (S1): 0.232
f. Design Spectral Response Acceleration at 1-Second Period (SD1): 0.30
g. Seismic Design Category: D

1.5 SUBMITTALS

A. Product Data:

1. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
   a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
   b. Annotate to indicate application of each product submitted and compliance with requirements.
2. Electrical equipment manufacturer's special certification requirements per ASCE-07 Section 13.2.2 for structures with a Seismic Design Category C through F containing electrical equipment that must remain operable following the design earthquake. Equipment manufacturer's certification may be submitted with Product Data for the applicable equipment under the appropriate Division 26 specification sections
   a. Provide manufacturer's certification of operability approved and stamped by a registered professional engineer.
   b. Indicate whether certification is based on shake table testing or experience data.
3. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
4. Restrained-Isolation Devices: Include ratings for horizontal, vertical, and combined loads. Bumper restraints or snubbers shall have nominal clearance (air gap) between equipment frame and restraint less than 0.25 inch.

B. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.

C. Welding certificates.

D. Qualification Data: For professional structural engineer to assess.

E. Field quality-control test reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combined shear, compressive and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer in project state.

E. Comply with NFPA 70.

PART 2 – PRODUCTS

2.1 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amber/Booth Company, Inc.
2. California Dynamics Corporation
3. Cooper B-Line, Inc.; a division of Cooper Industries
4. Hilti Inc.
5. Loos & Co.; Seismic Earthquake Division
6. Mason Industries
7. TOLCO Incorporated; a brand of NIBCO INC.
8. Unistrut; Tyco International, Ltd.

B. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

D. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchors and studs.

E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices.

F. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

G. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

H. Finish: Manufacturer's standard prime-coat finish ready for field painting.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Design Professional shall obtain equipment Center of Gravity and Weight data from manufacturers for equipment to be secured.

B. Design restraints to comply with critical equipment manufacturers requirements and to achieve system operability as defined by manufacturer’s certification design limits per Section 1.5 subpart A.2.

C. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Conduit Support Restraints:

1. Install transverse restraints at both ends if the conduit run is less than thirty (30) feet. Install transverse restraints at both ends and at ninety-degree (90º) bends.
2. Install longitudinal restraints at one (1) per conduit run.
3. Transverse restraints for one (1) support may serve as the longitudinal brace for a perpendicular run if the restraint is within four (4) feet of the intersection and the restraint are sized for the larger run.
4. Conduits less than two and one half (2.5) inches diameter suspended by individual hanger rods may be excluded from the above requirements.

5. Clevis or trapeze supported conduits suspended by hanger rods where the point of attachment is less than twelve (12) inches in length from the conduit to the structural connection of the clevis or trapeze may be excluded from the above requirements.

B. Equipment Restraints:

1. Install restrained isolators on electrical equipment.
2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
3. Install seismic-restraint devices using methods approved by [an evaluation service member of an agency acceptable to authorities having jurisdiction providing required submittals for component.
4. Equipment weighing less than fifty (50) lbs may be excluded from the above requirements.

C. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

D. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

E. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre-stressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in runs of raceways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Contractor shall engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
2. Test to ninety percent (90%) of rated proof load of device.

END OF SECTION

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Equipment identification labels.
5. Miscellaneous identification products.

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout the Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with the location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 – PRODUCTS

2.1 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.2 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm).

B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for the label.

C. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

D. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

2.3 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in Division 09 Painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify the identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by the manufacturer of the identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

G. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 120V to ground: Identify with the self-adhesive vinyl label. Install labels at 30-foot (10-m) maximum intervals.

B. Provide Arc Flash Hazard warning labels on equipment identified in NEC Art. 110-16.

C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and hand-holes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase Identification, 600 V or Less: Use colors listed below for grounded and ungrounded feeder and branch-circuit conductors.
    a. The color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
    b. Colors for 208/120-V Circuits:
        1) Phase A: Black.
        2) Phase B: Red.
        3) Phase C: Blue.
        4) Neutral: White

    c. Colors for 240-V Circuits:
        1) Phase A: Black
        2) Phase B: Red
        3) Neutral: White Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

D. Power-Circuit Conductor Identification, More than 600 V: For conductors in vaults, pull and junction boxes, manholes, and hand holes, use nonmetallic plastic tag holder with adhesive-backed phase tags, and a separate tag with the circuit designation.

E. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

F. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.

G. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by the system and circuit designation.
2. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

H. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

I. Equipment Identification Labels: On each unit of equipment, install a unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:
   a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches high.
   b. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
2. Equipment to Be Labeled:
   a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.
   b. Enclosures and electrical cabinets.
   c. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
   d. Enclosed controllers.
3. Variable-speed controllers.
4. Pushbutton stations.
   a. Contactors.
   b. Monitoring and control equipment.

END OF SECTION

SECTION 26 09 23

LIGHTING CONTROL DEVICES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following lighting control devices:

1. Time switches.
2. Photoelectric switches.
3. Indoor occupancy sensors.
4. Outdoor motion sensors.
5. Lighting contactors.

B. Related Sections include the following:

1. Division 26 Section "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

1.3 DEFINITIONS

A. LED: Light-emitting diode.

B. PIR: Passive infrared.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control test reports.

C. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

PART 2 – PRODUCTS

2.1 TIME SWITCHES

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:

1. Area Lighting Research, Inc.; Tyco Electronics.
2. Grasslin Controls Corporation; a GE Industrial Systems Company.
3. Intermatic, Inc.
4. Leviton Mfg. Company Inc.
5. Lightolier Controls; a Genlyte Company.
6. Lithonia Lighting; Acuity Lighting Group, Inc.
7. Paragon Electric Co.; Invensys Climate Controls.
8. Square D; Schneider Electric.
9. TORK.
10. Touch-Plate, Inc.
11. Watt Stopper (The).

2.2 OUTDOOR PHOTOELECTRIC SWITCHES

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:

1. Area Lighting Research, Inc.; Tyco Electronics.
2. Grasslin Controls Corporation; a GE Industrial Systems Company.
3. Intermatic, Inc.
4. Lithonia Lighting; Acuity Lighting Group, Inc.
5. Novitas, Inc.
6. Paragon Electric Co.; Invensys Climate Controls.
7. Square D; Schneider Electric.
8. TORK.
9. Touch-Plate, Inc.
10. Watt Stopper (The).

B. Description: Solid state, with SPST, DPST dry contacts rated for 1800 VA to operate connected load, relay, or contactor coils; complying with UL 773.

1. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lx), with an adjustment for turn-on and turn-off levels within that range.
2. Time Delay: 30-second minimum, to prevent false operation.
3. Lightning Arrester: Air-gap type.
4. Mounting: Twist lock complying with IEEE C136.10, with base.

2.3 INDOOR PHOTOELECTRIC SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. Allen-Bradley/Rockwell Automation.
2. Area Lighting Research, Inc.; Tyco Electronics.
3. Eaton Electrical Inc; Cutler-Hammer Products.
4. Grasslin Controls Corporation; a GE Industrial Systems Company.
5. Intermatic, Inc.
6. Lithonia Lighting; Acuity Lighting Group, Inc.
7. MicroLite Lighting Control Systems.
8. Novitas, Inc.
9. Paragon Electric Co.; Invensys Climate Controls.
10. Square D; Schneider Electric.
11. TORK.
12. Touch-Plate, Inc.
13. Watt Stopper (The).

B. Ceiling-Mounted Photoelectric Switch: Solid-state, light-level sensor unit, with separate relay unit mounted on luminaire, to detect changes in lighting levels that are perceived by the eye. Cadmium sulfide photoresistors are not acceptable.

1. Sensor Output: Contacts rated to operate the associated relay, complying with UL 773A. Sensor shall be powered from the relay unit.
2. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
3. Light-Level Monitoring Range: 10 to 200 fc (108 to 2152 lx) or 100 to 1000 fc (1080 to 10 800 lx), with an adjustment for turn-on and turn-off levels within that range as applicable.
4. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling, with deadband adjustment.
5. Indicator: Two LEDs to indicate the beginning of on-off cycles.

2.4 INDOOR OCCUPANCY SENSORS AND VACANCY SENSORS

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:
1. Hubbell Lighting.

2. Leviton Mfg. Company Inc.
3. Lithonia Lighting; Acuity Lighting Group, Inc.
4. Novitas, Inc.
5. RAB Lighting, Inc.
6. Sensor Switch, Inc.
7. TORK.
8. Watt Stopper (The).

B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.

1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
4. Mounting:
   a. Sensor: Suitable for mounting in any position on a standard outlet box.
   b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
   c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
6. Bypass Switch: Override the on function in case of sensor failure.
7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lx); keep lighting off when selected lighting level is present.

C. PIR Type: Ceiling mounting; detect occupancy or vacancy by sensing a combination of heat and movement in area of coverage.

1. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm).
2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
3. Detection Coverage (Corridor): Detect occupancy within 90 feet (27.4 m) when mounted on a 10-foot- (3-m-) high ceiling.

D. Ultrasonic Type: Ceiling mounting; detect occupancy or vacancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage.

1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. (56 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. (186 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet (27.4 m) when mounted on a 10-foot- (3-m-) high ceiling in a corridor not wider than 14 feet (4.3 m).

G. Dual-Technology Type: Ceiling mounting; detect occupancy or vacancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit. Preference shall be given to dual technology type.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

H. Occupancy and vacancy sensors shall not be used in the small buildings on this project.

2.5 OUTDOOR MOTION SENSORS (PIR)

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:

1. Bryant Electric; a Hubbell Company.
2. Hubbell Lighting.
3. Lithonia Lighting; Acuity Lighting Group, Inc.
4. Paragon Electric Co.; Invensys Climate Controls.
5. RAB Lighting, Inc.
6. TORK.
7. Watt Stopper (The).

B. Performance Requirements: Suitable for operation in ambient temperatures ranging from minus 40 to plus 130 deg F (minus 40 to plus 54 deg C), rated as raintight according to UL 773A.

1. Operation: Turn lights on when sensing infrared energy changes between background and moving body in area of coverage; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
2. Mounting:
   a. Sensor: Suitable for mounting in any position on a standard outdoor junction box.
   b. Relay: Internally mounted in a standard weatherproof electrical enclosure.
3. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
4. Bypass Switch: Override the on function in case of sensor failure.
5. Automatic Light-Level Sensor: Adjustable from 1 to 20 fc (11 to 215 lx); keep lighting off during daylight hours.

C. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm).

D. Detection Coverage: Up to 35 feet (11 m), with a field of view of 90 degrees, Up to 100 feet (30 m), with a field of view of 60 degrees, Up to 35 feet (11 m), with a field of view of 180 degrees, Up to 52.5 feet (16 m), with a field of view of 270 degrees.

E. Lighting Fixture Mounted Sensor: Suitable for switching 300 W of tungsten load at 120- or 277-V ac.

F. Individually Mounted Sensor: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.

1. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
2. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.

2.6 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multi-conductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multi-conductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

PART 3 – EXECUTION

3.1 SENSOR INSTALLATION

A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 WIRING INSTALLATION

A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 1/2 inch (13 mm).

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.3 IDENTIFICATION

A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
2. Operational Test: Verify operation of each lighting control device, and adjust time delays.
3. Ensure color temperatures do not exceed 3000K max to mitigate disruption to wildlife.

B. Lighting control devices that fail tests and inspections are defective work.

3.5 ADJUSTING

A. Occupancy and Vacancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control system.

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.
3. Electronic-grade panelboards.

1.3 DEFINITIONS

A. SVR: Suppressed voltage rating.

B. TVSS: Transient voltage surge suppressor.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
6. Include wiring diagrams for power, signal, and control wiring.
7. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
8. All panelboards, switchboards, and other equipment shall be fully rated for available fault current.

C. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

D. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

E. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation & Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from a single source from a single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NEMA PB 1.

F. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NECA 407 and NEMA PB 1.

1.8 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining an ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
    a. Ambient Temperature: Not exceeding minus 22 deg F (minus 30 deg C) 23 deg F (minus 5 deg C) to plus 104 deg F (plus 40 deg C).
    b. Altitude: Not exceeding 6600 feet (2000 m).

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet (2000 m).

C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Contracting Officer no fewer than 14 days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Contracting Officer's written permission.
3. Comply with NFPA 70E.

1.9 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within the specified warranty period.

1. Warranty Period: Five years from the date of Substantial Completion.

1.11 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Two spares for each type of panelboard cabinet lock.
2. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types: Two spares for each panelboard.
3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces.

B. Enclosures: Flush- and surface-mounted cabinets.

1. Rated for environmental conditions at the installed location.
   a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
   b. Outdoor Locations: NEMA 250, Type 3R.
   c. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
   d. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.

3. Hinged Front Cover: Entire front trim hinged to box and with standard door within a hinged trim cover.
4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
6. Finishes:
   a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
   b. Back Boxes: Galvanized steel.
   c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.
7. Directory Card: Inside panelboard door, mounted in the transparent card holder.

C. Incoming Mains Location: Top and bottom.

D. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity, per drawings.
2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
3. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from the box.
4. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
5. Split Bus: Vertical buses divided into individual vertical sections.

E. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Tin-plated aluminum, Hard-drawn copper, 98 percent conductivity per drawings.
2. Main and Neutral Lugs: Compression or Mechanical type.
3. Ground Lugs and Bus-Configured Terminators: Compression or Mechanical type.
4. Feed-Through Lugs: Compression or Mechanical type, suitable for use with a conductor material. Locate at the opposite end of the bus from incoming lugs or main device.
5. Subfeed (Double) Lugs: Compression or Mechanical type suitable for use with a conductor material. Locate at the same end of the bus as incoming lugs or main device.
6. Gutter-Tap Lugs: Compression or Mechanical type suitable for use with a conductor material. Locate at the same end of the bus as incoming lugs or main device.
7. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on the extra-capacity neutral bus.

F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.

G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 DISTRIBUTION PANELBOARDS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, power and feeder distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.

D. Mains: Circuit breaker or Fused switch or Lugs only per drawings.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where the individual positive-locking device requires a mechanical release for removal.

G. Branch Overcurrent Protective Devices: Fused switches.

H. Contactors in Main Bus: NEMA ICS 2, Class A, electrically or mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.

1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to the main bus ahead of contactor connection.
2. External Control-Power Source: per manufacturer.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker or lugs only per drawings.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Contactors in Main Bus: NEMA ICS 2, Class A, electrically or mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.

1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to the main bus ahead of contactor connection.
2. External Control-Power Source: per manufacturer.

F. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

G. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with the ground and neutral terminal buses.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with the front-mounted, field-adjustable trip setting.
3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
   a. Instantaneous trip.
   b. Long- and short-time pickup levels.

c. Long- and short-time time adjustments.
d. Ground-fault pickup level, time delay, and I2t response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
   Standard frame sizes, trip ratings, and a number of poles.
9. Lugs: Compression or Mechanical style, suitable for number, size, trip ratings, and conductor materials.
10. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
11. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
12. Communication Capability: Integral communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."
13. Shunt Trip: per manufacturer trip coil energized from the separate circuit, set to trip at 75 percent of rated voltage.
14. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
15. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
16. Alarm Switch: Single-pole, normally open contact that actuates only when a circuit breaker trips.
17. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when the circuit breaker is in off position.
18. Zone-Selective Interlocking: Integral with the electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
19. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
20. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
21. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

1. Fuses, and Spare-Fuse Cabinet: Comply with requirements specified in Division 26 Section "Fuses."
2. Fused Switch Features and Accessories: Standard ampere ratings and number of poles.
3. Auxiliary Contacts: Two normally open and normally closed contact(s) that operate with switch handle operation.

2.5 PANELBOARD SUPPRESSORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Current Technology; a subsidiary of Danahar Corporation.
2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
4. Liebert Corporation.
5. Siemens Energy & Automation, Inc.
6. Square D; a brand of Schneider Electric.

B. Surge Protection Device: IEEE C62.41-compliant, integrally mounted, plug-in or wired-in, solid-state, parallel-connected, modular (with field-replaceable modules) type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the panelboard short-circuit rating, and with the following features and accessories:

1. Accessories:
   a. Fuses rated at 200-kA interrupting capacity.
   b. Fabrication using bolted compression lugs for internal wiring.
   c. Integral disconnect switch.
   d. Redundant suppression circuits.
   e. Redundant replaceable modules.
   f. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
   g. LED indicator lights for power and protection status.
   h. Audible alarm, with silencing switch, to indicate when protection has failed.
   i. Form-C contacts rated at 5 A and 250-V-AC, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on the failure of any surge diversion module or on the opening of any current-limiting device. Coordinate with building power monitoring and control system.
   j. Four-digit, transient-event counter set to totalize transient surges.
2. Peak Single-Impulse Surge Current Rating: 160 kA per mode/320 kA per phase.
3. Minimum single-impulse current ratings, using 8-by-20-mic.sec. waveform described in IEEE C62.41.2.
   a. Line to Neutral: 70,000A.
   b. Line to Ground: 70,000A.
   c. Neutral to Ground: 50,000A.
4. Withstand Capabilities: 12,000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.
5. Protection modes and UL 1449 SVR for grounded wye circuits with 480Y/277, 208Y/120, 600Y/347-V, three-phase, four-wire circuits shall be as follows:
   Line to Neutral: 800 V for 480Y/277, 400 V for 208Y/120, 1200 V for 600Y/347.
   Line to Ground: 800 V for 480Y/277, 400 V for 208Y/120, 1200 V for 600Y/347.
   Neutral to Ground: 800 V for 480Y/277, 400 V for 208Y/120, 1200 V for 600Y/347.
6. Protection modes and UL 1449 SVR for 240/120-V, single-phase, three-wire circuits shall be as follows:
   a. Line to Neutral: 400 V.
   b. Line to Ground: 400 V.
   c. Neutral to Ground: 400 V.

7. Protection modes and UL 1449 SVR for 240/120-V, three-phase, four-wire circuits with high leg shall be as follows:
    a. Line to Neutral: 400 V, 800 V from the high leg.
    b. Line to Ground: 400 V.
    c. Neutral to Ground: 400 V.
8. Protection modes and UL 1449 SVR for 240-, 480-, or 600-V, three-phase, three-wire, delta circuits shall be as follows:
    a. Line to Line: 2000 V for 480 V, 1000 V for 240 V, 2500 V for 600 V.
    b. Line to Ground: 1500 V for 480 V, 800 V for 240 V, 2500 V for 600 V.

2.6 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NECA 407 and NEMA PB 1.1.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting the performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install panelboards and accessories according to NECA 407 and NEMA PB 1.1.

B. Equipment Mounting: Install panelboards on concrete bases, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete and/or Miscellaneous Cast-in-Place Concrete."

1. Install dowel rods to connect the concrete base to the concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
2. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into the structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to panelboards.
5. Attach panelboard to the vertical finished or structural surface behind the panelboard.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

D. Comply with mounting and anchoring requirements.

E. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.

F. Mount panelboard cabinet plumb and rigid without distortion of the box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

G. Install overcurrent protective devices and controllers not already factory installed. Set field-adjustable, circuit-breaker trip ranges.

H. Install filler plates in unused spaces.

I. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.

J. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

K. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and a control circuit.
2. Test continuity of each circuit.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:
    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to the portable scanner.
    b. Instruments and Equipment:
        1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

C. Panelboards will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by the manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as directed.

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during a period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at the time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.6 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to the manufacturer's written instructions.

END OF SECTION

SECTION 26 26 00

POWER DISTRIBUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes project specific utility responsibilities and requirements.

B. Cost associated with utility related work will be part of contractor's requirements.

1.3 DEFINITIONS

A. Utility-SCE (Southern California Edison), Tulare Planning Office, Josh Caldwell – Planning Specialist 559-685-3714.

B. Email: Joshua.Caldwell@sce.com

1.4 ACTION SUBMITTALS

A. Submit all data per 01 33 00.

B. Timing schedules and critical items to identify work required from contractor and SCE to minimize system shutdown time.

C. Copies of all correspondence with SCE.

1.5 COORDINATION

A. Coordinate any power disruption 2 weeks in advance. Provide notice in writing to the contracting officer.

B. Coordinate revision of the existing utility power scheme at Buckeye from the existing open delta system to a closed delta system.

C. Provide Metering enclosure equipment approved by the serving utility.

PART 2 – PRODUCTS

2.1 EQUIPMENT FOR UTILITY COMPANY ELECTRICITY METERING

A. Only meters will be furnished by utility company.

B. All other products and materials are to be furnished by contractor.

C. Meter Sockets: Comply with requirements of electrical-power utility company.

D. Housing: NEMA 250, Type 3R enclosure.

E. Minimum Short-Circuit Rating: 65,000 A symmetrical at rated voltage.

F. Comply with NFPA 70.

G. CONDUIT

1. Schedule 80 PVC
   a. See Specification section 26 05 33 for additional info.

2.2 GENERAL REQUIREMENTS FOR METERING AND DISTRIBUTION EQUIPMENT

A. Copper bussing.

B. Enclosures:

1. Rated for environmental conditions at installed location.
2. Outdoor Locations: NEMA 250, Type 3R.

C. Directory Card: Inside door, mounted in transparent card holder.

D. Conductor Connectors: Suitable for use with conductor material and sizes.

E. Main and Neutral Lugs: Mechanical type.

F. Ground Lugs and Bus Configured Terminators: Mechanical type.

G. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

H. Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Provide new meter/main at Ash Mountain WWTP Sprayfield Pump House. Meter enclosure is to meet SCE requirements.

B. Utility to provide service meter.

C. Ground and bond as per NEC Art. 250.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Snap switches and wall-box dimmers.
3. Cord and plug sets.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. TVSS: Transient voltage surge suppressor.

F. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: List of legends and description of materials and process used for pre-marking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for the intended use.

C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

2.3 GFCI RECEPTACLES

A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when the device is tripped.

B. Provide weather resistant devices.

C. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

2. Products: Subject to compliance with requirements, provide one of the following:
    a. Cooper; GF20.
    b. Pass & Seymour; 2084.
    c. Leviton.

2.4 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
    a. Cooper; L520R.
    b. Hubbell; HBL2310.
    c. Leviton; 2310.
    d. Pass & Seymour; L520-R.

B. 50A generator power inlet receptacle. Comply with UL/CSA.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
    a. Milbank mmtsinlet50
    b. Reliance PB50
    c. Generac 6347
2. NEMA 3R enclosure
3. 50A, 125/250V, 3P4W (2 hot, 1 neutral, 1 gnd) Power Inlet

2.5 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Smooth, high-impact thermoplastic 0.035-inch

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, in-use, die-cast aluminum with lockable cover.

2.6 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.

1. Wiring Devices Connected to Normal Power System: As selected by the contracting officer unless otherwise indicated or required by NFPA 70 or device listing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:

1. Take steps to ensure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from the stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
    a. Cut back and pigtail, or replace all damaged conductors.
    b. Straighten conductors that remain and remove corrosion and foreign matter.
    c. Pigtailing existing conductors are permitted provided the outlet box is large enough.

D. Device Installation:

1. Replace all devices that have been in temporary use during the construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around the terminal screw.
6. Use a torque screwdriver when torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the left.
2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.

H. Adjust locations of floor service outlets and service poles to suit the arrangement of partitions and furnishings.

3.2 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on the face of the plate, and durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

A. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.

END OF SECTION

SECTION 26 28 13

FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cartridge fuses rated six hundred (600) V-AC and less for use in enclosed switches.
2. Plug-fuse adapters for use in Edison-base, plug-fuse sockets.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide a list of fuses with adjusted ratings.
   a. For each fuse having adjusted ratings, include the location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
   b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
3. Current-limitation curves for fuses with current-limiting characteristics.
4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of the fuse.
5. Coordination charts and tables and related data.

B. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation & Maintenance Data," include the following:

1. Ambient temperature adjustment information.
2. Current-limitation curves for fuses with current-limiting characteristics.
3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of the fuse.
4. Coordination charts and tables and related data.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from a single source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Comply with UL 248-11 for plug fuses.

1.5 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than forty degrees F (40°F) or more than one hundred degrees F (100°F), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.6 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

1.7 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: One for each size and type.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Bussmann, Inc.
2. Edison Fuse, Inc.
3. Ferraz Shawmut, Inc.
4. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

2.3 PLUG FUSES

A. Characteristics: UL 248-11, nonrenewable plug fuses; 125-V-AC.

2.4 PLUG-FUSE ADAPTERS

A. Characteristics: Adapters for using Type S, rejection-base plug fuses in Edison-base fuseholders or sockets; ampere ratings matching fuse ratings; irremovable once installed.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine the utilization of equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing the fuse.

B. Install plug-fuse adapters in Edison-base fuseholders and sockets. Ensure that adapters are irremovable once installed.

3.3 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on the inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION

SECTION 26 28 16

ENCLOSED SWITCHES & CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Non-fusible switches.
3. Receptacle switches.
4. Shunt trip switches.
5. Molded-case circuit breakers (MCCBs).
6. Molded-case switches.
7. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Include evidence of NRTL listing for a series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

C. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation & Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within the same product category, from a single source from a single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus twenty-two degrees F (-22°F) and not exceeding one hundred-four degrees F (104°F)
2. Altitude: Not exceeding two thousand five hundred (2,500) feet.

B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Contracting Officer no fewer than seven days in advance of proposed interruption of electric service.
2. Indicate the method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Contracting Officer's written permission.
4. Comply with NFPA 70E.

1.7 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.8 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: One for each size and type.
2. Fuse Pullers: One for each size and type.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Square D; a brand of Schneider Electric or approved equal.

B. Type HD, Heavy Duty, Single Throw, 240-V-AC, 800 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with cartridge fuse interiors to accommodate indicated fuses, lockable handle with the capability to accept two padlocks, and interlocked with cover in the closed position.

C. Type HD, Heavy Duty, Single Throw, 600-V-AC, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with the capability to accept three padlocks, and interlocked with cover in the closed position.

D. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.2 NONFUSIBLE AND MANUAL SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 600-V-AC, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with the capability to accept three padlocks, and interlocked with cover in the closed position.

C. Type HD, Heavy Duty, Double Pole, Double Throw, 240 V-AC, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, designed for manual transfer of loads from one supply to another, lockable handle with the capability to accept three padlocks, and interlocked with cover in the closed position.

D. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

2.3 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at the installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Wash-Down Areas: NEMA 250, Type 4X.
4. Corrosive or hazardous locations: NEMA 250, Type 4X.
5. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
6. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Non-corrosive Liquids. NEMA 250, Type 12.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting the performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration & Seismic Controls for Electrical Systems."

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by the manufacturer.

END OF SECTION

SECTION 26 29 13

ENCLOSED MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. The Conditions of the Contract and applicable requirements of Division 01 and Section 26 00 00, “Electrical General Requirements,” govern this Section.

1.2 DESCRIPTION OF WORK:

A. Work Included: The extent of motor starter work is as shown and scheduled, as indicated by the requirements of this Section, and as specified elsewhere in these Specifications.

B. Types: The types of motor starters required for the project include, but are not limited to, the following:

1. Individual motor starters.
2. Combination motor starters.
3. Manual motor starters.

1.3 STANDARDS:

A. Products shall be designed, manufactured, tested, and installed in compliance with the following standards:

1. NEMA ICS 2 Industrial Control Devices, Controllers, and Assemblies.
2. NEMA KS 1 Enclosed Switches.

1.4 QUALITY ASSURANCE:

A. Manufacturers: Provide products complying with these specifications and produced by one of the following:

1. Allen-Bradley.
2. Cutler-Hammer, Inc.
3. General Electric Company.
4. Square D Company.
5. Siemens.

B. UL Listing: Motor starters shall conform to all applicable UL Standards and shall be UL-listed.

1.5 SUBMITTALS:

A. Shop drawing submittals shall include, but not be limited to, the following:

1. Cut sheets of individual and combination motor starters with construction, ratings, voltage, poles, and all associated accessories clearly indicated.

2. Cut sheets of manual motor starters with ratings, voltage, poles, and all associated accessories clearly indicated.

3. Cut sheets of manual motor disconnect switches with ratings, voltage, poles, and all associated accessories clearly indicated.

4. Additional information as required in Section 26 00 00, “Electrical General Requirements”.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Store motor starters in a clean, dry space. Maintain factory-wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle motor starters carefully to avoid damage to material components, enclosure and finish.

PART 2 - PRODUCTS

2.1 INDIVIDUAL MOTOR STARTERS:

A. General: Individual motor starters shall consist of an integrally mounted, magnetic, full-voltage,non-reversing (FVNR), 2-speed - 1-winding (2S-1W), or 2-speed - 2-winding (2S-2W) starter in a heavy-duty type, dead front, sheet steel enclosure and shall be surface- mounted. Size and number of poles shall be as shown and required by equipment served. All starters shall be constructed and tested in accordance with the latest NEMA standards and shall be NEMA standard sizes. IEC sizes are not acceptable. All starters shall contain 480V – 120V control transformer.

B. Contacts: Magnetic starter contacts shall be solid silver cadmium oxide alloy and shall not require any filing, dressing or cleaning throughout the life of the starter.

C. Operating Coils: Operating coils shall be 120 volts and shall be pressure molded and designed so that accidental exposure to excessive voltage up to 480 volts will not damage the coil. The starter design shall also be such that when a coil fails due to an overvoltage condition, the starter shall definitely open and shall not freeze in the closed position.

D. Overload Relays: [All starters shall have user selectable class 10/20/30 solid state overload relays. Overload relays shall have visual trip indication, be ambient insensitive within an operating temperature range to minus 20 and to plus 70 degrees Celsius. They shall provide built in thermal memory to prevent hot motor restarts. Relays shall provide protection against phase current loss, and phase current unbalance, adjustable from 20 to 50 percent for all 3 phases. Relay shall have adjustable full load current dial. They shall have a reset mechanism that resets on the upstroke only. OR They shall have remote reset capability.]

E. Pilot Lights: Provide red RUNNING pilot lights for all motor starters. Furnish additional pilot Lights for motor starters as shown. Provide amber FAST and green SLOW pilot lights for all two speed starters. Pilot lights shall be mounted in the starter enclosure cover. Pilot lights shall be operated from an interlock on the motor starter and shall not be wired across the operating coil. Pilot lights shall be LED type.

F. Controls: Provide starters with HAND-OFF-AUTOMATIC switches, or START-STOP pushbuttons as shown or required. Provide for FAST-SLOW speed selection from HVAC control system

in the automatic position for all two speed starters. Provide two-speed starters with FAST-SLOW selector switches for manual speed selection in the HAND position. All two speed starters shall have deceleration relays between fast and slow speeds. Coordinate motor starter controls with the requirements of Division 22 & 26. Motor starter controls shall be mounted in the starter enclosure cover.

G. Control Power: A single-phase control power transformer shall be included integrally with each starter for 120 volt control power. The primary shall be connected to the line side of the motor starter and shall have both legs fused; the secondary shall have one leg fused and one leg grounded. Arrange transformer terminals so that wiring to terminals will not be located above the transformer.

H. Auxiliary Contacts: Each starter shall have a minimum of one normally open and one normally closed convertible auxiliary contact in addition to the number of contacts required for the "holding interlock". Provide additional contacts if required for control, interlock, and monitoring. In addition, it shall be possible to field-install one or more additional auxiliary contacts without removing existing wiring or removing the starter from its enclosure.

I. Unit Wiring: Unit shall be completely prewired to terminals to eliminate any interior field wiring except for:

1. Connection of power supply conductors to switch line side terminals.
2. Motor leads to the starter load side terminals.
3. Control conductors to holding coil terminals.

J. Enclosures: All motor starter enclosures shall be NEMA 3R, general purpose enclosures, unless shown otherwise.

2.2 COMBINATION MOTOR STARTERS:

A. General: Combination motor starters shall consist of an integrally mounted magnetic starter and a breaker type disconnect switch in a heavy-duty type, dead front, sheet steel NEMA 3R enclosure, surface mounted. Size and number of poles shall be as shown and required by equipment served. Combination motor starters shall be as specified for individual motor starters in Paragraph 2.1, except as modified herein.

B. Disconnect Switch: Disconnect switches shall be as specified in Section 262816, "Enclosed Switches and Circuit Breakers".

C. Unit Wiring: Unit shall be completely prewired to terminals to eliminate any interior field wiring except for:

1. Connection of power supply conductors to switch line side terminals.
2. Motor leads to the starter load side terminals.
3. Control conductors to holding coil terminals.

D. Enclosures: All combination motor starter enclosures shall be NEMA 3R, enclosures, unless shown otherwise.

2.3 MANUAL MOTOR STARTERS:

A. General: Manual motor starters shall consist of an integral starter and overload protection in a common enclosure, surface mounted. Size and number of poles shall be as shown and required by equipment served. Furnish pilot light as indicated.

B. Manual Motor Starter: Manual motor starter with overload protection, one horsepower maximum, 115 or 230 volts; Square D Class 2510 FG-1-(1) Pole, FG-2-(2) Pole; Square D Class 2510 FG-1P-(1) Pole with pilot light, and FG-2P-(2) Pole with pilot light.

C. Enclosures: All manual motor starter enclosures shall be NEMA 1, general purpose enclosures, unless shown otherwise.

D. Switch: For self-protected motors where a single pole toggle motor control switch is allowed, the switch shall be as specified for toggle switches in Section 26 27 26, "Wiring Devices".

PART 3 - EXECUTION

3.1 INSTALLATION OF MOTOR STARTERS:

A. General: Install motor starters where shown, in accordance with the manufacturer's written instructions, the applicable requirements of the NEC and the NECA's "Standard of Installation", and recognized industry practices to ensure that products serve the intended function. Major equipment motor starters located in mechanical rooms that are a part of the main building service shall be located so as to be accessible “within arm’s reach” without resort to a ladder.

B. [Overloads: Provide solid state adjustable overload relays in each motor starter. Ratings shall be set based on actual motor nameplate full load amps.]

C. Coordination: Motor starter controls shall be provided to properly coordinate with controls

D. Supports: Provide all individual and combination motor starters with galvanized angle or other suitable supports where mounting on wall or other rigid surface is impractical. Starters shall not be supported by conduit alone. Where motor starters are mounted on equipment served, the switch shall not inhibit removal of any service panels or interfere with any required access areas. All motor starters shall be installed plumb and aligned in the plane of the wall in/on which they are installed.

3.2 TESTING:

A. Pre-energization Check: Check motor starters for continuity of circuits, short circuits, presents of foreign material, and remedy prior to energizing.

B. Post Hookup Test: Subsequent to wire and cable hook-ups, energize motor starter and demonstrate satisfactory functioning.

C. Motor-starter Coordination Documentation: Provide motor-starter coordination documents including, but not limited to, the following information in the operation and maintenance manuals.

1. Motor size in horsepower.
2. Motor full load amps.
3. Motor efficiency.
4. Motor service factor.
5. Size and manufacturer's catalog number of starter and thermal overloads.

D. Motor Rotation: Verify that motor rotation is correct as connected. Where rotation must be changed, reconnect phase conductors to motor leads at motor junction box.

3.3 IDENTIFICATION:

A. Refer to Section 26 05 53, “Identification for Electrical Systems”, for painting and nameplate requirements for all motor starters.

B. Every starter shall have an internal wiring diagram on the inside of the starter cover and shall be labeled inside the cover to indicate the type and ampacity of thermal overloads installed.

END OF SECTION

SECTION 26 32 13

PACKAGED ENGINE GENERATOR SYSTEMS – PROPANE

PART 1 – GENERAL

1.1 SCOPE

A. This section includes packaged engine-generator sets using propane engine generator systems that include but are not limited to engine generator set, cooling system, combustion air intake and engine exhaust systems, starting system, enclosure, and the additional features specified.

B. It is the intent of this specification to define a propane engine generator set that will carry all loads from the Ash Mountain WWTP in a single step. See drawings for the panelboard schedule.

C. The generator set installation and related work shall conform to the requirements of all applicable specification sections and drawings issued as a part of the overall project construction contract.

1.2 REFERENCE SPECIFICATIONS

A. Section 26 00 00 Electrical General Requirements.

B. See Section 26 36 23 "Automatic Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

C. See Section 23 11 26 Facility Liquified Petroleum Gas Piping for propane tank, piping, and vaporizer.

1.3 REFERENCES CODES AND STANDARDS

A. The generator set shall conform to the requirements of the following codes and standards for the editions currently in effect:

1. EN50082-2, Electromagnetic Compatibility-Generic Immunity Requirements, Part 2: Industrial.
2. EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.
3. IEC8528 part 4, Control Systems for Generator Sets.
4. IEC Std 61000-2 and 61000-3 for susceptibility, 61000-6 radiated and conducted electromagnetic emissions.
5. IEEE446 Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.

6. NFPA 70, National Electrical Code, Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.
7. NFPA 110, Emergency and Standby Power Systems. The generator set shall meet all requirements for Level 1 systems. Level 1 prototype tests required by this standard shall have been performed on a complete and functional unit. Component level type tests will not substitute for this requirement.
8. UL2200 Standard for Safety: Stationary Engine Generator Assemblies.

1.4 DEFINITIONS

A. Emergency or Standby Rating: Power output rating equal to the power the generator set delivers continuously under normally varying load factors for the duration of a power outage, with capability for 100% rated load for the duration of the power outage.

B. Operational Bandwidth: The total variation from the lowest to the highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

C. Power Output Rating: Gross electrical power output of generator set minus total power requirements of electric motor-driven accessories normally constituting part of the engine assembly.

D. Steady-State Voltage Modulation: The uniform cyclical variation of voltage within the operational bandwidth, expressed in Hz or cycles per second.

1.5 SYSTEM DESCRIPTION

A. System Includes: Standby-rated, automatically started propane engine mechanically coupled to an a.c. generator unit. A vaporizer unit will be provided as part of the system, which may be located external to the generator assembly if required. Engine and generator shall be factory-mounted and aligned on a structural steel skid. Subsystems and auxiliary components and equipment shall be as indicated or specified. Provide all labor, materials, and equipment to furnish, install, and place in operation the power generation system in accordance with the contract documents and manufacturer's drawings and installation instructions. These specifications also describe requirements for the design, fabrication, and testing of the power system. The installation of the power generation system shall include the following:

1. Engine-driven generator set
2. Control system
3. Cooling system
4. Fuel supply and storage system
5. Generator set accessories.
6. Mounting system
7. Operation and Interface controls, including control and monitoring panel.

B. Functional Description: When the mode selector switch on the control and monitoring panel is in the "automatic" position, remote control contacts in an automatic transfer switch initiates the starting and stopping of the generator set. When the mode selector switch is placed in the "on" position, the generator set shall start manually. The "off" position of the same switch shall initiate shutdown of the generator set. When the unit is running, specified system or equipment failures or derangements shall automatically shut the unit down and initiate alarms. Operation of a remote emergency stop switch shall also shut down the unit. Contractor to propose a location for the remote emergency stop switch. Location shall be approved by Contracting Officer.

C. The engine-generator and related work shall be provided as a complete and operable system, in full compliance with all requirements on the drawings and all specifications requirements. The contractor shall provide all work required to comply with the drawings and specifications, even if not explicitly indicated or specified. The contractor shall be responsible for coordinating installation of the engine-generator system with all field conditions and the work of other trades. Minimum clearances and work required for compliance with NFPA 70 "National Electrical Code" and the manufacturer's instructions shall be provided.

D. All equipment shall be new and of current production by an international, power system manufacturer of generators, transfer switches, and paralleling switchgear. The manufacturer shall be a supplier of a complete and coordinated system. There will be single-source responsibility for warranty, parts, and service through a factory-authorized representative with factory-trained technicians. The power system shall be furnished by a single manufacturer who shall be responsible for the design, coordination, and testing of the complete system. The entire system shall be installed as shown on the plans, drawings, and specifications herein. The equipment shall be produced by a manufacturer who is ISO 9001 certified for the design, development, production, and service of its complete product line. The power system shall be produced by a manufacturer who has produced this type of equipment for a period of at least ten (10) years and who maintains a service organization available twenty-four hours a day throughout the year. System manufacturer shall maintain a service center capable of providing training, parts, and emergency maintenance and repairs at the Project site with two (2) hours maximum response time.

1.6 SUBMITTALS

A. Initial Submittals

1. Submit per Sections 01 33 23 and 26 00 00.
2. General: Unless specified otherwise, the contractor shall submit the following documentation:
3. Product data for products specified in this Section. Include data on features, performance, components, and ratings, including KW, KVA, starting KVA, and voltage dip curves. Include dimensioned outline plan and elevation drawings of engine generator set and other system components. Submit certified total harmonic current distortion ratings for voltage regulators.
    a. Provide individual cut sheets for all system components.

4. Shop Drawings: Include general arrangement drawings showing locations of auxiliary components in relation to the engine generator set and duct, piping, and wiring connections between the generator set and the auxiliary equipment. Include skid mounting pattern, associated dimensions, and minimum concrete pad design details. Show connections, mounting, and support provisions and access and working space requirements. Show plan view and elevations of sides and ends of generator system.
5. Computer calculations by generator manufacturer to verify proposed generator and engine ratings for compliance with specified/indicated ratings and applied loads indicated in the generator load schedule. Frequency and voltage dip on a step load shall be computed and provided to Contracting Officer.
6. Qualification Data for Manufacturer: Include capabilities and experience data required to demonstrate qualifications specified in Quality Assurance Article. Include list of three completed projects with equipment like the system specified herein, with project names and addresses and names of Engineers and Owners, plus other information specified.
7. Location of local service shop with parts to meet requirements in 1.05.B.

B. Within Sixty (60) days of Notice to Proceed

1. Coordination and installation layout drawings shall be submitted for approval.
2. The purpose of the submittals specified herein is not only to show compliance with the requirements, but is also for future identification, replacement, duplication, and servicing.
3. The work described in all submittals shall be carefully checked by the contractor and proposed equipment manufacturer for all clearances, including those required for maintenance and servicing, field conditions, maintenance of architectural conditions, and proper coordination. Each submittal shall include a certification by the contractor and proposed equipment manufacturer that all related conditions have been checked and that no conflict exists. No submittal will be reviewed without such certification.
4. Based on equipment drawings and diagrams provided by the Supplier as a part of project submittals, the Contractor shall prepare field wiring diagrams and revised layout drawings for the generator set equipment, automatic transfer switches, and related equipment. Layout drawings will verify equipment locations, conduit and wiring provisions, and space allocated for maintenance and service. Layout drawings will indicate code-required clearances and manufacturer-recommended clearances around all equipment.
    a. Layout drawings will verify equipment locations, conduit and wiring provisions, and space allocated for maintenance and service. Layout drawings will indicate code-required clearances and manufacturer-recommended clearances around all equipment. Not all required conduits or devices are shown on contract drawings.
    b. The contractor shall integrate generator, generator controls, fuel tank and controls and Automatic transfers switch and supply complete proposed dimensioned shop drawing of the entire generator and fuel supply system and all electrical conduits and devices required for a complete system.

C. Initial Submittals

1. Compliance Certification: Submit a letter, signed and on OEM letter head, stating that the requirements of this contract have been reviewed and the Generator to be supplied meets all requirements and specifications. Make note of any non-compliance or substitutions made as part of this equipment supply in this letter. Any deviations and alternates to the specifications and drawings shall be fully described in attached documentation as to what the contractor and manufacturer propose to provide. Approval of deviations will remain within the sole discretion of the CO. If proposed deviations or alternates are disapproved, the contractor shall provide equipment and materials in full compliance with the specifications, at no additional cost and without schedule extension.
2. Seismic Design and Testing Certificate: Document compliance with all specification and applicable building code requirements for equipment seismic design and testing.
3. EPA: Document compliance with all specification and applicable building code requirements for equipment emissions.
4. Schematic and Wiring Diagrams for System: Show power and control connections schematics and physical wiring diagrams and distinguish between factory-installed and field-installed wiring.
    a. Provide wire numbers on both schematic and wiring diagrams for all conductors. Install wire numbers on all conductors to match schematics and wiring diagrams.

D. Prior to OEM Delivery

1. Provide two weeks' notice to the CO of factory testing. The Government may witness these tests at factory.
2. Factory Test Reports: For units to be shipped for this Project showing evidence of compliance with specified requirements. (i.e. full load power test at specified rating)
3. Exhaust Emissions Test Report, where required by federal, state, or local regulations.
4. Certification of Torsional Vibration Compatibility: Conform to NFPA 110.

E. Closeout

1. Submit as a part of project closeout documentation O&M operation and maintenance data for system and components for inclusion in Operating and Maintenance Manual specified in Division 1 of the construction contract. Include all features and operating sequences, both automatic and manual. List all factory settings of relays and provide relay setting and calibration instructions. Include detailed operating instructions. Cover operation under both normal and abnormal conditions.
    a. See part 3 Execution for additional O&M manual's requirements.
2. After completion of field testing, submit field test report as a record of tests specified in Part 3.
3. Deliver all inventoried spare parts in original enclosures to CO. Provide a summary list of all materials.

F. Submittal Submission Schedule: All drawings, etc., shall be submitted sufficiently in advance of field requirements to allow ample time for checking, and no claim for extension of contract time will be granted to Supplier or Contractor, by reason of his failure in this respect. All submittals shall be complete and shall contain all required and detailed information. Submittals with multiple parts shall be submitted as a complete package.

G. Use approved submittal data and provide a proposed layout for all conduits and piping to be brought into the generator enclosure. Provide a shop drawing to show proposed conduit and piping layouts. Provide both a scaled PDF and DWG drawings showing the proposed layout.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Refer to requirements specified above in paragraph “System Description”.

B. Field-Testing Organization Qualifications: To qualify for acceptance, a testing organization must demonstrate, based on evaluation of organization-submitted criteria conforming to ASTM E 699, that it has the experience and capability to conduct the indicated testing satisfactorily.

C. Comply with NFPA 70, "National Electrical Code."

D. Comply with NFPA 110, "Standard for Emergency and Standby Power Systems," for requirements for a Level 1 emergency power supply system.

E. Listing and labeling: Electrical equipment shall be listed and labeled by Underwriter’s Laboratories (UL), or another nationally recognized testing laboratory (NRTL). All equipment, materials, and devices required to comply with referenced UL standards shall bear labeling from the NRTL to verify compliance. Engine-generator sets shall be listed and labeled to UL 2200.

F. The Terms "Listed" and "Labeled": As defined in the "National Electrical Code," Article 100.

G. Engine Exhaust Emissions: Comply with applicable Federal, State, and local government requirements.

H. Single-Source Responsibility: Obtain engine generator system components from a single manufacturer with responsibility for entire system. Unit shall be a representative product built from components that have proven compatibility and reliability and are coordinated to operate as a unit as evidenced by records of prototype testing.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Supplier shall deliver engine generator set and system components to their final locations in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is made safe from such hazards. Supplier is responsible for transportation of equipment to the project site unloading area designated by the Owner’s Representative. Contractor is responsible for unloading of all equipment and provisions for safe and protected storage at the project site until equipment is installed by the Contractor.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with this specification, generators shall be from one of the manufacturers listed below:

B. Generac – Basis of Design

C. Alternate manufacturers or approved equal:

1. Cummins
2. Caterpillar
3. Kohler

D. Note: Listing of a manufacturer above does not commit the Government to accepting any proposals from a manufacturer listed. All proposals must include the submittal data listed in paragraph “Submittals” specified hereinbefore.

2.2 SYSTEM SERVICE CONDITIONS

A. Service Conditions: Engine generator system shall operate within the following service conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: Minus 20 degrees F to plus 104 degrees F.
2. Relative Humidity: 0 to 95 percent.
3. Altitude: 1400 to 1600 feet above sea level
4. Fuel Type: Propane.
5. Installation Location: Exterior location within a weatherproof enclosure. Enclosure to be provided by contractor as part of generator system.

2.3 ENGINE GENERATOR SYSTEM

A. General: System shall be a coordinated assembly of compatible components.

B. Ratings: Voltage, frequency, and power output ratings of the system shall be as indicated on the Engine-Generator Set Load Schedule.

C. Output Connections: As indicated.

D. Safety Standard: Comply with ASME B15.1, "Safety Standard for Mechanical Power Transmission Apparatus."

E. Nameplates: Each major system component shall be equipped with a conspicuous nameplate of the component manufacturer. Nameplate shall identify manufacturer of origin and address, and the model and serial number of the item. Provide all electrical characteristics on nameplate.

F. Manufacturer: The engine-generator set along with all major items of auxiliary equipment shall be manufactured by a manufacturer currently engaged in the production of such equipment. The unit shall be factory-assembled and factory-tested before being shipped to the job site.

G. Local Service and Maintenance: The engine-generator and automatic transfer switch manufacturer shall maintain a local service shop with an adequate stock of spare parts and trained mechanics within 100 miles of the site. Provide location certification with initial submittals.

1. Identify local service and maintenance capability to meet this requirement in initial submittals.

H. Responsibility: The engine-generator set and its associated equipment shall be assembled, tested, and shipped by one manufacturer who shall accept full responsibility for the quality and performance of all components.

2.4 SYSTEM PERFORMANCE

A. Steady-State Voltage Operational Bandwidth: 0.5 percent of rated output voltage from no load to full load.

B. Steady-State Frequency Modulation: Less than 1 Hz.

C. Transient Voltage Performance: Not more than 15 percent variation for 100 percent step-load increase or decrease. Voltage shall recover to +/-0.5% of rated voltage within 1 second.

D. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.

E. Steady-State Frequency Stability: When the system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no regular or cyclical hunting or surging of speed.

F. Transient Frequency Performance: No more than 3 Hz variations for a 50 percent step-load increase or decrease. Frequency shall recover to remain within the steady-state operating band within 3 seconds.

G. Output Waveform: At no load, the harmonic content measured line-to-line or line-to-neutral shall not exceed 5 percent total and 3 percent for single harmonics. The telephone influence factor determined according to NEMA MG1, "Motors and Generators," shall not exceed 50.

H. Sustained Short-Circuit and Overload Current: For a bolted short circuit at the system output terminals, the generator shall supply a minimum of 200 percent of rated full-load current for not less than 5 seconds and then clear the fault automatically, without damage to any generator system component. The generator shall sustain 150% of continuous load current for 2 minutes with field set for rated load excitation. Generator shall be equipped with a properly rated circuit breaker.

I. Temperature Rise of Generator: Within acceptable limits for insulation systems used according to NEMA MG1 when operating continuously at standby rating conditions.

J. Nonlinear Load Performance: System performance shall not be degraded from that specified in this Article by operation with the non-linear loads specified hereinafter.

K. Starting Time: Maximum total time for a cold start, with ambient temperature at the low end of the specified range, shall be 10 seconds. Time period includes output voltage and frequency settlement within specified steady-state bands, and load acceptance.

L. Generator Circuit Breaker: Ratings and features shall be as specified below in the generator load schedule, unless recommended otherwise by the generator manufacturer as a part of submittals and approved in writing by the Owner's Representative. All circuit breakers indicated to be provided with the generator set shall be enclosed within the generator housing, either group mounted or provided in a panelboard assembly. Mounting method shall isolate the control panel from generator set vibration.

1. Provide a factory installed, 100% rated circuit breakers that are UL489 listed. Circuit breakers shall be sized for the rated ampacity of the loads served by the breaker per the NEC. Circuit breakers shall be provided for:
   a. Generator output line breaker (to ATS)
   b. Generator output load bank breaker.
   c. Breakers shall be located on generator assembly and shown on submittal documents.
   d. Provide on all breakers key interlocks with keying to prevent both line and load bank breakers to be closed at the same time.
2. The circuit breaker(s) shall incorporate an electronic trip device with the following characteristics:
   a. Adjustable long time delay
   b. Adjustable short time delay
   c. Instantaneous trip
3. Load side lugs shall be provided from the factory. The line circuit breaker shall include auxiliary contacts, shunt trip, undervoltage trip, alarm switch, and overcurrent switch functionality. Load side breaker connections made at the factory shall be separated from field connections.
4. The shunt trip device shall be connected to trip the generator breaker when the generator-set is shut down by other protective devices.
5. When GFI is required per the NEC, additional neutrals shall be factory installed, and the alarm indication shall be integrated with the generator-set alarms.
6. Barriers to provide segregation of wiring from an emergency source to emergency loads from all other wiring and equipment, if required by the NEC, shall be provided.

M. Load Schedule: As specified in paragraph "Submittals" in this section, submit computer calculations by the generator set manufacturer to verify compliance with the following ratings:

1. Basis of Design: 208/120V, 3 Phase, 4 wire, and will be 40kW in size.
2. Verify generator size with loads, see below, for a 15% voltage dip at max load.
3. KW, KVA, starting KVA, and voltage dip performance specified for the load schedule specified below.

4. Engine-Generator ratings and generator reactance values shall be adequate to ensure satisfactory operation for the loads specified in the load schedule below, including motor loads indicated in the load schedule below.
5. Starting of motor loads shall be based on the following conditions:
    a. Motor windings to be at room temperature.
    b. Generator to be driven by a synchronous driver.
    c. Generator is to be hot, equivalent to the stabilized temperature band between the generator's 75% and 100% continuous load rating.
6. Minimum ratings – Refer to generator set load schedule below.
    a. 130°C alternator temperature rise rating while operating in the ambient conditions specified hereinbefore for standby duty.
    b. Engine brake horsepower shall be sufficient to deliver full rated generator set kW/kVA when operated at rated rpm and equipped with all engine-mounted parasitic and external loads such as radiator fans and power generators.
    c. Alternator pitch: 2/3 pitch, unless recommended otherwise by generator manufacturer and documented in equipment submittals.
    d. The engine shall be EPA certified from the factory.
    e. Motor starting performance and voltage dip determinations shall be based on the complete generator set. The generator set shall be capable of supplying 157 KVA minimum for starting motor loads with a maximum instantaneous voltage dip of 15%, as measured by a digital RMS transient recorder in accordance with IEEE Standard 115. Motor starting performance and voltage dip determination that does not account for all components affecting total voltage dip, i.e., engine, alternator, voltage regulator, and governor will not be acceptable. As such, the generator set shall be prototype tested to optimize and determine performance as a generator set system.
    f. Refer to the load schedule below as a basis for the computer calculations by generator manufacturer to verify proposed generator and engine ratings for compliance with specified/indicated ratings and applied loads indicated in the generator load schedule.

2.5 LOAD SCHEDULE & BASIS OF DESIGN GENERATOR PERFORMANCE

Generator and Load Summary

Selected Generator & Alternator

Product Family Method :	Manual
Product Family :	SG/MG Spark
Sizing Method :	Manual
Generator :	1 x 100 kW, 9L
Quantity :	1
Alternator :	K0130124Y21 - 130kW

Model
100 kW, 9L

100 kw, LP Vapor Genset -- Site rated 95 kw
9.0 L Engine with Upsized (K0130124Y21 - 130kW) Alternator

Load Level		Transients		Harmonics	
Running :	27 %	Fdip (Hz):	4.8	THVD Cont:	0.0 %
Peak :	58	Vdip (%):	14.1	THVD Peak :	0.0 %

Load Summary -- Connected Load of 25.19 kW

Running		Transients		Harmonics	
kW:	25.19	kW (Step):	62.2	kVA:	0
kVA:	28.2	kW (Peak):	62.2	THID Cont:	0%
PF:	0.89	kVA (Step):	156.7	THID Peak :	0%

Solution Limits

Max Loading :	80 %	Fdip (Hz):	5	THVD Cont:	11 %
		Vdip (%):	15	THVD Peak :	13 %

Load List		Starting		Running		Harmonic Current Distortion			Limits	
Sequence	Description	kW	kVA	kW	kVA	Peak	Cont.	kVA	Vdip	Fdip
Step 1 (Concurrent)	Resistive : Vaporizer 1 X 1.20 kVA @ 1.00 PF , Harmonics: THID = 0.00%	1.2	1.2	1.2	1.2	0 %	0 %	0	15.00 %	5 Hertz
Step 1 (Concurrent)	Resistive : Winding Heater 1 X 0.50 kW @ 1.00 PF , Harmonics: THID = 0.00%	0.5	0.5	0.5	0.5	0 %	0 %	0	15.00 %	5 Hertz
Step 1 (Concurrent)	Resistive : Resistive #1 1 X 5.00 kW @ 1.00 PF , Harmonics: THID = 0.00%	5	5	5	5	0 %	0 %	0	17.50 %	6 Hertz
Step 1 (Concurrent)	Fire Pump : Well Pump 1 X 20.00 HP Code J (7.5 kVA/Hp) Across the Line Rated torque at start running at 100% ,	55.5	150	18.49	21.5	0 %	0 %	0	17.50 %	5 Hertz
Step 1 (Concurrent) Summary	All loads on (sequence starting) 62.2kW All loads on (sequence starting) 62.2 kW Application Peak	62.2	156.7	25.19	28.2	0 %	0 %	0	15 % 36 volts	8.3 % 5 hertz

2.6 ENGINE GENERATOR SET

A. Power Output Rating: Nominal ratings as indicated, with capacity as required to operate as a unit as evidenced by records of prototype testing.

B. Mounting Base: The engine-generator manufacturer shall assemble the engine and generator to a common base. The generator set base shall be designed and built by the engine-generator manufacturer to resist deflection, maintain alignment, and minimize resonant linear vibration. Mounting base shall have adequate strength and rigidity to maintain alignment of mounted components without dependence on a concrete foundation. The base shall be constructed of formed steel "C" channel members with a minimum thickness of 0.25 inches. The base arrangement shall incorporate a common interior width for furnishing dedicated stub up areas for mechanical and electrical connections. Steel cross members shall support genset and add rigidity to base with vibration isolators installed between generator set and supports. The base shall have provisions at each corner for overhead lifting. End caps shall be added to the base for the overhead lifting. The base shall include an integral catch pan to prevent the escape of fluids from leaks and failures.

C. Provide vibration isolator to pad for generator set.

D. Rigging Diagram: Inscribed on a metal plate permanently attached to the skid. Diagram indicates location and lifting capacity of each lifting attachment and location of the center of gravity.

2.7 ENGINE

A. Comply with NFPA 37, "Stationary Combustion Engines and Gas Turbines."

B. Fuel: Propane vapor. Vaporizer to be provided as part of the generator package and installed adjacent to the generator.

C. Engine: 1800 rpm, 4 cycle. Provide adequate horsepower to supply running loads load and for maximum starting KVA with the specified maximum voltage dip. See basis on design above for loads.

D. Lubrication System: Includes but not limited to the following:

1. Oil Pump: The lubrication oil pump shall be a positive displacement type that is integral with the engine and driven from the engine crankshaft. The system shall incorporate full flow filtration with bypass valve to continue lubrication in the event of filter clogging.
2. Bypass Valve: The bypass valve shall be integral with the engine filter base or receptacle. Systems where bypass valves are in the replaceable oil filter are not acceptable. Pistons shall be oil cooled by continuous jet spray to the underside or inside of the crown and piston pin.
3. Filter and Strainer: Rated to remove 90 percent of particles 5 microns and smaller while passing full flow.
4. Oil Cooler: Maintains lubricating oil at the manufacturer's recommended optimum temperature.

5. Thermostatic Control Valve: Controls flow in the system to maintain optimum oil temperature. Unit shall be capable of full flow and shall be designed to be fail-safe.
6. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without the use of pumps or siphons or special tools or appliances.

E. Engine Fuel System: Comply with NFPA 58, "Liquified Petroleum Gas Code."

F. Jacket Coolant Heater: Electric immersion type, factory-installed in the jacket coolant system, and rated for the voltage provided in the circuit indicated. Unit shall be rated and thermostatically controlled to maintain an engine temperature of 78 degrees F at the low end of the ambient temperature range specified under "Environmental Conditions" above. Provide manual shutoff valves to isolate the heater during servicing. Provide a 120VAC coolant circulating pump and associated controls and circuitry to circulate coolant in engine block

G. Speed Governor: Adjustable isochronous electronic type, with speed sensing, providing 0.25% maximum steady-state frequency regulation.

H. Provide a 120VAC thermostatically controlled crankcase oil heater and a circuit from power
I. panel to power.

2.8 ENGINE COOLING SYSTEM

A. Description: Closed-loop, liquid-cooled, with radiator factory-mounted on engine generator set skid and integral engine-driven coolant pumping.

B. Radiator: Factory-piped and -rated for specified coolant.

1. Radiator Core Tubes: Nonferrous metal construction other than aluminum.
2. Size of Radiator: Adequate to contain expansion of total system coolant.
3. Fan: Driven by multiple belts from engine shaft.

C. Coolant: Solution of 50 percent ethylene glycol and 50 percent water.

D. Temperature Control: Self-contained thermostatic control valve shall modulate coolant flow automatically to maintain optimum constant coolant temperature as recommended by the engine manufacturer. Features shall include:
1. Thermostatic Elements: Interchangeable and nonadjustable.
2. Actuator Design: Normally open valves to return to open position when actuator fails.

E. Coolant Hose: Flexible assembly with nonporous rubber inside surface and aging, ultraviolet, and abrasion-resistant fabric outer covering.

1. Rating: 50 psi maximum working pressure with 180 deg F coolant, and non-collapsible under vacuum.
2. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

2.9 FUEL SUPPLY SYSTEM

A. Propane Tank:

1. Tank capacity shall supply fuel to the engine for an uninterrupted period of 48 hours operation at 80 percent of rated power output of the engine generator system without being refilled, with a minimum capacity of 500 gallons of liquid propane fuel.
2. Tank will bear their mark of UL Approval according to its classification.
3. Exterior Finish. The tank exterior finish shall be a polyurea-textured rubberized coating.

B. Vaporizer to be provided as part of the generator package and installed adjacent to the generator.

2.10 ENGINE EXHAUST SYSTEM

A. Muffler: Horizontal aluminized critical-type, sized as recommended by the engine manufacturer.

B. Connections from Engine to Exhaust System: Flexible section of corrugated stainless steel pipe.

1. Connection from Exhaust Pipe to Muffler: Stainless-steel expansion joint with liners.

C. Supports for Muffler and Exhaust Piping: Vibration isolating-type.

D. Discharge: Provide elbow and vertical riser, with hinged rain cap. Supports and bracing as recommended by the manufacturer.

2.11 COMBUSTION AIR-INTAKE SYSTEM

A. Air-Intake Silencer: Filter-type providing filtration as recommended by the engine manufacturer.

1. Mounting: Factory-installed on engine generator set at a location readily accessible for servicing.

B. Supports for Air-Intake Piping and Filter-Silencer: Vibration isolation-type as recommended by manufacturer.

2.12 STARTING SYSTEM

A. Description: 24 VDC electric starting system with negative ground, and including the following items:

1. Components: Rated so they will not be damaged during a full engine-cranking cycle with the ambient temperature at the maximum specified in paragraph "Environmental Conditions."

2. Cranking Motor: Heavy-duty 24-volt positive-engagement solenoid shift-starting motor that automatically engages and releases from the engine flywheel without binding.
3. Cranking Cycle: As required by NFPA 110 for system level specified.
4. Batteries shall comply with SAE J537, "Storage Batteries," and shall have adequate capacity within the ambient temperature range specified in paragraph "Environmental Conditions" to provide the specified cranking cycle series at least three times without recharging. Provide BCI group 31 batteries for all each generator which must meet the engine manufactures' specifications for the ambient conditions specified in “Project Conditions” and shall comply with the NFPA requirements for engine cranking cycles. Each battery shall be rated according to SAE Standards J-537 with a minimum cold cranking amp of 950 amps and a minimum reserve capacity of 185 Minutes at 80 degrees F. The battery plates shall be constructed of a calcium-lead alloy to provide long waterless operation and extended battery life. The battery elements must be anchor-locked with full-frame grids and tight-packed commercial plates to resist the effects of vibration. The battery must contain a handle to aid in lifting and the case must be constructed of polypropylene to resist breakage and extend service life. Removable cell covers shall be provided to allow for checking of electrolyte specific gravity.
5. Battery Cable: Size as recommended by the generator set manufacturer for the required cable length. Include required interconnecting conductors and connection accessories.
6. Battery Compartment: Factory-fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall maintain battery above 50 degrees F within range specified under "Environmental Conditions;" and shall shut off automatically when battery temperature reaches 70 degrees F. Include accessories required to support and fasten batteries in place.
7. Battery-Charging Alternator: Factory-mounted on engine with solid-state voltage-regulation and 35 ampere minimum continuous rating.
8. Battery Charger/Conditioner: Microprocessor control, Current limiting, automatic equalizing and float charging-type designed for operation 90% to 110% VAC 60 Hz of nominal source voltage. Unit shall comply with UL 1564, “Industrial Battery Chargers” and have EMI Compliance to FCC Part 15(B), Class B. In addition, the battery charger will include the following features:
    a. Operation: Equalizing charging rate of 8 amperes shall be initiated automatically after the battery has lost charge until an adjustable equalizing voltage is achieved at the battery terminals. The unit shall then automatically implement an automatic 3-stage float to equalization charge mode to switch to a lower float-charging mode and shall continue operating in that mode until the battery is discharged again.
    b. Automatic Temperature Compensation: Adjusts the float and equalizes voltages for variations in the ambient temperature from minus 40 degrees F to 140 degrees F to prevent overcharging at high temperatures and undercharging at low temperatures.
    c. Automatic Voltage Regulation: Voltage regulation of 1% from no to full load over 10% AC input line voltage variations.
    d. Ammeter and Voltmeter: Flush mounted in a location easy to read. Meters shall indicate charging rates.
    e. Safety Functions: Include sensing of abnormally low battery voltage arranged to close contacts providing "low battery voltage" indication on control and monitoring panel. Also provide sensing of high battery voltage and loss of a.c. input or d.c. output of battery charger. Either of these conditions shall close contacts that provide "battery charger malfunction" indication at system control and monitoring panel. Provide alarm circuit board with alarm contacts for low battery voltage, high battery voltage, and battery charger malfunction.

f. Enclosure and Mounting: NEMA Class 1, mounted within generator set enclosures.
g. Integral temperature-controlled cooling fan.

2.13 CONTROL AND MONITORING

A. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped on a common control and monitoring panel mounted on the generator set. These controls shall be enclosed with a lockable door for access.

B. Controller

1. Refer to paragraph “MANUFACTURERS’ for controller basis of design specification.
   a. The generator set controller shall be a microprocessor based control system that will provide automatic starting, system monitoring, and protection. The controller system shall also provide local monitoring and remote monitoring. The control system shall be capable of PC based updating of all necessary parameters, firmware, and software. The controller shall be mounted on the generator set and shall have integral vibration isolation. The controller shall be prototype and reliability tested to ensure operation in the conditions encountered.
2. Codes and Standards
   a. The generator set controller shall meet NFPA 110 Level 1 requirements and shall include an integral alarm horn as required by NFPA.
   b. The controller shall meet NFPA 99 and NEC requirements.
   c. The controller shall be UL 508 listed.
3. Applicability
   a. The controller shall be a standard offering in the manufacturer's controller product line.
   b. The controller shall support 24-volt starting systems.
   c. The controller's environmental specification shall be: -40°C to 70°C operating temperature range and 5-95% humidity, non-condensing.
   d. The controller shall mount on the generator
4. Hardware Requirements
   a. Control Panel shall include:
      i. The control shall have a run-off/reset-auto three-position selector switch
      ii. Emergency Stop Switch. The controller mounted, latch type remote stop switch shall be red in color with a "mushroom" type head. Depressing the stop button will immediately stop the generator set and lockout the generator set for any automatic remote starting.
      iii. Indications for the following states:
         1) System Ready
         2) Not in Auto
         3) System Warning
         4) System Shutdown
      iv. Digital Display. The digital display shall be a vacuum fluorescent display with at least two lines of alphanumeric data, with 20 characters per line. The display shall be viewable in all light conditions. The display shall display status of all faults and warnings. The display shall also display any engine faults. The 16-button keypad gives the user information access and local programming capability.

v. Environmentally sealed tactile-feel membrane keypad for menu selection and data entry.
vi. For ease of use, an operating guide shall be printed on the controller faceplate.
vii. Alarm Horn. The controller shall provide an alarm horn that sounds when any faults or warnings are present. The horn shall also sound when the controller is not in the AUTO mode. Location of horn shall be nearby the operator's panel and identified on the submittal drawings.
viii. Lamp Test Button. When this button is depressed, it shall test all controller lamps.
ix. Alarm Off. This button will silence the alarm horn when the unit is AUTO.
x. Panel lights shall be supplied as standard.

5. Control Functional Requirements
   a. The generator controller shall display and monitor the following engine and alternator functions and allow adjustments of certain parameters at the controller:
      i. Field-programmable time delay for engine start. Adjustment range 0-120 seconds in 1 second increments.
      ii. Field-programmable time delay engine cool down. Adjustment range 0-10 minutes in 5 second increments (minimum).
      iii. Capability to start and run at user-adjustable idle speed during warm-up for a selectable time period (0-10 minutes), until engine reaches preprogrammed temperature, or as supported by ECM- equipped engine.
      iv. The idle function including engine cooldown at idle speed.
      v. Real-time clock and calendar for time stamping of events.
      vi. Output with adjustable timer for an ether injection starting system. Adjustment range, 0-10 seconds
      vii. Output for shedding of loads if the generator set reaches a user programmable percentage of its kW rating. Load shed shall also be enabled if the generator set output frequency falls below 57 Hz.
      viii. Programmable cyclic cranking that provides up to 30 seconds of programmable cyclic cranking and up to 60 seconds rest with up to 6 cycles.
      ix. The controller vacuum fluorescent display should turn off automatically after the controller is inactive for 5 minutes.
      x. Control logic with alternator protection for overload and short circuit matched to each individual alternator and duty cycle.
      xi. Control logic with RMS digital voltage regulation. The system shall have integral microprocessor based voltage regulator system that provides +/- 0.25% voltage regulation no-load to full load with three phase sensing. A separate voltage regulator is not acceptable. The digital voltage regulator shall be applicable to single- or three-phase systems. The system shall be prototype tested and control variation of voltage to frequency. The voltage regulator shall be adjustable at the controller with maximum +/- 20% adjustable of nominal voltage.
      xii. The capability to exercise the generator set by programming a running time into the controller. This feature shall also be programmable through the PC software.
6. Alternator thermal overload protection. The system shall have integral alternator overload and short circuit protection matched to each alternator for the particular voltage and phase configuration.
7. Control function shall include output voltage adjustment.
8. The control shall detect the following conditions and display on control panel:
   a. Customer programmed digital auxiliary input ON
   b. Emergency stop

c. High coolant temperature
d. High oil temperature
e. Controller internal fault
f. Locked rotor - fail to rotate
g. Low coolant level
h. Low oil pressure
i. Master switch error
j. Over-crank
k. Overspeed with user-adjustable level.
l. Overvoltage with user adjustable level.
m. Over-frequency with user adjustable level.
n. Underfrequency with user adjustable level.
o. Undervoltage with user adjustable level.
p. Coolant temperature signal loss
q. Oil pressure gauge signal loss

9. Conditions resulting in generator warning (generator will continue to operate):
   a. Battery charger failure
   b. Customer programmed digital auxiliary input on
   c. Power system supplying load
   d. Ground fault detected
   e. High battery voltage - Level shall be user adjustable.
   f. High coolant temperature
   g. Load shed
   h. Loss of AC sensing
   i. Underfrequency
   j. Low battery voltage - level shall be user adjustable
   k. Low coolant temperature
   l. Low fuel level or pressure
   m. Low oil pressure
   n. Overcurrent
   o. Speed sensor fault
   p. Weak battery
   q. Alternator protection activated
   r. Alternator Winding High Temperature
10. Control Monitoring Requirements
    a. The generator set shall have alarms and status indication lamps that show non-automatic status and warning and shutdown conditions. The controller shall indicate with a warning lamp and or alarm and on the digital display screen any shutdown, warning or engine fault condition that exists in the generator set system. The following alarms and shutdowns shall exist as a minimum:
       i. All monitored functions must be viewable on the control panel display.
       ii. The following generator set functions shall be monitored:
           1) All output voltages - line to line, and line to neutral, 0.25% accuracy
           2) All line currents, 0.25% accuracy
           3) Output frequency, 0.25% accuracy
           4) Power factor by phase with leading/lagging indication
           5) Total instantaneous kilowatt loading and kilowatts per line, 0.5% accuracy
           6) kVARS total and per phase, 0.5% accuracy
           7) kVA total and per phase, 0.5% accuracy
           8) kW hours

9) A display of percent generator set duty level (actual kW loading divided by the kW rating)

11. Engine parameters listed below shall be monitored, as available with ECM equipped engines
    a. Coolant temperature both in English and metric units
    b. Oil pressure in English and metric units
    c. Battery voltage
    d. RPM
    e. Lube oil temperature
    f. Lube oil level
    g. Crankcase pressure
    h. Coolant level
    i. Coolant pressure
    j. Fuel pressure
    k. Fuel temperature
    l. Fuel rate
    m. Fuel used during the last run
    n. Ambient temperature
12. Operational records shall be stored in the control beginning at system startup.
    a. Run time hours
    b. Run time loaded hours
    c. Run time unloaded hours
    d. Number of starts
    e. Factory test date
    f. Last run data including date, duration, and whether loaded or unloaded
    g. Run time kilowatt hours
13. The following operational records shall be a resettable for maintenance purposes:
    a. Run time hours
    b. Run time loaded hours
    c. Run time unloaded hours
    d. Run time kilowatt hours
    e. Days of operation
    f. Number of starts
    g. Start date after reset
14. The controller shall store the last one hundred generator set system events with date and time of the event.
15. For maintenance and service purposes, the controller shall store and display on demand the following information:
    a. Manufacturer's model and serial number
    b. Battery voltage
    c. Generator set kilowatt rating
    d. Rated current
    e. System voltage
    f. System frequency
    g. Number of phases
16. Inputs and Outputs
    a. Inputs
        i. There shall be 4 dry contact inputs that can be user-configured to shut down the generator set or provide a warning.
        ii. There shall be 2 user-programmable analog inputs for ECM- equipped engines for monitoring and control.

iii. Each analog input can accept 0-5 volt analog signals
iv. Resolution shall be 1:8192 minimum (13-Bit resolution)
v. Each input shall include range settings for 2 warnings and 2 shutdowns.
vi. All values shall be on the control panel display.
vii. Shall be user-assigned.
viii. Additional standard inputs required:
1) Input for an external ground fault detector. Digital display shall show "ground fault" upon detection of a ground fault.
2) Reset of system faults.
3) Remote two-wire start.
4) Remote emergency stop.
ix. Idle mode enable.

b. Outputs
i. All NFPA 110 Level 1 outputs shall be available.
ii. Ten outputs shall be available for interfacing to other equipment.
1) All outputs shall be user-configurable from a list of functions and faults
2) These outputs shall drive 0.5A minimum.

c. A programmable user-defined common fault output shall be available.

17. Communications
a. If the generator set engine is equipped with an ECM (engine control module), the controller shall communicate with the ECM for control, monitoring, diagnosis, and meet SAE J1939 standards.
b. The controller shall have the capability to communicate to a personal computer (IBM or compatible) running Windows 7 or later.
c. Communications shall be available for CAN, and Ethernet bus networks.
d. Both Generator and transfer switch controls shall be equipped with communications modules capable of connecting to the same communication network.
e. Cabling shall not be limited to the controller location.

18. Communications accessories
a. Supply all hardware and software required to perform personal computer interface. Connectivity to RJ45 for Ethernet or USB shall be supplied as required.

19. Remote annunciator panel. To be located in the Benson Park Pump House or as approved by the Contracting Officer
a. The remote annunciator shall meet NFPA 110, Level 1 requirements and enable remote viewing of the generator status. The panel shall be connected to the generator controller via either network communication wires or via hard wired connections. Remote annunciator shall also indicate ATS source availability, contactor position, and loaded or unloaded test for up to four transfer switches. The panel shall have the capability to be either flush- mounted or surface-mounted. The annunciator shall meet UL508 requirements.

20. Remote Generator Run Annunciation at lodge
a. A single contact from ATS will close to monitor generator run status and be connected to lodge annunciator over existing control cable located in well house pump control panel; see sections 26 09 00 for additional requirements and details.

C. Supporting Items: Include sensors, transducers, terminals, relays, and other devices, and wiring required to support specified items. Locate sensors and other supporting items on engine, generator, or elsewhere as indicated. Where not indicated, locate to suit manufacturer's standard.

D. Wiring: Provide types and number of conductors required in each conduit to provide the functions specified.

1. Provide wire numbers on all conductors to match schematic and wiring diagrams. Show wire numbers on these drawings.

2.14 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1, "Motors and Generators," and specified performance requirements.

B. Drive: Generator shaft shall be directly connected to the engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: NEMA Class H. Temperature rise of rotor and stator shall be limited to the temperature rise indicated on the generator set schedule.

D. Stator Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.

E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at rated capacity.

F. Excitation system shall be brushless, permanent magnet type, and shall derive excitation current from a pilot exciter mounted on the rotor shaft. Exciter shall enable the generator to provide the short circuit current specified hereinafter in paragraph "System Performance."

G. Pitch: Generator pitch shall be as indicated on the engine-generator set schedule.

H. Enclosure: Drip proof. Using not less than 14-gauge thick material.

I. Instrument Transformers: Mounted within generator enclosure.

J. Voltage Regulator: Microprocessor controlled, digital solid-state-type, environmentally sealed, separate from exciter, providing performance as specified. Provide the following performance, features and accessories:

1. Adjustment on control and monitoring panel provides plus or minus 10 percent adjustment of output voltage operating band.
2. Voltage regulator shall be suitable for use with non-linear and silicon-controlled rectifier (SCR) loads, and shall be designed to maintain voltage control with at least 20% total harmonic current distortion. Provide additional circuitry and filtering as required for the application and to comply with all specifications.

K. Surge Protection: Conform to UL 1449, "Transient Voltage Surge Suppressors." Mount suppressors in generator enclosure and connect to load terminals.

L. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above the dew point. Provide 120VAC circuit and conduit from panel on building to generator.

M. Alternator:

1. The alternator shall be salient-pole, brushless, pitch as indicated on the generator load schedule, with 4 bus bar provision for external connections, self-ventilated, with drip-proof construction and amortisseur rotor windings, and skewed for smooth voltage waveform. The ratings shall meet the NEMA standard (MG1-32.40) temperature rise limits. The insulation shall be class H per UL1446 and the varnish shall be a vacuum pressure impregnated, fungus resistant epoxy. Temperature rise of the rotor and stator shall be limited to 130°C Standby. The PMG based excitation system shall be of brushless construction controlled by a digital, three phase sensing, solid- state, voltage regulator. The AVR shall be capable of proper operation under severe nonlinear loads and provide individual adjustments for voltage range, stability and volts-per-hertz operations. The AVR shall be protected from the environment by conformal coating. The waveform harmonic distortion shall not exceed 5% total RMS measured line-to-line at full rated load. The TIF factor shall not exceed 50.
2. The alternator shall have a maintenance-free bearing, designed for 40,000 hour B10 life. The alternator shall be directly connected to the flywheel housing with a semi-flexible coupling between the rotor and the flywheel.
3. The generator shall be inherently capable of sustaining at least 200% of rated current for at least 5 seconds under a short circuit without the addition of separate current-support devices.
4. Provide winding RTD temperature sensor and Bearing temperature sensors and readouts.

2.15 SEISMIC REQUIREMENTS

A. Internal and external supports for components, supports, and fastenings for equipment, piping, and wiring shall be designed to withstand static or anticipated seismic forces, or both, in all directions. The generator set shall be IBC Certified as meeting the required maximum seismic design acceleration level per the International Building Code in effect at the time of issuance of this specification for the specific location of the generator installation site. The generator shall be analyzed, or shake tested by a third party, accompanied by a Certificate of Compliance, and include a seismic label on the generator set (per Section 1702 of the IBC Code). Seismic certified generators shall be installed per the specific seismic instructions provided by the manufacturer.

2.16 OUTDOOR GENERATOR SET ENCLOSURE

A. Enclosure: Level 1 Sound Attenuated Enclosure. Dimensions of the enclosure are not to exceed 120” X 40”

1. The generator set shall be supplied with a Sound Attenuated Enclosure, providing a sound pressure of 76 dB(A) while the generator is operating at 80% load at 7 meters (23 feet) - free field - using acoustic insulation and acoustic-lined inlet hoods, constructed from high strength, low alloy 14-gauge galvanized steel. The acoustic insulation used shall meet UL 94 HF1 flammability classification. The enclosure shall be manufactured from bolted panels to facilitate service, future modifications, or field replacement. The enclosure shall use external vertical air inlet and outlet hoods with 90 degree angles to discharge air up and reduce noise. The enclosure shall have an integral rodent guard and skid end caps and shall have bracing to meet 241 kph (150 mph) wind loading.

2. The enclosure components and skid shall be cleaned with a two-stage alkaline cleaning process to remove grease, grit, and grime from parts. Components shall then be subjected to a zirconium-based conversion coating process to prepare the metal for electrocoat adhesion. All enclosure parts shall receive an 100% epoxy primer electrocoat with high-edge protection. Following the electrocoat process, the parts shall be finish coated with powder baked paint for corrosion-resistance.
3. The enclosure must surpass a 3,000 hour salt spray corrosion test per ASTM B-1117.
4. Enclosures will be finished in the manufacturer's standard color. Available color and finish options shall be presented to the Contracting Officer for selection and approval.
5. The enclosures shall allow the generator set to operate at full load in an ambient temperature of 50°C with no additional derating of the electrical output of the generator set.
6. Enclosures shall be equipped with sufficient side and end doors to allow access for operation, inspection, and service of the unit and all options. Minimum requirements are two doors per side. When the generator set controller faces the rear of the generator set, an additional rear facing door is required. Access to the controller and main line circuit breaker shall meet the requirements of the National Electric Code.
7. Doors shall be fitted with hinges, hardware, and the doors shall be removable.
8. Doors shall be equipped with lockable latches. Locks shall be keyed alike. Door locks shall be recessed to minimize potential of damage to door/enclosure.
9. A duct between the radiator and air outlet shall be provided to prevent re-circulation of hot air.
10. The complete exhaust system shall be internal to the enclosure.
11. The critical silencer shall be fitted with a tailpipe and rain cap.

B. Space Heater: Provide a space heater in order to comply with specification requirements for cranking capacity and environmental conditions. Provide complete with all required accessories and wiring, including field wiring. Provide circuit from new power panel.

2.17 FINISHES

A. Indoor Enclosures and Components: Manufacturer's standard enamel over corrosion-resistant pretreatment and primer.

B. Outdoor Enclosures: Refer to enclosure specifications above.

2.18 SOURCE QUALITY CONTROL

A. Factory Tests: Include prototype testing and Project-specific equipment tests (equipment manufactured specifically for this Project).

B. Prototype Testing: Performed on a separate engine generator set using the same engine model, constructed of identical or equivalent components, and equipped with identical or equivalent accessories.

1. Tests: Conform to those required for Level 1 energy converters in paragraphs 3.2.1, 3.2.1.1, and 3.2.1.2 of NFPA 110. In addition, provide the following testing:
   a. Maximum power (kW).

b. Maximum kilovolt amperes (kVA).
c. Alternator temperature rise by embedded thermocouple and by resistance method per NEMA MG1-32.6
d. Governor speed regulation under steady-state and transient conditions.
e. Voltage regulation and generator transient response.
f. Fuel consumption at 1/4, 1/2, 3/4, and full load.
g. Harmonic analysis, voltage waveform deviation, and telephone influence factor.
h. Three-phase line-to-line short circuit test.
i. Alternator cooling air flow.
j. Torsional analysis testing to verify that the generator set is free of harmful torsional stresses.
k. Maximum motor starting (kVA) at 15% instantaneous voltage dip
l. Endurance testing

2. Components and Accessories: Items furnished with installed unit that are not identical to those on tested prototype have been acceptably tested to demonstrate compatibility and reliability.

C. Project-Specific Equipment Tests: Test engine generator set and other system components and accessories prior to shipment. Test items individually and assembled and connected as a complete system at the factory in a manner equivalent to that required at the Project site. Record and report test data. Conform to SAE 8528, "Engine Power Test Code-Spark Ignition and Propane," and the following:

1. Test Equipment: Use instruments calibrated within the previous 12 months and with accuracy directly traceable to the National Institute of Standards and Technology (NIST).
2. Hydrostatic Test: Perform on radiator, heat exchanger, and engine water jacket.
3. Generator Tests: Conform to IEEE 115, "Test Procedures for Synchronous Machines."
4. Complete System Continuous Operation Test: Includes nonstop operation for a minimum of 4 hours, including at least 1 hour each at 1/4, 1/2, 3/4, and full load. If unit stops during the 4-hour test, repeat the complete test. Record the following minimum data at the start and end of each load run, at 15-minute intervals between those times, and at 15-minute intervals during the balance of the test:
   a. Fuel consumption.
   b. Exhaust temperature.
   c. Jacket water temperature.
   d. Lubricating oil temperature and pressure.
   e. Generator load current and voltage, each phase.
   f. Generator system gross and net output kW.
5. Complete System Performance Tests: Include the following to demonstrate conformance to specified performance requirements:
   a. Single-step load pickup.
   b. Transient and steady-state governing.
   c. Transient and steady-state voltage performance.
   d. Safety shutdown devices
   e. Rated Power @ 0.8 PF
   f. Maximum power

D. Observation of Test: Provide 2-week advance notice of tests and opportunity for observation of test by Government’s representatives.

E. Report test results within 10 days of completion of test and issue a certified test record to Government's Representative prior to shipment.

2.19 WARRANTY

A. Warranty and Service: The generator set shall include a standard warranty covering two years or 2,000 hours, whichever occurs first, to guarantee against defective material and workmanship in accordance with the manufacturer's published warranty from the date of project final acceptance. The generator set manufacturer and its distributor shall maintain a 24-hour parts and service organization. This organization shall regularly engage in maintenance contract programs to perform preventive maintenance and service on equipment like that specified. A service agreement shall be available and shall include system operation under simulated operating conditions; adjustment to the generator set, transfer switch, and switchgear controls as required, and certification in the owner's maintenance log of repairs made and functional tests performed on all systems. Warranty shall start after final acceptance of project.

1. At the end of the first year after generator acceptance the manufacturer's field technician shall test all generator functions, alarms and operation and provide a field report of any deficiencies and correct any deficiencies. Cost of this is to be included in the project cost by contractor.

2.20 SPARE PARTS

A. Provide the following spare parts labeled with function and part ID number:

1. 5 oil filters
2. 5 air filters
3. 5 filters for any auxiliary equipment
4. 1 set of fan belts
5. Any other consumable items to perform OEM recommended maintenance for 2500 hours of operation.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Anchor generator set and other system components on concrete bases conforming to specified requirements and as indicated. Provide anchorage according to manufacturer's recommendations.

B. Exhaust Piping Installation: In accordance with manufacturer's recommendations.

C. Maintain minimum working space around components according to manufacturer's recommendations and NEC.

D. Manufacturer's Field Services: Arrange and pay for the services of a factory-authorized service representative to supervise the installing, connecting, testing, and adjusting of the unit.

E. Grounding: Provide grounding of the engine-generator set as indicated or specified. Additional grounding requirements are specified in Section 26 05 26 “Grounding & Bonding for Electrical Systems.”

1. Provide a ground as shown on drawings and bond to generator frame.

3.2 IDENTIFICATION

A. Identify system components with labeling in accordance with manufacturer recommendations.

3.3 FIELD QUALITY CONTROL

A. Supervised Adjusting and Pretesting: Under supervision of factory-authorized service representative, Contractor shall pretest all system functions, operations, and protective features. Provide all instruments and equipment required for tests. Adjust to ensure operation is according to Specifications.

B. Tests: Under supervision of factory-authorized service representative, Contractor shall perform the tests listed below according to manufacturer's recommendations upon completion of installation of system. Use instruments bearing records of calibration within the last 12 months, traceable to NIST standards, and adequate for making positive observation of test results. Include the following tests:

1. Battery Tests: Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery. Verify acceptance of charge for each element of battery after discharge. Verify measurements are within manufacturer’s specifications.
2. Battery Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
3. System Integrity Tests:
    a. Methodically verify proper installation, connection, and integrity of each element of engine generator system before and during system operation. Check for air, exhaust, and fluid leaks
    b. Simulation of malfunctions to verify proper operation of local and remote protective, alarm, and monitoring devices.
4. Load Test: Provide a temporary variable resistive load bank capable of simulating kW of load for which unit is rated. Run unit at 25, 50, and 75 percent of rated capacity for 30 minutes each, and at 100 percent for 3 hours. Record voltage, frequency, load current, battery-charging current, power output, oil pressure, and coolant temperature periodically during the test.
5. Exhaust Emissions Test: Not required.
6. Voltage and Frequency Transient Stability Tests: Not required.

7. Operational Tests: The manufacturer's factory-trained service representative shall perform an installation check, startup, and building load test. The Contractor Officer shall be notified of the time and date of the site test. Set all generator and transfer switch controls in compliance with drawings and specifications. Perform two (2) complete operational tests by simulating loss of commercial power. Verify engine-generator start-up, load transfer, operation, for one- hour minimum, sequencing of loads, and voltage drop. Reapply commercial power and verify load re-transfer and engine-generator cool down and shut down. The tests shall include but not be limited to:
   a. Fuel, lubricating oil, and antifreeze shall be checked for conformity to the manufacturer's recommendations, under the environmental conditions present and expected.
   b. Accessories that normally function while the set is standing by shall be checked prior to cranking the engine. These shall include: block heaters, battery chargers, alternator strip heaters, remote annunciators, etc.
   c. Generator set startup under test mode to check for exhaust leaks, path of exhaust gases outside the building, cooling air flow, movement during starting and stopping, vibration during operation, normal and emergency line-to-line voltage and frequency, and phase rotation.
   d. Automatic start by means of a simulated power outage to test remote-automatic starting, transfer of the load, and automatic shutdown. Prior to this test, all transfer switch timers shall be adjusted for proper system coordination. Engine coolant temperature, oil pressure, and battery charge level along with generator set voltage, amperes, and frequency shall be monitored throughout the test.

C. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

D. Commissioning: The Government will be retaining the services of an independent commissioning agent to participate in additional commissioning, documentation, and testing. The Supplier shall provide the services of the manufacturer's factory-trained distributor service representative for two 8 hour days for commissioning testing. The Contractor shall provide the services of licensed electrician for two 8 hour days for commissioning testing. Commissioning testing procedures will be provided to the Supplier and Contractor after review and approval of project submittals.

E. Coordinate testing and training with testing/training of automatic transfer switches and run them concurrently.

3.4 CLEANING

A. Upon completion of installation, inspect system components. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean components internally using methods and materials recommended by manufacturer.

3.5 DEMONSTRATION & TRAINING

A. Training: Supplier shall provide the services of a generator factory-authorized service representative to demonstrate adjustment, operation, and maintenance of the system and to train Owner's personnel for a minimum of 8 hours total.

B. Schedule training at with at least 14-day advance written notice.

C. Training shall not be performed until all testing and commission has been completed and any repairs performed and until an approved Operation and Maintenance manual has been provided.

D. Operator training shall use approved O&M manual narratives and drawings.

3.6 OPERATION & MAINTENANCE MANUALS

A. Provide a hard copy of final O&M manual's and an electronic copy in PDF to allow entire manual to be reprinted from PDF file.

B. Provide an as-built complete Operation and Maintenance manual for the generator / alternator and all auxiliary equipment including the following items:

1. Complete engine manual with all components listed, parts list and repair parts and diagrams.
2. Complete alternator and controls manuals with all electrical diagrams and parts lists.
3. As-built schematic and wiring diagrams showing all generator and control systems components, annunciators, inter-wiring to ATS-1 and all internal electrical components.
4. Provide Laymen's operations and maintenance instructions written for this specific project for normal operation, and maintenance activities. This is in addition to factory supplied manuals.

C. Operator training will be done after final O&M manual is approved.

D. Submit a preliminary O&M manual's for approval 30 days minimum prior to final testing and training.

END OF SECTION

SECTION 26 36 23

AUTOMATIC TRANSFER SWITCHES – SMALL (LESS THAN 300A)

PART 1 – GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, connection, and testing of open-transition automatic transfer switches (ATS) with bypass isolation, indicated as automatic transfer switches or ATS in this section. It is the intent of this section to specify an automatic transfer switch designed for compatibility and used with the propane generator set described in Section 26 32 13 for the Ash Mountain Standby Generator System.

1.2 RELATED WORK

A. Section 03 30 00, Cast-In-Place Concrete: Requirements for concrete equipment pads.

B. Section 26 00 00, Electrical General Requirements: Requirements that apply to all sections of Division 26.

C. Section 26 05 19, Low-Voltage Electrical Power Conductors & Cables: Low-voltage conductors.

D. Section 26 05 26, Grounding & Bonding for Electrical Systems: Requirements for personal safety and to provide a low impedance path for possible ground fault currents.

E. Section 26 05 33, Raceways & Boxes for Electrical Systems: Conduits.

F. Section 26 32 13, Packaged Engine Generator Systems: Propane Generator.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Section 01 40 00, Quality Requirements.

B. A factory-authorized representative shall be capable of providing emergency maintenance and repairs at the project site within 4 hours maximum of notification.

C. Automatic transfer switch, bypass/isolation switch, and annunciation control panels shall be products of the same manufacturer.

1.4 FACTORY TESTS

A. ATS shall be thoroughly tested at the factory to assure that there are no electrical or mechanical defects.

B. Factory Tests shall be in accordance with the following requirements:

1. Perform visual inspection to verify that each ATS is as specified.
2. Perform mechanical test to verify that ATS sections are free of mechanical defects.
3. Perform insulation resistance test to ensure electrical integrity and continuity of entire system.
4. Perform main switch contact resistance test.
5. Perform electrical tests to verify complete system electrical operation.

1.5 SUBMITTALS - FOR REVIEW/APPROVAL

A. The following information shall be submitted to the Contracting Officer CO:

1. Front view and plan view of the assembly with overall dimensions and door swing dimensions
2. Schematic diagram
3. Assembly ratings including:
   a. Voltage rating (Minimum 240 VAC)
   b. Continuous current rating (Minimum 200 Amps)
   c. Withstand and closing ratings of 65 kA at 240 volts when protected by the specified circuit breaker.
4. Cable terminal sizes
5. Product data sheets.
6. Busway connection points

1.6 SUBMITTALS - FOR CONSTRUCTION

A. The following information shall be submitted for record purposes:

1. Final as-built drawings and information for items listed in section 1.4
2. Field Wiring diagrams
3. Certified production test reports
4. Installation information
5. Seismic certification as specified.

B. Manuals:

1. Submit, simultaneously with the shop drawings, copies of complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.
   a. Schematic signal and control diagrams, with all terminals identified, matching terminal identification in the automatic transfer switches.
   b. Include information for testing, repair, troubleshooting, assembly, disassembly, and factory recommended/required periodic maintenance procedures and frequency.
   c. Provide a replacement and spare parts list. Include a list of tools and instruments for testing and maintenance purposes.

2. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
    a. Include complete "As Installed" diagrams that indicate all pieces of equipment and their interconnecting wiring.
    b. Include complete diagrams of the internal wiring for each piece of equipment, including "As Installed" revisions of the diagrams.
    c. The wiring diagrams shall identify the terminals to facilitate installation, maintenance, operation, and testing.
3. Certifications:
    a. When submitting the shop drawings, submit a certified test report from a recognized independent testing laboratory that a representative sample has passed UL 1008 prototype testing.
    b. Two weeks prior to final inspection, submit the following.
        i. Certification by the manufacturer that the ATS conform to the requirements of the drawings and specifications.
        ii. Certification by the Contractor that transfer switches have been properly installed, adjusted, and tested.

1.7 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. Institute of Electrical and Electronic Engineers (IEEE):

1.	446-95	Emergency and Standby Power Systems for Industrial and Commercial Applications
2.	C37.90.1-12	Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus
3.	C62.41.1-02	Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
4.	C62.41.2-02	Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

C. International Code Council (ICC):

1.	IBC-15	International Building Code

D. National Electrical Manufacturers Association (NEMA):

1.	250-14	Enclosures for Electrical Equipment (1000 Volts Maximum)
2.	ICS 6-06	Enclosures
3.	ICS 4-15	Application Guideline for Terminal Blocks
4.	MG 1-16	Motors and Generators

E. National Fire Protection Association (NFPA):

1.	70–17	National Electrical Code (NEC)
2.	99-15	Health Care Facilities
3.	110-16	Emergency and Standby Power Systems

F. Underwriters Laboratories, Inc. (UL):

1.	50-15	Enclosures for Electrical Equipment
2.	508-99	Industrial Control Equipment
3.	891-05	Switchboards
4.	1008-14	Transfer Switch Equipment

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Automatic transfer switches shall comply with IEEE, NEMA, NFPA, UL, and have the following features:

1. Automatic transfer switches shall be open transition switches, draw-out construction, electrically operated, mechanically held open contact type, without integral overcurrent protection. Automatic transfer switches utilizing automatic or non-automatic molded case circuit breakers, insulated case circuit breakers, or power circuit breakers as switching mechanisms are not acceptable.
2. Automatic transfer switches shall be completely factory-assembled and wired such that only external circuit connections are required in the field.
3. Each automatic transfer switch shall be equipped with an integral bypass/isolation switch.
4. Ratings:
   a. Phases, voltage, continuous current, poles, and withstand and closing ratings shall be as shown on the drawings.
   b. Transfer switches are to be rated for continuous duty at specified continuous current rating on 60Hz systems.
   c. Minimum automatic transfer switch rating: 200 A.
5. Markings:
   a. Markings shall be in accordance with UL 1008.
6. Tests:
   a. Automatic transfer switches shall be tested in accordance with UL 1008. The contacts of the transfer switch shall not weld during the performance of withstand and closing tests when used with the upstream overcurrent device and available fault current specified.
7. Surge Withstand Test:
   a. Automatic transfer switches utilizing solid-state devices in sensing, relaying, operating, or communication equipment or circuits shall comply with IEEE C37.90.1.
8. Housing:
   a. Enclose automatic transfer switches in wall-mounted steel cabinets, with metal gauge not less than No. 14, in accordance with UL 508, or in a switchboard assembly in accordance with UL 891, as shown on the drawings.

b. Enclosure shall be constructed so that personnel are protected from energized bypass-isolation components during automatic transfer switch maintenance.
c. Automatic transfer switch components shall be removable without disconnecting external source or load power conductors.
d. Finish: Cabinets shall be given a phosphate treatment, painted with rust-inhibiting primer, and finish-painted with the manufacturer's standard enamel or lacquer finish.
e. Viewing Ports: Provide viewing ports so that contacts may be inspected without disassembly.

9. Operating Mechanism:
   a. Actuated by an electrical operator.
   b. Electrically and mechanically interlocked so that the main contact cannot be closed simultaneously in both normal and emergency position.
   c. Normal and emergency main contacts shall be mechanically locked in position by the operating linkage upon completion of transfer. Release of the locking mechanism shall be possible only by normal operating action.
   d. Contact transfer time shall not exceed six cycles.
   e. Operating mechanism components and mechanical interlocks shall be insulated or grounded.
10. Contacts:
   a. Main contacts: Silver alloy.
   b. Neutral contacts: Silver alloy, with same current rating as phase contacts.
   c. Current carrying capacity of arcing contacts shall not be used in the determination of the automatic transfer switch rating and shall be separate from the main contacts.
   d. Main and arcing contacts shall be visible for inspection with cabinet door open and barrier covers removed.
11. Manual Operator:
   a. Capable of operation by one person in either direction under no load.
12. Replaceable Parts:
   a. Include the main and arcing contacts individually or as units, as well as relays, and control devices.
   b. Automatic transfer switch contacts and accessories shall be replaceable from the front without removing the switch from the cabinet and without removing main conductors.
13. Sensing Features:
   a. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100% of nominal, and dropout voltage is adjustable from 75 to 98% of pickup value. Factory set for pickup at 90% and dropout at 85%.
   b. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
   c. Voltage/Frequency Lockout Relay: Prevent premature transfer to the engine-generator. Pickup voltage shall be adjustable from 85 to 100% of nominal. Factory set for pickup at 90%. Pickup frequency shall be adjustable from 90 to 100% of nominal. Factory set for pickup at 95%.
   d. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
   e. Test Switch: Simulate normal-source failure.

f. Switch-Position Indication: Indicate source to which load is connected.
g. Source-Available Indication: Supervise sources via transfer switch normal- and emergency-source sensing circuits.
h. Normal Power Indication: Indicate "Normal Source Available."
i. Emergency Power Indication: Indicate "Emergency Source Available."
j. Transfer Override Control: Overrides automatic retransfer control so that automatic transfer switch shall remain connected to emergency power source regardless of condition of normal source. Control panel shall indicate override status.
k. Engine Starting Contacts: One isolated and normally closed and one isolated and normally open; rated 5 A at 30 V DC minimum.
l. Engine Shutdown Contacts: Time delay adjustable from zero to 15 minutes, and factory set for 5 minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
m. Engine-Generator Exerciser: Programmable exerciser starts engine-generator(s) and transfers load to them from normal source for a preset time, then retransfers and shuts down engine-generator(s) after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period.

14. Controls:
    a. Controls shall provide indication of switch status and be equipped with alarm diagnostics.
    b. Controls shall control operation of the automatic transfer switches.
15. Factory Wiring: Train and bundle factory wiring and label either by color-code or by numbered/lettered wire markers. Labels shall match those on the shop drawings.
16. Annunciation, Control, and Programming Interface Components: Devices for communicating with remote programming devices, annunciators, or control panels.

2.2 SEQUENCE OF OPERATION

A. The specified voltage decrease in one or more phases of the normal power source shall initiate the transfer sequence. The automatic transfer switch shall start the engine-generator(s) after a specified time delay to permit override of momentary dips in the normal power source.

B. The automatic transfer switch shall transfer the load from normal to emergency source when the frequency and voltage of the engine-generator(s) have attained the specified percent of rated value.

C. Engine Start: A voltage decrease, at any automatic transfer switch, in one or more phases of the normal power source to less than the specified value of normal shall start the engine-generator(s) after a specified time delay.

D. Transfer to Emergency System Loads: Automatic transfer switches for Emergency System loads shall transfer their loads from normal to emergency source when frequency and voltage of the engine-generator(s) have attained the specified percent of rated value. Only those switches with deficient normal source voltage shall transfer.

E. Transfer to Equipment Branch Loads: Automatic transfer switches for Equipment Branch loads shall transfer their loads to the engine-generator on a time-delayed, staggered basis, after the Emergency System switches have transferred. Only those switches with deficient normal source voltage shall transfer.

F. Retransfer to Normal (All Loads): Automatic transfer switches shall retransfer the load from emergency to normal source upon restoration of normal supply in all phases to the specified percent or more of normal voltage, and after a specified time delay. Should the emergency source fail during this time, the automatic transfer switches shall immediately transfer to the normal source whenever it becomes available. After restoring to normal source, the engine-generator(s) shall continue to run unloaded for a specified interval before shut-down.

2.3 BYPASS-ISOLATION SWITCH

A. Provide each automatic transfer switch with two-way bypass-isolation manual type switch. The bypass-isolation switch shall permit load by-pass to either normal or emergency power source and complete isolation of the automatic transfer switch, independent of transfer switch position. Bypass and isolation shall be possible under all conditions including when the automatic transfer switch is removed from service.

B. Operation: The bypass-isolation switch shall have provisions for operation by one person through the movement of a maximum of two handles at a common dead front panel in no more than 15 seconds. Provide a lock, which must energize to unlock the bypass switch, to prevent bypassing to a dead source. Provide means to prevent simultaneous connection between normal and emergency sources.
   1. Bypass to normal (or emergency): Operation of bypass handle shall allow direct connection of the load to the normal (or emergency) source, without load interruption or by using a break-before-make design or provide separate load interrupter contacts to momentarily interrupt the load.
      a. Ensure continuity of auxiliary circuits necessary for proper operation of the system.
      b. A red indicating lamp shall light when the automatic transfer switch is bypassed.
      c. Bypassing source to source: If the power source is lost while in the bypass position, bypass to the alternate source shall be achievable without re-energization of the automatic transfer switch service and load connections.
   2. Isolation: Operation of the isolating handle shall isolate all live power conductors to the automatic transfer switch without interruption of the load.
      a. Interlocking: Provide interlocking as part of the bypass- isolation switch to eliminate personnel controlled sequence of operation, and to prevent operation to the isolation position until the bypass function has been completed.
      b. Padlocking: Include provisions to padlock the isolating handle in the isolated position.
      c. Visual verification: The isolation blades shall be visible in the isolated position.
   3. Testing: It shall be possible to test (normal electrical operation) the automatic transfer switch and engine–generator(s) with the isolation contacts closed and the load bypassed without interruption of power to the load.

C. Ratings: The electrical capabilities and ratings of the bypass-isolation switch shall be compatible with those of the associated automatic transfer switch, including any required additional withstand tests.

2.4 REMOTE ANNUNCIATOR SYSTEM

A. Remote annunciator panel shall annunciate conditions for indicated automatic transfer switches. Annunciation shall include the following:

1. Sources available, as defined by actual pickup and dropout settings of automatic transfer switch controls.
2. Switch position.
3. Switch in test mode.
4. Failure of communication link.

B. Remote annunciator panel shall be visual and audible type with LED display panel, audible signal, and silencing switch.

1. Panel shall indicate each automatic transfer switch monitored, the location of automatic transfer switch, and the identity of load it serves.
2. Mounting: Steel cabinet, flush or surface mounted, as shown on the drawings.
3. Locate annunciator inside well pump house. Location to be approved by contracting officer.

2.5 REMOTE ANNUNCIATOR AND CONTROL SYSTEM

A. Include the following functions for indicated automatic transfer switches:

1. Indication of sources available, as defined by actual pickup and dropout settings of automatic transfer switch controls.
2. Indication of automatic transfer switch position.
3. Indication of automatic transfer switch in test mode.
4. Indication of failure of communication link.
5. Key-switch or user-code access to control functions of panel.
6. Control of automatic transfer switch test initiation.
7. Control of automatic transfer switch operation in either direction.
8. Control of time-delay bypass for transfer to normal source.

B. Malfunction of remote annunciator and control system or communication link shall not affect functions of automatic transfer switches. Automatic transfer switch sensing, controlling, or operating functions shall not depend on remote annunciator and control system for proper operation.

C. Remote annunciation and control system shall include the following features:

1. Touchscreen type operator interface.
2. Control and indication means grouped together for each automatic transfer switch.
3. Label each indication and control group. Indicate the automatic transfer switch it controls, the location of the automatic transfer switch, and the identity of the load that it serves.
4. Digital Communication Capability: Matched to that of automatic transfer switches supervised.
5. Mounting: Steel cabinet, flush or surface mounted, as shown on the drawings.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install automatic transfer switches and associated remote components in accordance with the NEC, as shown on the drawings, and manufacturer’s instructions.

B. Anchor automatic transfer switches with rustproof bolts, nuts, and washers not less than 12 mm (1/2 inch) diameter, in accordance with manufacturer’s instructions, and as shown on drawings.

C. In seismic areas, automatic transfer switches shall be adequately anchored and braced per details on structural contract drawings to withstand the seismic forces at the location where installed.

D. Provide conduit turnups and cable entrance space required by the equipment to be mounted. Seal voids around conduit openings in slab with water- and oil-resistant caulking or sealant. Cut off and bush conduits 3 inches above slab surface. Concrete work shall be as specified in Section 03 30 00, Cast-in-Place Concrete.

E. Anchor remote control and/or annunciator panel to wall.

3.2 ACCEPTANCE CHECKS AND TESTS

A. An authorized representative of the automatic transfer switch manufacturer shall technically supervise and participate during all of the field adjustments and tests. Major adjustments and field tests shall be witnessed by the CO. The manufacturer’s representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer’s recommendations.

B. Perform manufacturer’s required field tests in accordance with the manufacturer's recommendations. In addition, include the following:

1. Visual Inspection and Tests:
    a. Compare equipment nameplate data with specifications and approved shop drawings.
    b. Inspect physical, electrical, and mechanical condition.
    c. Confirm correct application of manufacturer's recommended lubricants.
    d. Verify appropriate anchorage, required area clearances, and correct alignment.
    e. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method or performing thermographic survey after energization.
    f. Verify grounding connections.
    g. Verify ratings of sensors.
    h. Vacuum-clean enclosure interior. Clean enclosure exterior.
    i. Exercise all active components.
    j. Verify that manual transfer warning signs are properly placed.
    k. Verify the correct operation of all sensing devices, alarms, and indicating devices.
2. Electrical tests:
    a. Perform insulation-resistance tests.
    b. After energizing circuits, demonstrate the interlocking sequence and operational function for each automatic transfer switch at least three times.

i. Test bypass-isolation unit functional modes and related automatic transfer switch operations.
ii. Power failure of normal source shall be simulated by opening upstream protective device. This test shall be performed a minimum of five times.
iii. Power failure of emergency source with normal source available shall be simulated by opening upstream protective device for emergency source. This test shall be performed a minimum of five times.
iv. Low phase-to-ground voltage shall be simulated for each phase of normal source.
v. Operation and settings shall be verified for specified automatic transfer switch operational feature, such as override time delay, transfer time delay, return time delay, engine shutdown time delay, exerciser, auxiliary contacts, and supplemental features.
vi. Verify pickup and dropout voltages by data readout or inspection of control settings.
vii. Verify that bypass and isolation functions perform correctly, including the physical removal of the automatic transfer switch while in bypass mode.

3. When any defects are detected, correct the defects and repeat the tests as requested by the CO at no additional cost to the Government.

3.3 OPERATION & MAINTENANCE MANUAL

A. Provide a detailed operation and maintenance manual for normal operational sequences including complete parts list, project specific operations instructions in a written document.

B. Provide complete electronic copies in PDF and hard copies of manuals.

C. Provide as-built wiring and schematic diagrams in hard copy and PDF format.

3.4 FIELD SETTINGS VERIFICATION

A. The automatic transfer switch settings shall be verified in the field by an authorized representative of the manufacturer.

3.5 FOLLOW-UP VERIFICATION

A. Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the automatic transfer switches are in good operating condition and properly performing the intended function.

3.6 INSTRUCTION

A. Furnish the services of a factory trained technician for one 4-hour training period for instructing personnel in the maintenance and operation of the automatic transfer switches, on the dates requested by the CO.

END OF SECTION

SECTION 26 51 00

INTERIOR LIGHTING

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior lighting fixtures (luminaires) that use LED technology.
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, and finishes. Provide the complete luminaire to correspond with the features, accessories, number of LED's, wattage, and/or size specified in the text description of each luminaire type.

B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.

C. Lighting fixture schedule indicating the fixture manufacturer, catalog number, input watts, CRI and Kelvin temperature color identification, and description shall be included on the electrical documents.

D. Luminaire voltage shall match the voltage of the circuit serving the same.

1.3 INFORMATIONAL SUBMITTALS

A. Product Data: For each type of luminaire, arranged in order of luminaire designation. Include data on features, accessories, finishes, and the following:

1. Material and physical description of luminaire including dimensions.
2. Emergency lighting units including battery and charger.
3. Energy-efficiency data.
4. Life, output (lumens, CCT, and CRI), Kelvin temperature, and energy-efficiency data for LED light bars.
5. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each luminaire type. The adjustment factors shall be for light bars, drivers, and accessories identical to those indicated for the luminaire as applied in this Project.
   a. Testing Agency Certified Data: For indicated luminaires, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining

luminaires shall be certified by manufacturer. LM-79 and LM-80 data for solid state lighting.

b. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

6. Photometric data, certified by a qualified independent testing agency, in IESNA format, based on certified results of laboratory tests of each luminaire type, outfitted with light bars, drivers and accessories identical to those indicated for the luminaire as applied in the Project.
7. Low voltage transformers.
8. LED power supplies.
9. Types of LED's, including manufacturer, wattage, and Color Rendering Index (CRI) and color temperature in degrees Kelvin (K).

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

1.5 WARRANTY

A. LED Fixtures, Light Emitting Diodes (LEDs), and Drivers: Manufacturer shall provide five-year warranty against defects in materials and workmanship for all products. Project contractor shall replace defective fixtures and components during the first year of warranty without additional compensation.

B. Warranty period shall begin on date of substantial completion.

PART 2 -- PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers and products are subject to review and approval.

1. Provide fixtures from manufacturers listing in the luminaire schedule in the contract drawings
2. Provide cutsheets for specified fixtures.

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. All fixtures shall be LED type.

C. Incandescent, MR16, and quartz lamp fixtures are prohibited.

D. Fluorescent and induction lamp fixtures are prohibited.

E. HID lamp fixtures are prohibited.

F. LED: UL listed per document UL 8750.

G. Metal Parts: Free of burrs and sharp corners and edges.

H. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.

I. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit maintenance without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during maintenance and when secured in operating position.

J. Diffusers and Globes:

1. Use of lay-in acrylic lens luminaires requires approval.
2. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
   a. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
   b. UV stabilized.
   c. Glass: Annealed crystal glass unless otherwise indicated.

K. Air-handling fluorescent fixtures shall not be used.

2.3 LED LUMINAIRES AND DRIVERS

A. All Luminaires

1. Comply with IES LM-79-08 Approved Method for measuring lumen maintenance of LED light sources.
2. Comply with IES LM-80-08 Approved Method for electrical and photometric measurement of SSL product.
3. Comply with In-Situ testing for more reliable results.
4. LED’s shall be Restriction of Hazardous Substances Directive (RoHS) compliant.
5. LED arrays shall be sealed, high performance, long life type; minimum 70% rated output at 50,000 hours. (L70)
6. LED luminaires shall deliver a minimum of 80 lumens per watt.
   a. LED’s shall be “Bin No. 1” quality.
7. Drivers shall be solid state and accept 120 through 277 VAC at 60 Hz input.
8. The LED light source shall be fully dimmable with use of compatible dimmers switch designated for low voltage loads.

9. LED color temperatures: [3000/3500/4000/other (requires approval)] as noted, +/- 275K.
10. Luminaires shall have internal thermal protection.
11. Luminaires shall not draw power in the off state. Luminaires with integral occupancy, motion, photo-controls, or individually addressable luminaires with external control and intelligence are exempt from this requirement. The power draw for such luminaires shall not exceed 0.5 watts when in the off state.
12. Color spatial uniformity shall be within .004 of CIE 1976 diagram.
13. Color maintenance over rated life shall be within .007 of CIE 1976.
14. Indoor luminaires shall have a minimum CRI of 85.
15. Luminaire manufacturers shall adhere to device manufacturer guidelines, certification programs, and test procedures for thermal management
16. LED package(s)/module(s)/array(s) used in qualified luminaires shall deliver a minimum 70% of initial lumens, when installed in-situ, for a minimum of 50,000 hours.
17. Luminaires shall be fully accessible from below ceiling plane for changing drivers, power supplies and arrays.

B. Power Supplies and Drivers

1. Power Factor: 0.90 or higher
2. Maximum driver case temperature not to exceed driver manufacturer recommended in-situ operation.
3. Output operating frequency: 60Hz.
4. Interference: EMI and RFI compliant with FCC 47 CFR Part 15.
5. Total Harmonic Distortion Rating: 20% Maximum.
6. Meet electrical and thermal conditions as described in LM-80 Section 5.0.
7. Fully dimmable, 0 – 10 VDC standard.
8. Secondary Current: Confirm secondary current specified by individual luminaire manufacturers.
9. Compatibility of dimming switches: Certified by manufacturer for use with individually specified luminaire and individually specified control components.

2.4 LED ARRAYS

A. All LED’s of the same type are to be provided by the same manufacturer.

B. Equip each luminaire with the proper LED array of the type shown or specified in the Luminaire Schedule

2.5 WIRING

A. No internal wiring shall be visible at normal viewing angles.

2.6 EMERGENCY POWER UNIT

A. Internal Type, locations without life safety generator: Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body. Comply with UL924. All emergency fixture batteries shall be capable of fully lighting the associated fixture for a minimum of 90 minutes.

1. Emergency Connection: Operate as night light where not required to be switched.
    a. Test Push Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
        i. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
        ii. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
2. Battery: Sealed, maintenance-free, nickel-cadmium type.
3. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
4. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.
5. Interference: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for non-consumer equipment.
6. Protection: Class P thermal cutout.

B. Wall or ceiling mount dual head emergency lights with battery may be utilized.

2.7 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
2. Self-Powered Exit Signs (Battery Type), locations without a life safety generator: Integral automatic charger in a self-contained power pack.
    a. Battery: Sealed, maintenance-free, nickel-cadmium type.
    b. Charger: Fully automatic, solid-state type with sealed transfer relay.
    c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
    d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

2.8 LAMPS (EXISTING FLUORESCENT REPLACEMENT)

A. T8 rapid-start lamps, rated 28 W maximum, nominal length of 48 inches 2800 initial lumens (minimum), CRI 85 (minimum), color temperature 3500K, and average rated life of 36,000 hours.

1. Standard lamp is Sylvania Product Number 22178, F028/835/XP/SS/ECO with matching ballast: 1 lamp – QHE1x32 T8/UNV ISN-SC, 2 lamp – QHE 2x32 T8/UNV ISNSC, and 3 lamp – QHE 3x32 T8/UNV ISN-SC. Or equivalent Phillips lamps and ballasts.

2.9 KELVIN TEMPERATURE AND CRI STANDARDS

A. Standard Color Temperature:

1. Color Index: CRI 80-85 (provide CR 95 minimum in galleries or other spaces requiring higher CRI).
2. Kelvin temperature for indoor luminaires shall be 4000K.

2.10 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Section 26 05 29, Hangers & Supports for Electrical Systems for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2 inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2 inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 ga.

E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 ga.

F. Rod Hangers: 3/16 inch minimum diameter, cadmium-plated, threaded steel rod.

G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

B. Provide final aiming and focusing of luminaires under direction of USF-PM. All exterior lights final aiming and focusing shall be performed during non-daylight hours.

C. Comply with NFPA 70 for minimum fixture supports.

D. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.

E. Adjust amiable lighting fixtures to provide required light intensities.

F. Connect wiring according to Section 26 05 19, Low-Voltage Electrical Power Conductors & Cables.

G. All fixtures LEDs boards and drivers shall be readily accessible from underneath the fixture, through the lens, door, open aperture, etc.

H. For LED luminaires, adhere to manufacturers installation guidelines regarding proper thermal management.

I. Provide emergency lights in all restrooms.

3.2 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

C. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

D. Replace all inoperable LED arrays at the end of construction prior to facility entering use.

END OF SECTION

SECTION 26 56 00

EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Exterior luminaires with lamps and drivers
   2. Luminaire supports.
   3. Luminaire-mounted photoelectric relays.

B. Related Documents & Sections:
   1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections apply to the work of this Section.

C. Coordination Requirements:
   1. Coordinate the installation of all light fixtures with the work of other trades. This includes but is not limited to placement of fixtures in conjunction with civil work such as sidewalks, roadways, parking lots, landscaping and building exteriors.
   2. Coordinate the installation of all light fixtures with mounting surfaces fixtures will be mounted within, onto, or through. Coordinate placement of fixture supports, anchors, and mounts in conjunction with ceiling and wall system supports, anchors and mounts. Light fixture trims shall be coordinated with ceiling and wall surfaces.
   3. Coordinate the installation of all light fixtures with required external surge protection devices. See Paragraphs 2.5 & 2.8 below for more on surge protection requirements.

1.2 SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, and finishes.
   1. Submit manufacturer's product datasheet on each and every lighting fixture.
   2. Furnish shop drawing portfolios (collated & bound sets) containing the following information:
      a. Name of manufacturer, make and model of each particular fixture in the project.
      b. Product listing information (UL, ETL, DLC, Dark Sky, etc…)
      c. Descriptive cut sheets Indicate fixture catalog number selections, highlight or make obvious which part numbers are used to build the complete fixture catalog number.
      d. Complete photometric information and coefficient of utilization tables.
      e. Fixture voltage, match to project specifics.
      f. Wiring diagrams for power, control, and signal wiring.
      g. Photoelectric relays and how they interconnect into the system schematically.
      h. The number, type and wattage of the fixture lamps. Include lamp rated life, color temperature, color rending index (CRI), initial & mean lumen output.
      i. The wattage and illumination information for LED fixtures. Include rated life, color temperature, CRI, initial & mean lumen output of LED fixtures.

j. Lens information including type, pattern, thickness, material type, special features.
k. Fixture options, mounting details and ceiling compatibility information.
l. Construction of fixture housing and door, door type, access hole information.
m. Fixture ballast and driver manufacturer and type information.
n. Means of attaching luminaries to supports and indication that the attachment is suitable for components involved.

3. All lighting fixtures required to be used on this project shall be submitted in one single submittal so that all fixtures can be reviewed at one time. Those fixtures not receiving a shop drawing action of "Reviewed" or "Reviewed and Noted" on the first submittal shall be resubmitted for review. A light fixture receiving a shop drawing action of "Resubmit" or "Rejected" after the third review for any reason, shall be furnished as originally specified.
4. The portfolios shall be made from standard manufacturer's specification sheets. Each fixture shall be identified by the letter or number indicated on the fixture schedule or project plan sheets as applicable. The combining of more than one fixture type of fixture on a single sheet shall not be acceptable.

B. Shop Drawings for nonstandard or custom lighting fixtures: Show details indicating dimensions, weights, methods of field assembly, components, features, and accessories. Product Certificates: For each type of ballast and driver, dimmer-controlled fixtures, provided by manufacturer.

C. Product Schedule: For all luminaires and lamps, using the same designations as on the Project Drawings.

D. Qualification Data: For testing laboratory providing photometric data for luminaires.

E. Product Certificates: For each luminaire type and for each photoelectric relay type.

F. Product Test Reports: For each luminaire, for tests performed by a qualified testing agency. Provide all applicable source quality-control reports.

G. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

H. Provide all applicable field quality-control reports.

I. Project Record Documents: Record actual connections and locations of luminaires and any associated remote mounted components. Provide this information along with project ‘as-builts’ per the contract documents plans and specifications.

J. Warranty: Provide a copy of the sample warranty prior to commencement of work. Include a copy of the final approved warranty in the project close out documentation.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with IEEE C2, "National Electrical Safety Code."

C. Comply with NFPA 70.

D. Manufacturers: Firms regularly engaged in the manufacturer of interior and exterior light fixtures of types and ratings required, whose products have been in satisfactory use in similar service for not less than three (3) years.

E. Installer: Qualified with at least three (3) years of successful installation experience on projects with interior and exterior lighting fixture work similar to that required for this project.

F. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

G. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products and complying with applicable IES testing standards.

H. Provide luminaires from a single manufacturer for each luminaire type.

I. Mockups: As required on a project-by-project basis (typically not required) for exterior luminaires, complete with power and control connections.
   1. Obtain Architect's approval of luminaires in mockups before starting installations.
   2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed work.
   3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.4 REFERENCES

A. NEC Compliance: Comply with the NEC (NFPA 70) as applicable to the installation and construction of lighting fixtures.

B. NEMA Compliance: Comply with applicable requirements of NEMA Standard Pub. Nos. LE-1 and LE-2 pertaining to lighting equipment.

C. ANSI/UL Compliance: Comply with ANSI/UL Standards pertaining to interior and exterior lighting fixtures for hazardous locations. ANSI C82.11 - American National Standard for Lamp Ballasts - High Frequency Fluorescent Lamp Ballasts - Supplements.

D. IEEE C62.41.2 - Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits.

E. IESNA LM-79 - Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products; Illuminating Engineering Society.

F. IESNA LM-80 - Approved Method: Measuring Lumen Maintenance of LED Light Sources.

G. NECA 1 - Good Workmanship in Electrical Construction, latest edition.

H. NECA/IESNA 501 – Standard for Installing Exterior Lighting Systems, latest edition.

I. Underwriter's Laboratories (UL) Listings. Provide fixtures that have been UL Listed and labeled to any or all of the following standards as applicable to the project:
   1. UL 844 - Luminaires for Use in Hazardous (Classified) Locations.
   2. UL 924 - Emergency Lighting and Power Equipment.
   3. UL 1598 - Luminaires.
   4. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products.

1.5 DELIVERY, STORAGE AND PROTECTION

A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 501 (exterior lighting), NECA/IESNA 502 (industrial lighting), and all manufacturer's written instructions.

B. Keep fixtures in original product packaging until ready for installation. Do not leave unpackaged fixtures unattended or where they are subject to dirt, debris, or damage.

C. All fixtures shall be kept warm, dry, safe and secure. Adhere to manufacturer storage requirements.

D. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.6 EXTRA MATERIALS

A. At substantial completion of the project, furnish the following extra materials that match specified and installed products to the Owner for future use after completion of project warranty periods. Extra materials shall be delivered and stored at a location or locations directed by the Owner. Products shall be packaged with protective covering for storage and shall be suitably labeled by product type.
   1. Provide ten extra lamps for every 100 lamps (of each rating and type) installed on the project. Provide a minimum of at least one extra lamp for each lamp type and rating used.
   2. Provide one extra lens or louver for every 100 units (of each type) installed on the project. Provide a minimum of at least one extra lens and one extra louver for each type used.
   3. Provide one extra driver for every 100 units (of each type) installed on the project. Provide a minimum of at least one extra driver for each type used.
   4. Provide one extra set (complete set) of fuses for every 100 units (of each type) installed on the project. Provide a minimum of at least one set of fuses for each type used.
   5. Provide one extra photoelectric relay for every 100 units (of each type) installed on the project. Provide a minimum of at least one extra photoelectric relay for each type used.

1.7 WARRANTY

A. Provide a five (5) year manufacturer warranty for all exterior fixtures, LED drivers, and LED light boards (light engines) from date of substantial completion of the project. This warranty to cover all product defects, performance criteria, and parts.

B. Manufacturer and installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures, including luminaire support components.
      b. Faulty operation of luminaires and accessories.
      c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

PART 2 – PRODUCTS

2.1 FIXTURES, GENERAL

A. All fixtures shall be UL or other qualified third party listed for the environment where they will be installed including: damp, wet, extreme temperature, or hazardous locations.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.

D. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.
   1. LER Tests Incandescent Fixtures: Where LER is specified, test according to NEMA LE 5A.

E. Lateral Light Distribution Patterns: Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

F. Metal Parts: Free of burrs and sharp corners and edges.

G. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging.

H. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

I. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

J. Exposed Hardware Material: Stainless steel.

K. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

L. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.

M. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
   1. White Surfaces: 85 percent.
   2. Specular Surfaces: 83 percent.
   3. Diffusing Specular Surfaces: 75 percent.

N. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

O. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

P. Variations in Luminaire Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.

Q. Diffusers and Globes:
   1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
   2. Glass: Annealed crystal glass unless otherwise indicated.
   3. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

R. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
   1. Label shall include the following lamp and ballast characteristics:
      a. "USES ONLY" and include specific lamp type.
      b. Lamp diameter, shape, size, wattage and coating.
      c. CCT and CRI for all luminaires.

S. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant to withstand common vibrations encountered at installation site.
   1. The term “withstand” means “the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event.”

T. Color Temperature: To minimize disruption to wildlife, color temperature on all outdoor lighting shall be 3000K maximum.

2.2 MANUFACTURERS

A. Manufacturers: As noted on the drawings by notes and/or by the light fixture schedule dictated by this Section. Subject to compliance with requirements, provide products by one following:

1. Lithonia
2. Cooper
3. Hubbell
4. McGraw-Edison

2.3 LUMINAIRE SUPPORT COMPONENTS

A. Comply with general requirements found in the UNL Design Guidelines. Comply with all manufacturer written instructions for the physical characteristics and installation procedures.

2.4 LED LIGHTING FIXTURES

A. Complete LED lighting fixtures for general illumination shall have been tested by IES LM-79 and LM-80 requirements.

B. LED light fixtures shall be fabricated, assembled, and manufactured as a complete fixture unit, including housing, mounting hardware, driver, light boards (light engines), and lens.

C. LED lighting fixtures shall allow for separate replacement of the light boards and driver. In other words, 'throw away' fixtures with non-replaceable components are not permitted.

D. LED lighting fixtures shall be capable of continuous dimming as a standard offering. Dimming range to be from 100% to at least 20% of rated lumen output. Dimming control shall be 0-10VDC.

E. All LED fixture control devices shall be compatible with the type of drivers and dimming requirements of the particular project and coordinated with the lighting fixture submittals prior to ordering.

F. Universal input voltage (120-277 VAC) drivers shall be provided for all LED applications.

G. In-line fusing: On the primary for each luminaire

2.5 LED DRIVERS

A. Drivers shall operate from a 60Hz input AC voltage from 120V-277V. Unit shall have an input voltage tolerance range of at least +/- 10%.

B. The Total Harmonic Distortion (THD) of the driver input current shall be no more than 20% when operating at nominal input voltage.

C. Drivers shall have a minimum Power Factor (PF) of 0.90.

D. Drivers shall comply with IEEE/ANSI C62.41 Category C2 (medium) for transient voltage protection. This shall include a 10kV rating, and 5kA rating per the standard 8x20us combo wave testing parameters.

E. Drivers shall comply with the requirements of the FCC rules and regulations, Title 47 CFR Part 18, Non-consumer (Class A) for EMI & EMF (conducted and radiated) interference.

F. Fixtures may require additional surge protection apart from what is integral with the LED driver. See Paragraph 2.8 below for more details.

2.6 LED BOARDS

A. Rated minimum life of 60,000 hours minimum per IES LM-70 testing requirements.

B. Provide a TM21 report on LED boards to be used which tests LED life and lumen maintenance per the IES LM-80 standard, and LED light output and efficacy per the IES LM-70 standard.

C. The correlated color temperature (CCT) of the LEDs shall be 4000K unless noted otherwise. The CCT shall be uniform for all LED modules within like luminaire types and luminaires within a given project. The LED CCT measurements shall have a maximum of three standard deviations (3 SDCM, +/-90K) tolerance on the MacAdam Ellipse.

D. Provide LED boards such that any individual LED failure on a section of LED board within the fixture will not result in significant output loss of the overall fixture.

2.7 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

A. Comply with UL 773 or UL 773A.

B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc (16 to 32 lx) and off at 4.5 to 10 fc (48 to 108 lx) with 15-second minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.
   1. Relay with locking-type receptacle shall comply with ANSI C136.10.
   2. Adjustable window slide for adjusting on-off set points.

2.8 EXTERNAL LED DRIVER SURGE PROTECTION DEVICE (SPD)

A. All pole mounted LED light fixtures shall come equipped with an additional layer of SPD protection. This additional protection shall be in addition to requirements of the surge protection integral to the LED driver itself.

B. The SPD shall be circuited immediately upstream of the LED driver and mounted either within the fixture or immediately adjacent to it in a concealed, protected, and accessible location. Do not void manufacturer warranty or listing requirements when mounting the SPD.

C. The external SPD shall be circuited either in series or parallel with the light fixture circuit as required of the project and Owner needs. In series circuiting shall de-energize the fixture upon SPD failure (indicating a problem) while parallel circuiting shall allow for continued fixture use after SPD failure.

D. The additional SPD shall have a kilo-amp rating in excess of the kilo-amp rating of the fixture it is protecting. Minimum specifications shall meet IEEE/ANSI Category C2 (medium) 10kV, 5kA@ 8/20us standard combo and 6kV, 100kHz ring wave protection.

E. The additional SPD shall have a let-through voltage rating or Voltage Performance Rating (VPR) that limits the voltage to the downstream driver to within the voltage tolerance of the driver. Anticipated maximum clamping voltage (8/20us @ 10kA) as follows: 600V (120V circuit), 1000V (208-240V circuit), 1500V (277V circuit), and 2500V (480V circuit).

3. EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.

C. Examine walls, roofs, canopy ceilings and overhang ceilings for suitable conditions where luminaires will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is substantially complete, clean luminaires used for temporary lighting and install new lamps.

3.3 LUMINAIRE INSTALLATION

A. Install lamps in each luminaire.

B. Fasten luminaire to indicated structural supports. Additional support requirements include:

1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
2. Sized and rated for luminaire weight.
   Able to maintain luminaire position after cleaning and relamping.
3. Support luminaires without causing deflection of finished surface.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100
5. percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

C. Wall-Mounted Luminaire Support:
   1. Attached to structural members in walls.

D. Wiring Method: Install cables in raceways. Conceal raceways and cables.

E. Install luminaires level, plumb, and square with finished grade unless otherwise indicated. Install luminaires at height and aiming angle as indicated on Drawings.

F. Coordinate layout and installation of luminaires with other construction.

G. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.

H. Comply with requirements in Section 260519 “Conductors”, Section 260526 “Grounding System”, and Section 260533 “Raceways” for wiring connections and wiring methods.

3.4 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Section 260533 "Raceways" In concrete foundations, wrap conduit with 0.010-inch- (0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals.

3.6 FIELD QUALITY CONTROL

A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

B. Perform the following tests and inspections:
   1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
   2. Verify operation of photoelectric controls.

C. Illumination Tests:
   1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s):
      a. IES LM-5.
      b. IES LM-50.
      c. IES LM-52.
      d. IES LM-64.
      e. IES LM-72.
   2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

D. Luminaire will be considered defective if it does not pass tests and inspections.

E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain luminaires and photocell relays.

3.8 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
   1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
   2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
   3. Adjust the aim of luminaires in the presence of the Architect and UNL Project Manager.

END OF SECTION

DIVISION 31

EARTHWORK

SECTION 31 00 00

EARTHWORK

PART 1 - GENERAL

1.1 PROJECT-RELATED

A. The following information will be indicated on the project drawings:

1. Surface elevations, existing and new.
2. Location of underground obstructions and existing utilities.
3. Location of borrow and disposal area if located on Government property.
4. Clearing stripping and grubbing limits, if different from clearing limits.
5. Pipe trench excavation details.
6. Location and limits of hard material (rocks), where known or suspected.
7. Details of sewage absorption trenches, absorption pits, and subsurface drains.

1.2 MEASUREMENT PROCEDURES

A. Excavation

1. The unit of measurement for excavation and borrow will be the cubic yard, computed by the average end area method from cross-sections taken before and after the excavation and borrow operations, including the excavation for ditches, gutters, and channel changes, when the material is acceptably utilized or disposed of as herein specified.
2. The measurements will include authorized excavation of rock (except for piping trenches that are covered below), authorized excavation of unsatisfactory subgrade soil, and the volume of loose, scattered rocks and boulders collected within the limits of the work; allowance will be made on the same basis for selected backfill ordered as replacement.
3. The measurement will not include the volume of subgrade material or other material that is scarified or plowed and reused in place and will not include the volume excavated without authorization or the volume of any material used for purposes other than directed.
4. The volume of overburden stripped from borrow pits and the volume of excavation for ditches to drain borrow pits, unless used as borrow material, will not be measured for payment.
5. The measurement will not include the volume of any excavation performed before the taking of elevations and measurements of the undisturbed grade.

B. Piping Trench Excavation

1. Measure trench excavation by the number of linear feet along the centerline of the trench and excavate to the depths and widths specified for the size of the pipe.
2. Replace unstable trench bottoms with a selected granular material.
3. Include the additional width at manholes and similar structures, the furnishing, placing and removal of sheeting and bracing, pumping, and bailing, and all incidentals necessary to complete the work required by this section.

C. Rock Excavation for Trenches (Not needed)

D. Topsoil Requirements

1. Separate excavation, hauling and spreading, or piling of topsoil and related miscellaneous operations will be considered subsidiary obligations of the Contractor, covered under the contract unit price for excavation.

E. Select Granular Material

1. Measure selects granular material in place as the actual cubic yards replacing wet or unstable material in trench bottoms within the limits shown.
2. Provide unit prices which include furnishing and placing the granular material, excavation and disposal of unsatisfactory material, and additional requirements for sheeting and bracing, pumping, bailing, cleaning, and other incidentals necessary to complete the work.

1.3 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 180 .....(2017) Standard Method of Test for Moisture-Density Relations of Soils Using a 10-lb Rammer and an 18-in. Drop

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C600.....(2017) Installation of Ductile-Iron Mains and Their Appurtenances

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M.....(2020) Structural Welding Code - Steel AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)
AWPA P5.....(2015) Standard for Waterborne Preservatives

ASTM INTERNATIONAL (ASTM)

ASTM A139/A139M .....(2016) Standard Specification for Electric-Fusion (ARC)-Welded Steel Pipe (NPS 4 and over)
ASTM A252.....(2010) Standard Specification for Welded and Seamless Steel Pipe Piles
ASTM C33/C33M.....(2018) Standard Specification for Concrete Aggregates
ASTM C136/C136M.....(2019) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM D698.....(2012; E 2014; E 2015) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft.

ASTM D1140 .....(2017) Standard Test Methods for Determining the Amount of Material Finer than No. 200 Sieve in Soils by Washing
ASTM D1556/D1556M .....(2015; E 2016) Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method
ASTM D1557 .....(2012; E 2015) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3)
ASTM D1883 .....(2016) Standard Test Method for California Bearing Ratio (CBR) of Laboratory-Compacted Soils
ASTM D2167 .....(2015) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D2434 .....(1968; R 2006) Permeability of Granular Soils (Constant Head)
ASTM D2487 .....(2017; E 2020) Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D2937 .....(2017; E 2017; E 2018) Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method
ASTM D4318 .....(2017; E 2018) Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D4718/D4718M .....(2015) Standard Practice for Correction of Unit Weight and Water Content for Soils Containing Oversize Particles
ASTM D6938 .....(2017a) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 .....(2014) Safety -- Safety and Health Requirements Manual

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 600/4-79/020 .....(1983) Methods for Chemical Analysis of Water and Wastes

EPA SW-846.3-3 .....(1999, Third Edition, Update III-A) Test Methods for Evaluating Solid Waste: Physical/Chemical Methods

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-203 .....(Rev C; Notice 3) Paper, Kraft, Untreated

1.4 DEFINITIONS

A Satisfactory Materials: Comprise any materials classified by ASTM D2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP. Satisfactory materials for grading comprise stones less than 8 inches, except for fill material for pavements and railroads which comprise stones less than 3 inches in any dimension.

B. Unsatisfactory Materials: Materials that do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills; trash; refuse; backfills from previous construction; and material classified as satisfactory which contains root and other organic matter or frozen material. Notify the Contracting Officer when encountering any contaminated materials.

C. Cohesionless and Cohesive Materials: Cohesionless materials include materials classified in ASTM D2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic. Perform testing, required for classifying materials, following ASTM D4318, ASTM C136/C136M, and ASTM D1140.

D. Degree of Compaction: The degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D1557 [ASTM D698] abbreviated as a percent of laboratory maximum density. Since ASTM D1557 applies only to soils that have 30 percent or less by weight of their particles retained on the 3/4 inch sieve, express the degree of compaction for material having more than 30 percent by weight of their particles retained on the 3/4 inch sieve as a percentage of the maximum density following AASHTO T 180 and corrected with ASTM D4718/D4718M. To maintain the same percentage of coarse material, use the "remove and replace" procedure as described in NOTE 8 of Paragraph 7.2 in AASHTO T 180.

E. Topsoil: Material suitable for topsoils obtained from offsite areas is defined as Natural, friable soil representative of productive, well-drained soils in the area, free of subsoil, stumps, rocks larger than a one-inch diameter, brush, weeds, toxic substances, and other material detrimental to plant growth. Amend the topsoil pH range to obtain a pH of 5.5 to 7.

F. Hard/Unyielding Materials: Hard/Unyielding materials comprise weathered rock, dense consolidated deposits, or conglomerate materials that are not included in the definition of "rock" with stones greater than 3-inches in any dimension or as defined by the pipe manufacturer, whichever is smaller. These materials usually require the use of heavy excavation equipment, ripper teeth, or jackhammers for removal.

G. Rock: Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement exceeding 1/2 cubic yard in volume. Removal of hard material will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.

H. Unstable Material: Unstable materials are too wet to properly support the utility pipe, conduit, or appurtenant structure.

I. Select Granular Material: Select granular material consists of materials classified as GW, GP, SW, or SP, by ASTM D2487 where indicated. The liquid limit of such material must not exceed 35 percent when tested following ASTM D4318. The plasticity index must not be greater than 12 percent when tested following ASTM D4318, and not more than 35 percent by weight may be finer than the No. 200 sieve when tested following ASTM D1140. Provide a minimum coefficient of permeability of 0.002 feet per minute when tested following ASTM D2434.

J. Initial Backfill Material: Initial backfill consists of select granular material or satisfactory materials free from rocks 3-inches or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller. When the pipe is coated or wrapped for corrosion protection, free the initial backfilling material of stones larger than 3-inches in any dimension or as recommended by the pipe manufacturer, whichever is smaller.

K. Expansive Soils: Expansive soils are defined as soils that have a plasticity index equal to or greater than 23 when tested following ASTM D4318.

L. Non-frost Susceptible (NFS) Material: Nonfrost susceptible material is a uniformly graded washed sand with a maximum particle size of 5 mm and less than 5 percent passing the No. 200 size sieve, and with not more than 3 percent by weight finer than 0.02 mm grain size.

1.5 SYSTEM DESCRIPTION

A. No subsurface soil boring logs are available for the project site, nor has there been a subsoil investigation report prepared for this site.

B. Classification of Excavation: No consideration will be given to the nature of the materials, and all excavations will be designated as unclassified excavations.

C. Common Excavation: Include common excavation with the satisfactory removal and disposal of all materials not classified as rock excavation.

D. Rock Excavation: The consideration of rock excavation is not expected for this project.

1. If rock is encountered, submit a notification of encountering rock to the Contracting Officer.
2. Include rock excavation with excavating, grading, disposing of material classified as rock, and the satisfactory removal and disposal of boulders 1/2 cubic yard or more in volume; solid rock; rock material that is in ledges, bedded deposits, and unstratified masses, which cannot be removed without systematic drilling and blasting; firmly cemented conglomerate deposits possessing the characteristics of solid rock impossible to remove without systematic drilling and blasting; and hard materials (see Definitions).
   a. However, if rock is encountered, blasting will not be permitted as a means of removal.
3. Include the removal of any single concrete or masonry structures, except pavements, exceeding 1/2 cubic yard in volume that may be encountered in the work in this classification.
4. If at any time during excavation, including excavation from borrow areas, the Contractor encounters material that may be classified as rock excavation, uncover such material and notify the Contracting Officer.
   a. Do not proceed with the excavation of this material until the Contracting Officer has classified the materials as common excavation or rock excavation and has taken cross-sections as required.
   b. Failure on the part of the Contractor to uncover such material, notify the Contracting Officer, and allow ample time for classification and cross-sectioning of the undisturbed surface of such material will cause the forfeiture of the Contractor's right of claim to any classification or volume of material to be paid for other than that allowed by the Contracting Officer for the areas of work in which such deposits occur.

PART 2 - PRODUCTS

2.1 REQUIREMENTS FOR OFFSITE SOILS

A. Test offsite soils brought in for use as backfill for Total Petroleum Hydrocarbons (TPH), Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and full Toxicity Characteristic Leaching Procedure (TCLP) including ignitability, corrosivity, and reactivity.

B. Backfill shall contain a maximum of 100 parts per million (ppm) of total petroleum hydrocarbons (TPH) and a maximum of 10 ppm of the sum of Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and shall pass the TCPL test.

C. Determine TPH concentrations by using EPA 600/4-79/020 Method and determine BTEX concentrations by using EPA SW-846.3-3 Method 5030/8020. Perform TCLP following EPA SW-846.3-3 Method 1311.

D. Provide Borrow Site Testing for TPH, BTEX, and TCLP from a composite sample of material from the borrow site, with at least one test from each borrow site.

E. Do not bring material onsite until the submitted test results have been approved by the Contracting Officer.

2.2 BURIED WARNING AND IDENTIFICATION TAPE

A. Provide metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines.

1. Provide tape on rolls, 3 inches minimum width, color-coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length.
2. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording.
3. Provide permanent color and printing, unaffected by moisture or soil.

Warning Tape Color Codes	
Red	Electric
Yellow	Gas, Oil; Dangerous Materials
Orange	Telephone and Other Communications
Blue	Water Systems
Green	Sewer Systems
White	Steam Systems
Gray	Compressed Air

B. Warning Tape for Metallic Piping

1. Provide acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above, with a minimum thickness of 0.003 inches and a minimum strength of 1500 psi lengthwise, and 1250 psi crosswise, with a maximum 350 percent elongation.

C. Detectable Warning Tape for Non-Metallic Piping

1. Provide polyethylene plastic tape conforming to the width, color, and printing requirements specified above, with a minimum thickness of 0.004 inches, and a minimum strength of 1500 psi lengthwise and 1250 psi crosswise.
2. Manufacture tape with integral wires, foil backing, or other means of enabling detection by a metal detector when the tape is buried up to 3 feet deep.
3. Encase metallic elements of the tape in a protective jacket or provide other means of corrosion protection.

D. Detection Wire For Non-Metallic Piping

1. Insulate a single strand, solid copper detection wire with a minimum of 12 AWG.

PART 3 - EXECUTION

3.1 STRIPPING OF TOPSOIL

A. Where indicated or directed, strip topsoil to a depth of 4-inches.

B. Spread topsoil on areas already graded and prepared for topsoil, or transport and deposit in stockpiles convenient to areas that are to receive an application of the topsoil later, or at locations indicated or specified.

C. Keep topsoil separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 2 inches in diameter, and other materials that would interfere with planting and maintenance operations.

D. Remove from the site any surplus of topsoil from excavations and gradings.

3.2 GENERAL EXCAVATION

A. Perform excavation of every type of material encountered within the limits of the project to the lines, grades, and elevations indicated and as specified.

B. Perform the grading per the typical sections shown and the tolerances specified in paragraph FINISHING.

C. Transport satisfactory excavated materials and place them in the fill or embankment within the limits of the work.

D. Excavate unsatisfactory materials encountered within the limits of the work below grade and replace them with satisfactory materials as directed. Include such excavated material and the satisfactory material ordered as a replacement in excavation.

E. Dispose of surplus satisfactory excavated material not required for fill and unsatisfactory excavated material as specified in paragraph DISPOSITION OF SURPLUS MATERIAL.

F. During construction, perform excavation and fill in a manner and sequence that will provide proper drainage at all times.

G. Excavate material required for fill or embankment over that produced by excavation within the grading limits from other approved areas selected by the Contractor as specified.

3.3 TRENCH EXCAVATION REQUIREMENTS

A. Excavate the trench as recommended by the manufacturer of the pipe to be installed.

B. Slope trench walls below the top of the pipe, or make vertical, and of such width, as recommended in the manufacturer's printed installation manual.

C. Provide vertical trench walls where no manufacturer's printed installation manual is available.

D. Shore trench walls, cut back to a stable slope, or provide equivalent means of protection for employees who may be exposed to moving ground or cave in, as determined by the Contractor’s Safety Engineer or another competent person; refer to USACE publication EM 385-1-1.

E. Excavate trench walls which are cut back to at least the angle of repose of the soil.

F. Give special attention to slopes that may be adversely affected by weather or moisture content.

G. Do not exceed the trench width below the pipe top of 24 inches plus pipe outside diameter (O.D.) for pipes of less than 24 inches inside diameter, and do not exceed 36 inches plus pipe outside diameter for sizes larger than 24 inches inside diameter.

H. Where recommended trench widths are exceeded, provide redesign, stronger pipe, or special installation procedures by the Contractor.

I. The Contractor is responsible for the cost of redesign, stronger pipe, or special installation procedures without any additional cost to the Government.

3.4 BOTTOM PREPARATION

A. Grade the bottoms of trenches accurately to provide uniform bearing and support for the bottom quadrant of each section of the pipe.

B. Excavate bell holes to the necessary size at each joint or coupling to eliminate point bearing.

C. Remove stones of 3- inches or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, to avoid point bearing.

3.5 REMOVAL OF UNYIELDING MATERIAL

A. Where unyielding material is encountered in the bottom of the trench, remove such material 6-inches below the required grade and replace it with suitable materials as provided in the paragraph BACKFILLING AND COMPACTION.

3.6 REMOVAL OF UNSTABLE MATERIAL

A. Where unstable material is encountered in the bottom of the trench, remove such material to the depth directed and replace it to the proper grade with select granular material as provided in the paragraph BACKFILLING AND COMPACTION.

B. When removal of unstable material is required due to the Contractor's fault or neglect in performing the work, the Contractor is responsible for excavating the resulting material and replacing it without additional cost to the Government.

3.7 EXCAVATION FOR APPURTENANCES

A. Provide excavation for manholes, catch basins, inlets, or similar structures of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown.

B. Clean and remove loose disintegrated rock and thin strata or other loose debris and cut to a firm surface either level, stepped, or serrated, and specify removal of unstable material.

C. When concrete or masonry is to be placed in an excavated area, take special care not to disturb the bottom of the excavation.

D. Do not excavate to the final grade level until just before the concrete or masonry is to be placed.

3.8 UNDERGROUND UTILITIES

A. The Contractor is responsible for the movement of construction machinery and equipment over pipes and utilities during construction.

B. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured.

C. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the Contracting Officer.

D. Report damage to utility lines or subsurface construction immediately to the Contracting Officer.

3.9 STRUCTURAL EXCAVATION

A. Ensure that footing subgrades have been inspected and approved by the Contracting Officer before concrete placement.

3.10 SELECTION OF BORROW MATERIAL

A. Select borrow material to meet the requirements and conditions of the particular fill or embankment for which it is to be used.

B. Unless otherwise provided in the contract, the Contractor is responsible for obtaining the right to procure material, pay royalties and other charges involved, and bear the expense of developing the sources, including rights-of-way for hauling from the owners.

C. Borrow material from approved sources on Government-controlled land may be obtained without payment of royalties.

D. Unless specifically provided, do not obtain borrow within the limits of the project site without prior written approval.

E. Consider necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon related operations to the borrow excavation.

3.11 OPENING AND DRAINAGE OF EXCAVATION AND BORROW PITS

A. Except as otherwise permitted, excavate borrow pits and other excavation areas providing adequate drainage.

B. Transport overburden and other spoil material to designated spoil areas or otherwise dispose of as directed.

C. Provide neatly trimmed and drained borrow pits after the excavations are completed.

D. Ensure that excavation of any area, operation of borrow pits, or dumping of spoil material results in minimum detrimental effects on natural environmental conditions.

3.12 SHORING

A. General Requirements

1. When any work requires excavations greater than 5 feet in depth or where it is known that in-situ soils lack the stability to hold near-vertical faces, a shoring plan will be required where sufficient room is available, the Contractor may slope back trench walls rather than having to use a shoring system.
2. The Contractor shall not slope the faces of excavations in lieu of providing shoring unless all of the following conditions are met:
    a. The excavation is less than 20 feet in depth.
    b. There are no adjacent structures, roads, or pavements that will affect the excavation.
    c. No equipment, stored material, or overlying material will affect the excavation.
    d. Vibration from equipment, traffic, or blasting will not affect the excavation.
    e. There will be no groundwater problems.
    f. Surcharges will not affect the excavation.
    g. Station operational considerations permit laying back the slopes of the excavation.
3. Submit a Shoring and Sheeting plan for approval 15 days before starting work.
    a. Submit drawings and calculations, certified by a registered professional engineer, describing the methods for shoring and sheeting of excavations.

c. Finish shoring, including sheet piling, and install as necessary to protect workmen, banks, adjacent paving, structures, and utilities.
d. Remove shoring, bracing, and sheeting as excavations are backfilled, in a manner to prevent caving.

3.13 GRADING AREAS

A. Where indicated, divide work into grading areas within which satisfactory excavated material will be placed in embankments, fills, and required backfills.

B. Do not haul satisfactory material excavated in one grading area to another grading area except when so directed in writing. Place and grade stockpiles of satisfactory and wasted materials as specified.

C. Keep stockpiles in a neat and well-drained condition, giving due consideration to drainage at all times.

D. Clear, grub, and seal by rubber-tired equipment, the ground surface at stockpile locations; separately stockpile excavated satisfactory and unsatisfactory materials.

E. Protect stockpiles of satisfactory materials from contamination which may destroy the quality and fitness of the stockpiled material.

F. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, remove and replace such material with satisfactory material from approved sources.

3.14 FINAL GRADE OF SURFACES TO SUPPORT CONCRETE

A. Do not excavate to the final grade until just before concrete is to be placed.

B. Roughen the level surfaces, and cut the sloped surfaces, as indicated, into rough steps or benches to provide a satisfactory bond. Protect shales from slaking and all surfaces from erosion resulting from ponding or water flow.

3.15 GROUND SURFACE PREPARATION

A. General Requirements

1. Remove and replace unsatisfactory material with satisfactory materials, as directed by the Contracting Officer, on surfaces to receive fill or in excavated areas.
2. Scarify the surface to a depth of 6 inches before the fill is started.
3. Plow, step, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so that the fill material will bond with the existing material.
4. When subgrades are less than the specified density, break up the ground surface to a minimum depth of 6 inches, pulverizing, and compacting to the specified density.
5. When the subgrade is part fill and part excavation or natural ground, scarify the excavated or natural ground portion to a depth of 12 inches and compact it as specified for the adjacent fill.

B. Frozen Material

1. Do not place material on surfaces that are muddy, frozen, or contain frost.
2. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted.
3. Moisten material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used.

3.16 UTILIZATION OF EXCAVATED MATERIALS

A. Use satisfactory material removed from excavations, insofar as practicable, in the construction of fills, embankments, subgrades, shoulders, bedding (as backfill), and for similar purposes.

B. Dispose of surplus satisfactory excavated material not required for fill and unsatisfactory excavated material as specified in paragraph DISPOSITION OF SURPLUS MATERIAL.

C. Stockpile and use coarse rock from excavations for constructing slopes or embankments adjacent to streams, or sides and bottoms of channels and for protecting against erosion.

D. Do not dispose of excavated material to obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.

3.17 BURIED TAPE AND DETECTION WIRE

A. Buried Warning and Identification Tape

1. Provide buried utility lines with utility identification tape. Bury tape 12 inches below the finished grade; under pavements and slabs, bury tape 6 inches below the top of the subgrade.

B. Buried Detection Wire

1. Bury detection wire directly above non-metallic piping at a distance not to exceed 12 inches above the top of the pipe.
2. Extend the wire continuously and unbroken, from manhole to manhole. Terminate the ends of the wire inside the manholes at each end of the pipe, with a minimum of 3 feet of wire, coiled, remaining accessible in each manhole. Furnish insulated wire over its entire length. Install wires at manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal.
3. For force mains, terminate the wire in the valve pit at the pump station end of the pipe.

3.18 FILLING, BACKFILLING, AND COMPACTION

A. Place fill and backfill beneath and adjacent to any and all types of structures, in successive horizontal layers of loose material not more than 8 inches in depth, or loose layers not more than 5 inches in depth when using hand-operated compaction equipment.

B. Compact to at least 90 percent of laboratory maximum density for cohesive materials or 95 percent of laboratory maximum density for cohesionless materials, except as otherwise specified.

C. Perform compaction in such a manner as to prevent wedging action or eccentric loading upon or against the structure.

D. Moisture condition fills and backfill material to a moisture content that will readily facilitate obtaining the specified compaction.

E. Prepare ground surface on which backfill is to be placed and provide compaction requirements for backfill materials in conformance with the applicable portions of paragraphs GROUND SURFACE PREPARATION.

F. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

G. Trench Backfill

1. Backfill trenches to the grade shown.
2. Do not backfill the trench until all specified tests are performed.
3. Replace unyielding material removed from the bottom of the trench with select granular material or initial backfill material.
4. Replace unstable material removed from the bottom of the trench or excavation with select granular material placed in layers not exceeding 6 inches loose thickness.

H. Bedding and Initial Backfill

1. Provide bedding of the type and thickness shown in the plans.
2. Place initial backfill material and compact it with approved tampers to a height of at least one foot above the utility pipe or conduit.
3. Bring up the backfill evenly on both sides of the pipe for the full length of the pipe. Take care to ensure thorough compaction of the fill under the haunches of the pipe.
4. Except as specified otherwise in the individual piping section, provide bedding for buried piping following AWWA C600, Type 4, except as specified herein.
5. Compact backfill to top of the pipe to 95 percent of ASTM D698 maximum density.
6. Provide plastic piping with bedding to the spring line of the pipe.

I. Provide materials as follows:

1. Class I - Angular, 0.25 to 1.5 inch, graded stone, including several fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.
2. Class II - Coarse sands and gravels with a maximum particle size of 1.5 inches, including various graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry.
    a. Soil Types GW, GP, SW, and SP are included in this class as specified in ASTM D2487.
    b. Sand - Clean, coarse-grained sand classified per Section 31 23 00 EXCAVATION AND FILL, or SW or SP by ASTM D2487 for bedding and backfill as indicated.
    c. Gravel and Crushed Stone - Clean, coarsely graded natural gravel, crushed stone, or a combination thereof identified per Section 31 23 00 EXCAVATION AND FILL, or having a classification of GW or GP following ASTM D2487. Do not exceed the maximum particle size of 3-inches.

d. Final Backfill - Fill the remainder of the trench, except for special materials for roadways, railroads, and airfields, with satisfactory material. Place backfill material and compact it as follows:
   1) Roadways, Railroads, and Airfields - Place backfill up to the required elevation as specified. Do not permit water flooding or jetting methods of compaction.
   2) Sidewalks, Turfed or Seeded Areas, and Miscellaneous Areas - Deposit backfill in layers of a maximum of 12 inches loose thickness, and compact it to 85 percent maximum density for cohesive soils and 90 percent maximum density for cohesionless soils. Do not permit compaction by water flooding or jetting. Apply this requirement to all other areas not specifically designated above.

J. Backfill for Appurtenances

1. After the manhole, catchbasin, inlet, or similar structure has been constructed, place backfill in such a manner that the structure is not damaged by the shock of falling earth. Deposit the backfill material, compact it as specified for the final backfill, and bring up the backfill evenly on all sides of the structure to prevent eccentric loading and excessive stress.

3.19 SPECIAL REQUIREMENTS

A. Special requirements for both excavation and backfill relating to the specific utilities are as follows:

B. Gas Distribution

1. Excavate trenches to a depth that will provide a minimum of 18 inches of cover in rock excavation and a minimum of 24 inches of cover in other excavation.

C. Water Lines

1. Excavate trenches to a depth that provides a minimum cover of 2 feet from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe for frost penetration in the region and safe operation of the utility. For fire protection yard mains or piping, reference is made to NFPA 24 for recommended depth of cover.

D. Heat Distribution System - Not Used

E. Electrical Distribution System

1. Provide a minimum cover of 24 inches from the finished grade to direct burial cable and conduit or duct line, unless otherwise indicated.

F. Pipeline Casing - Not Used

G. Rip-Rap Construction – Not Used

3.20 EMBANKMENTS – Not Used

3.21 SUBGRADE PREPARATION

A. Proof Rolling – Not Used

B. Construction

1. Shape subgrade to the line, grade, cross-section, and compact as specified.
2. Include plowing, disking, and any moistening or aerating required to obtain specified compaction for this operation.
3. Remove soft or otherwise unsatisfactory material and replace it with satisfactory excavated material or other approved material as directed.
4. Excavate rock encountered in the cut section to a depth of 6 inches below the finished grade for the subgrade.
5. Bring up low areas resulting from removal of unsatisfactory material or excavation of rock to required grade with satisfactory materials, and shape the entire subgrade to the line, grade, and cross-section, and compact as specified.
6. After rolling, the surface of the subgrade for roadways shall not show deviations greater than 1/2 inch when tested with a 12-foot straightedge applied both parallel and at right angles to the centerline of the area.
7. Do not vary the elevation of the finished subgrade more than 0.05 feet from the established grade and cross-section.

C. Compaction

1. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.
2. Except for paved areas, compact each layer of the embankment to at least 90 percent of laboratory maximum density per ASTM D1557.

D. Subgrade for Pavements

1. Compact subgrade for pavements to at least 95 percent of the laboratory maximum density for the depth below the surface of the pavement shown per the latest edition of the CalTrans Standard Specifications Manual.

E. Subgrade for Shoulders

1. Compact subgrade for shoulders to at least 90 percent of laboratory maximum density for the full depth of the shoulder.

3.15 SHOULDER CONSTRUCTION – Not Used

3.16 FINISHING

A. Finish the surface of excavations, embankments, and subgrades to a smooth and compact surface per the lines, grades, and cross-sections or elevations shown.

B. Provide the degree of finish for graded areas within 0.1 foot of the grades and elevations indicated except that the degree of finish for subgrades specified in paragraph SUBGRADE PREPARATION.

C. Finish gutters and ditches in a manner that will result in effective drainage.

D. Finish the surface of areas to be turfed to a smoothness suitable for the application of turfing materials.

E. Repair graded, topsoiled, or backfilled areas before acceptance of the work, and re-established grades to the required elevations and slopes.

F. Subgrade and Embankments

1. During construction, keep embankments and excavations shaped and drained.
2. Maintain ditches and drains along the subgrade to drain effectively at all times.
3. Do not disturb the finished subgrade by traffic or other operation.
4. Protect and maintain the finished subgrade in a satisfactory condition until ballast, subbase, base, or pavement is placed.
5. Do not permit the storage or stockpiling of materials on the finished subgrade.
6. Do not lay subbase, base course, ballast, or pavement until the subgrade has been checked and approved, and in no case place subbase, base, surfacing, pavement, or ballast on a muddy, spongy, or frozen subgrade.

G. Grading Around Structures

1. Construct areas within 5 feet outside of each building and structure line true-to-grade, shape to drain, and maintain free of trash and debris until the final inspection has been completed and the work has been accepted.

3.17 PLACING TOPSOIL

A. Topsoil will be separated, excavated, stored, and used for the surface finish in preparation for seeding, sodding, or other plantings only where the topsoil is superior for grass and other plant growth as compared to the balance of the excavated materials.

B. In areas to receive topsoil, prepare the compacted subgrade soil to a 2 inches depth for bonding of topsoil with subsoil.

C. Spread topsoil evenly and grade to the elevations and slopes shown. Do not spread topsoil when frozen or excessively wet or dry.

D. Obtain material required for topsoil over that produced by excavation within the grading limits from areas indicated.

3.18 TESTING

A. Perform testing by an NPS validated commercial testing laboratory or the Contractor's validated testing facility.

B. Submit qualifications of the NPS validated commercial testing laboratory or the Contractor's validated testing facilities. If the Contractor elects to establish testing facilities, do not permit work requiring testing until the Contractor's facilities have been inspected, NPS validated, and approved by the Contracting Officer.

C. Determine field in-place density following the Caltrans Standard Specification Manual.

D. When test results indicate, as determined by the Contracting Officer, that compaction is not as specified, remove the material, replace and recompact to meet specification requirements. Perform tests on recompacted areas to determine conformance with specification requirements.

E. Fill and Backfill Material Gradation

1. One test per 500 cubic yards stockpiled or in-place source material. Determine gradation of fill and backfill material following ASTM C136/C136M.

F. In-Place Densities

1. The following table will also help establish test frequency for various situations:

Material Type	Location of Material	Test Frequency
Undisturbed native soil	Structures	Two random tests in building footings and two tests on subgrade within building line
Lifts, Fills, and Backfills	Structures (adjacent to)	One test per structure per 2000 sq ft taken 1 foot below finished grade compacted by other than hand-operated machines
Lifts, Fills, and Backfills	Structures (adjacent to)	One test per structure per 200 sq ft taken 1 foot below finished grade compacted by hand-operated machines
Subgrades	Site inc. Roads (except airfields)	One test per 2500 sq ft
Embankments or borrow	Any	One test per lift per 500 cubic yds placed
Native soil subgrade other than structures and parking	Any	One test or one test per 10,000 sq ft whichever is greater
Borrow	Any	One test per lift per 500 cubic yds placed

2. If ASTM D6938 is used, check in-place densities by ASTM D1556/D1556M.

G. Moisture Contents

1. In the stockpile, excavation, or borrow areas, perform a minimum of two tests per day per type of material or source of material being placed during stable weather conditions.
2. During unstable weather, perform tests as dictated by local conditions and approved by the Contracting Officer.

H. Optimum Moisture and Laboratory Maximum Density

1. Perform tests for each type of material or source of material including borrowed material to determine the optimum moisture and laboratory maximum density values.
2. One representative test per 500 cubic yards of fill and backfill, or when any material change occurs which may affect the optimum moisture content or laboratory maximum density.

I. Tolerance Tests for Subgrades

1. Perform continuous checks on the degree of finish specified in paragraph SUBGRADE PREPARATION during construction of the subgrades.

J. Displacement of Sewers

1. After other required tests have been performed and the trench backfill compacted to 2 feet above the top of the pipe, inspect the pipe to determine whether significant displacement has occurred. Conduct this inspection in the presence of the Contracting Officer.
2. Inspect pipe sizes larger than 36 inches, while inspecting smaller diameter pipes by shining a light or laser between manholes or manhole locations, or by the use of television cameras passed through the pipe.
3. If, in the judgment of the Contracting Officer, the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, replace or repair the defects as directed at no additional cost to the Government.

3.19 DISPOSITION OF SURPLUS MATERIAL

A. Surplus material and excavated unsatisfactory material not required or suitable for filling or backfilling, and brush, refuse, stumps, roots, and timber shall be removed from Government property and properly disposed of in accordance with all applicable laws and regulations.

END OF SECTION

SECTION 31 05 16

AGGREGATE FOR EARTHWORK

PART 1 - GENERAL

1.1 RELATED SECTIONS

A. Section 01 33 23 - Submittal Procedures.

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

C. Section 31 23 00 - Excavation & Fill.

D. Section 32 11 23 - Aggregate Base Courses.

E. Section 32 12 16 - Asphalt Paving.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM International).

1. ASTM D4791, Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.

1.3 SOURCE QUALITY CONTROL

A. The Source of materials to be incorporated into work or stockpiles requires approval.

B. Inform Contracting Officer of proposed source of aggregates and provide access for sampling at least 4 weeks before commencing production.

C. If, in the opinion of the Owner, materials from the proposed source do not meet, or cannot be processed to meet, specified requirements, locate an alternative source or demonstrate that material from the source in question can be processed to meet specified requirements.

D. Should a change of material source be proposed, advise Contracting Officer four (4) weeks in advance of the proposed change to allow sampling and testing.

E. Acceptance of material at source does not preclude future rejection if it is subsequently found to lack uniformity, or if its field performance is found to be satisfactory.

1.4 SAMPLES

A. Aggregate will be subject to continual sampling by the Owner during production.

B. Provide Owner with access to source and processed material for sampling and testing.

C. The contractor shall bear the cost of sampling and testing aggregates that fail to meet specified requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aggregate quality: sound, hard, durable material free from soft, thin, elongated, or laminated particles, organic material, clay lumps or minerals, or other substances that would act in a deleterious manner for the use intended.

B. Flat and elongated particles of coarse aggregate: ASTM D4791.

1. The greatest dimension to exceed five times the least dimension.

C. Fine aggregates satisfying requirements of the applicable section to be one, or blend of the following:

1. Natural sand.
2. Manufactured sand.
3. Screenings produced in the crushing of quarried rock, boulders, gravel, or slag.

D. Coarse aggregates satisfying requirements of the applicable section to be one of or blend of the following:

1. Crushed rock or slag.
2. Gravel and crushed gravel composed of naturally formed particles of stone.

PART 3 - EXECUTION

3.1 TOPSOIL STRIPPING

A. Do not manage topsoil while in wet or frozen conditions or in any way in which soil structure is adversely affected.

B. Commence topsoil stripping of areas as indicated after the area has been cleared and removed from the site.

C. Strip topsoil to depths as indicated. Avoid mixing topsoil with subsoil.

D. Stockpile in locations as directed by Contracting Officer.

3.2 DEVELOPMENT OF AGGREGATE SOURCE

A. Contractor to produce aggregates off-site.

B. Contractor to develop aggregate source to prevent contamination of aggregates stockpiled.

3.3 PROCESSING

A. Process aggregates uniformly using methods that prevent contamination, segregation, and degradation.

B. Blend aggregates, if required, to obtain requirements, percentage of crushed particles, or particle shapes, as specified. Use methods and equipment approved by the Owner.

C. Wash aggregates, if required to meet specifications. Use only equipment approved by Contracting Officer.

D. When operating in stratified deposits use excavation equipment and methods that produce uniform, homogeneous aggregate.

3.4 HANDLING

A. Handle and transport aggregates to avoid segregation, contamination, and degradation.

3.5 STOCKPILING

A. Stockpile aggregates on-site in locations as indicated unless directed otherwise by Contracting Officer. Do not stockpile on completed pavement surfaces.

B. Stockpile aggregates in sufficient quantities to meet Project schedules.

C. Stockpiling sites to be level, well-drained, and of adequate bearing capacity and stability to support stockpiled materials and handling equipment.

D. Except where stockpiled on stabilized areas, provide a compacted sand base not less than 12 inches in depth to prevent contamination of aggregate. Stockpile aggregates on the ground but does not incorporate the bottom 12 inches of the pile into work.

E. Separate different aggregates by strong, full depth bulkheads, or stockpile far enough apart to prevent intermixing.

F. Do not use intermixed or contaminated materials. Remove and dispose of rejected materials as directed by Contracting Officer within 2 working days of rejection.

G. Stockpile materials in uniform layers.

H. Uniformly spot-dump aggregates are delivered to stockpile in trucks and build up stockpile as specified.

I. Do not cone piles or spill material over the edges of piles.

J. During winter operations, prevent ice and snow from becoming mixed into the stockpile or in the material being removed from the stockpile.

3.6 CLEANING

A. Leave aggregate stockpile site in tidy, well-drained condition, free of standing surface water.

END OF SECTION

SECTION 31 10 00

SITE CLEARING

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work of this Section includes clearing and grubbing, topsoil removal, and storage.

1.2 SUBMITTALS

A. Certifications and testing consistent with Submittal Procedures - Section 01 33 23.

PART 2 - PRODUCTS NOT USED.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protection

1. Provide barricades, coverings, and other protection necessary to prevent damage to existing improvements.
2. Protect improvements on Park property.
3. Protect existing trees.
    a. Do not smother trees by stockpiling construction materials or excavated materials within the drip line.
    b. Avoid foot or vehicular traffic or parking of vehicles within the drip line.
    c. Provide temporary protection as required to prevent damage to trees.
    d. Do not remove, injure, or destroy trees or other plants without prior approval from Contracting Officer.
    e. Provide protection for roots over one- and one-half inches in diameter that are cut during construction operations.
4. Coat cut faces with an emulsified asphalt, or another acceptable coating specially formulated for horticultural use on cut or damaged plant tissues.
5. Temporarily cover all exposed roots with wet burlap to prevent roots from drying out.
6. Provide earth cover as soon as possible.
7. Repair or replace trees and vegetation damaged by construction operations.
    a. Repair to be performed by a qualified arborist.
    b. Remove trees that cannot be repaired.
    c. Replace with new trees of a minimum four inches caliper.
8. Repairs or replacements are to be completed in a manner acceptable to Contracting Officer at no additional expense to Government.

B. Clearing and Grubbing

1. Special Requirements:
   a. See Section 01 11 00 - Summary of Work; Subsection 1.3.C Preservation of Natural Features Items 1 through 8.
   b. See Sheet G1, “General Notes” for additional information.
2. Do not clear and grub without prior approval from Contracting Officer.
3. Clear from the surface of the existing ground all trees and shrubs marked for removal, brush, downed timber, rotten wood, heavy growth of grass and weeds, vines, rubbish, and debris.
4. Grub (remove) all stumps, roots, root mats, logs, and debris encountered within the limits of construction.
5. In cut areas, totally grub.
6. In fill areas, where fill is less than three feet totally grub ground.
7. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated. Place fill material in horizontal layers not exceeding six inches loose depth, and thoroughly compact to a density equal to adjacent original ground.
8. Where fill is three feet or more in-depth, stumps may be left no higher than six inches above the existing ground surface.

C. Tree trimming

1. Utilize the services of a professional qualified arborist.
2. Only trim branches, trees, and shrubs marked for trimming by Contracting Officer. Coordinate with Park before performing any trimming operations. Make effort to minimize the amount of trimming required.

D. Topsoil

1. Reference specific requirements in drawings and specification section “Summary of Work”
2. Carefully strip native topsoil to whatever depths encountered, in a manner to prevent intermingling with underlying subsoil or objectionable material.
3. Remove heavy growths of grass before stripping.
   a. Where trees are indicated to be left standing, stop topsoil stripping sufficient distance from such trees to prevent damage to the main root system.
   b. Topsoil is defined as organic surface soil free of subsoil, clay lumps, stones, and other objects two inches in diameter, and without weeds, roots, and other objectionable material.
4. Stockpile topsoil directed by Contracting Officer for later used as final backfill.
   a. Construct storage piles to freely drain surface water.
   b. Cover storage piles to prevent erosion.
   c. Cover all storage piles with plastic to prevent the growth of weeds.

E. Disposal of waste materials

1. Burning materials on-site is prohibited.
2. Remove all waste materials from the site.

END OF SECTION

SECTION 31 11 00

CLEARING & GRUBBING

PART 1 - GENERAL

1.1 RELATED SECTIONS

A. Section 01 35 43.13 - Environmental Procedures for Hazard Materials.

B. Section 31 23 33 - Utility Trench Excavation & Backfill.

1.2 DEFINITIONS

A. Clearing consists of cutting off trees and brushing vegetative growth to not more than a specified height above ground and disposing of felled trees, previously uprooted trees and stumps, and surface debris.

B. Close-cut clearing consists of cutting off standing trees, brush, scrub, roots, stumps, and embedded logs, removing at, or close to, existing grade, and disposing of fallen timber and surface debris.

C. Clearing isolated trees consists of cutting off to not more than the specified height above ground of designated trees and disposing of felled trees and debris.

D. Underbrush clearing consists of removal from treed areas of undergrowth, deadwood, and trees smaller than 2 inches (50 mm) trunk diameter and disposing of all fallen timber and surface debris.

E. Grubbing consists of excavation and disposal of stumps and roots boulders and rock fragments of specified size to not less than a specified depth below the existing ground surface.

1.3 QUALITY ASSURANCE

A. Safety Requirements: worker protection.

1. Workers must wear gloves, dust masks, eye protection, and protective clothing when applying herbicide materials.
2. Workers must wear gloves, dust masks, safety boots, protective clothing, eye protection, and safety vests when clearing and grubbing.
3. Workers must not eat, drink, or smoke while applying herbicide material.
4. Clean up spills of preservative materials immediately with absorbent material and safely discard them to landfill.

1.4 STORAGE AND PROTECTION

A. Prevent damage to fencing, trees, landscaping, natural features, benchmarks, existing buildings, existing pavement, utility lines, site appurtenances, watercourses, and root systems of trees that are to remain.

B. Repair any damaged items to the approval of the Owner. Replace any trees designated to remain, if damaged, as directed by the Owner.

1.5 WASTE MANAGEMENT AND DISPOSAL

A. Consider felled timber from which sawlogs, pulpwood, posts, poles, ties, or fuelwood can be produced as saleable timber.

B. Trim limbs and tops and saw into saleable lengths. Stockpile adjacent to the site.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 PROTECTION

A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.

B. Inspect, repair, and maintain temporary erosion and sedimentation control measures during construction until permanent vegetation has been established.

C. Remove temporary erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.2 PREPARATION

A. Inspect site and verify with Owner, items designated to remain.

B. Locate and protect utility lines. Preserve in operating condition active utilities traversing site:

1. Notify Owner immediately of damage to or when unknown existing utility lines are encountered.
2. When utility lines that are to be removed are encountered within the area of operations, notify the Owner in ample time to minimize interruption of service.

C. Notify utility authorities before starting clearing and grubbing.

D. Keep roads and walks free of dirt and debris.

3.3 CLEARING

A. Clearing includes felling, trimming, and cutting of trees into sections and satisfactory disposal of trees and other vegetation designated for removal, including downed timber, snags, brush, and rubbish occurring within cleared areas.

B. Clear as directed by the Owner, by cutting at a height of not more than 12 inches (300 mm) above ground. In areas to be subsequently grubbed, the height of stumps left from clearing operations to be not more than 3 feet (1.0 m) above the ground surface.

C. Cut off branches and cut down trees overhanging area cleared as directed by Owner.

D. Cut off unsound branches on trees designated to remain as directed by the Owner.

3.4 CLOSE-CUT CLEARING

A. Close-cut clearing to ground level.

B. Cut off branches down trees overhanging area cleared as directed by Owner.

C. Cut off unsound branches on trees designated to remain as directed by the Owner.

3.5 ISOLATED TREES

A. Cut off isolated trees as directed by the Owner at a height of not more than 12 inches (300 mm) above the ground surface.

B. Grub out isolated tree stumps.

C. Prune individual trees as indicated.

D. Trim trees designated to be left standing within cleared areas of dead branches 1.5 inches (4.0 cm) or more in diameter, and trim branches to heights as indicated.

E. Cut limbs and branches to be trimmed close to the bole of the tree or main branches.

3.6 UNDERBRUSH CLEARING

A. Clear underbrush from areas as indicated at ground level.

3.7 GRUBBING

A. Remove and dispose of roots larger than 3 inches (7.5 cm) in diameter, matted roots, and designated stumps from indicated grubbing area.

B. Grub out stumps and roots to not less than 8 inches (200 mm) below the ground surface.

C. Grub out visible rock fragments and boulders, greater than 12 inches (300 mm) in greatest dimension, but less than 1/3 cubic yard (0.25 m3).

D. Fill depressions are made by grubbing with suitable material to make the new surface conform with the existing adjacent surface of the ground.

3.8 REMOVAL AND DISPOSAL

A. Remove cleared and grubbed materials off-site.

B. Cut timber greater than 5 inches (125 mm) in diameter to 10 feet (3.0 m) lengths and stockpile as indicated. Unless otherwise notified, stockpiled timber becomes property of the Owner.

C. Dispose of cleared and grubbed materials off-site.

D. Remove diseased trees identified by the Owner and dispose of this material with the approval of the Owner.

3.9 FINISHED SURFACE

A. Leave ground surface in a condition suitable for immediate grading operations stripping of topsoil to the approval of Owner.

3.10 CLEANING

A. On completion and verification of performance of the installation, remove surplus materials, excess materials, rubbish, tools, and equipment.

END OF SECTION

SECTION 31 13 00

SELECTIVE TREE & SHRUB REMOVAL & TRIMMING

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the protection and trimming of trees that are to remain but interfere with, or are affected by, execution of the Work, whether temporary or new construction.

1.2 SUBMITTALS

A. Submittals shall be following Section 01 33 23 and include:

1. Product data for each type of product specified.
2. 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.

B. Certification by qualified personnel that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.

C. Maintenance recommendations for care and protection of trees affected by construction after completing the Work.

1.3 QUALITY ASSURANCE

A. Tree Service Qualifications: Engage an experienced tree service firm that has completed tree protection and trimming work similar to that required for this Project and that will maintain experienced, qualified personnel on the Project site on a full-time basis during the execution of the Work.

1. Qualifications: Personnel certified by the International Society of Arboriculture or licensed in the jurisdiction where the Project is located.
2. Tree Pruning Standards: Comply with the National Arborist Association’s “Pruning Standards for Shade Trees” except where more stringent requirements are indicated.
3. Pre-installation Conference: Conduct a conference at the Project site before beginning site work.

B. Before commencing tree protection and trimming, meet with representatives of authorities having jurisdiction, the Owner, the Owner’s Representative, consultants, and other concerned entities. Review tree protection and trimming procedures and responsibilities. Notify participants at least three working days before convening the conference. Record discussions and agreements and furnish a copy to each participant.

C. Also, before the commencement of tree protection and trimming work, verify that the Owner has completed any of its pre-construction tree protection work as detailed and specified in the Contract Documents, not in this contract.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Drainage Fill: Selected crushed stone, or crushed or uncrushed gravel, washed, ASTM D 448, size 24, with 90 to 100 percent passing a 2½-inch sieve and not more than 10 percent passing a 3/4-inch sieve.

B. Topsoil: Fertile, friable, surface soil, containing natural loam and complying with ASTM D 5268. Provide topsoil that is free of stones larger than 1/2 inch in any dimension and free of other extraneous or toxic matter harmful to plant growth. Obtain topsoil only from well-drained sites where soil occurs in the depth of 4 inches or more; do not obtain from bogs or marshes.

C. Filter Fabric: Manufacturer's standard, nonwoven, pervious, geotextile fabric of polypropylene, nylon, or polyester fibers.

D. Organic Mulch: Shredded hardwood mulch, free from deleterious materials and suitable as a temporary protective top dressing of root protection zones.

E. Protective Fencing: 6 feet high galvanized chain link fencing (ASTM A392, A120, or A123), including fabric, posts, and another framework, hardware, and accessories for complete fence sections.

PART 3 - EXECUTION

3.1 PREPARATION

A. Provide temporary fencing located as indicated and dimensioned on the Tree Removal and Protection Plan and as directed by the Contracting Officer to protect remaining trees and other plants from damage as per details in construction drawings. Keep all tree protection fences in place and good repair until the end of the construction period. Place 2 inches to 3 inches of shredded hardwood bark mulch over entire root protection zones. Also, as noted in the Demolition and Tree Removal and Protection Plan, carefully remove any existing paving to be removed within tree protection zones before bark mulching.

B. Protect tree root systems from damage due to noxious materials caused by run-off or spillage while mixing, placing, or storing construction materials. Protect root systems from flooding, eroding, or excessive wetting caused by dewatering operations.

C. Do not store construction materials, debris, or excavated material within the drip line of the remaining trees. Do not permit vehicles or foot traffic within the drip line and prevent soil compaction over root systems.

D. Do not allow fires under or adjacent to remaining trees or other plants.

3.2 EXCAVATION

A. Install shoring or other protective support systems to minimize sloping or benching of excavations.

B. Do not excavate within the tree drip line, unless otherwise indicated.

C. Where demolition of existing paving and structures and excavation for new construction is required within tree drip lines, hand excavate to minimize damage to root systems. Use narrow tine spading forks and comb soil to expose roots.

1. Relocate roots in backfill areas wherever possible. If encountering large, main lateral roots, expose beyond excavation limits as required to bend and relocate without breaking. If encountered immediately adjacent to the location of new construction and relocation is not practical, cut roots approximately 3 inches back from new construction.
2. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition and temporarily support and protect roots from damage until they are permanently relocated and covered with earth.
3. Tree stumps within tree protection zones that do not interfere with proposed utilities, structures, footings, and paved areas should be left in place. Carefully grind stumps to 6"± below the proposed finish grade.
4. Where utility trenches are required within three drip lines, tunnel under or around the roots by drilling, auger boring, pipe jacking, or digging by hand. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with the installation of new work. Cut roots with sharp pruning instruments; do not break or chop.

3.3 REGRADING

A. Grade Lowering: Where new finish grade is indicated below existing grade around trees, slope grade away from trees as recommended by an arborist. Prune tree roots exposed during grade lowering. Do not cut main lateral roots or taproots; cut only smaller roots. Cut roots with sharp pruning instruments; do not break or chop.

B. Minor Fill: Where the existing grade is 6 inches or less below the elevation of the finish grade shown, fill with topsoil. Place topsoil in a single uncompacted layer and hand grade to required finish elevations.

C. Moderate Fill: Where the existing grade is more than 6 inches, but less than 12 inches below finish grade elevation, place a layer of drainage fill, filter fabric, and a final layer of topsoil on the existing grade.

1. Carefully place drainage fill against tree trunk approximately 2 inches above finish grade elevation and extend not less than 18 inches from the tree trunk on all sides. For the balance of area within the drip-line perimeter, place drainage fill to an elevation 6 inches below grade.
2. Place filter fabric with overlapping edges of 6 inches minimum.
3. Place fill layer of topsoil to finish grade. Do not compact drainage fill or topsoil. Hand grade to required finish elevations.

3.4 TREE PRUNING

A. If additional pruning is needed, prune trees to remain affected by temporary and new construction as directed by Contracting Officer.

B. Prune remaining trees to compensate for root loss caused by damaging or cutting the root system. Provide subsequent maintenance during the Contract period as recommended by the arborist.

C. Pruning Standards: Prune trees according to the National Arborist Association's "Pruning Standards for Shade Trees."

1. Class II: Standard pruning
2. Class III: Hazard pruning
3. Class IV: Crown-reduction pruning

D. Cut branches with sharp pruning instruments; do not break or chop.

E. Chip branches removed from trees. Spread material indicated or as directed by Contracting Officer.

3.5 TREE REPAIR AND PLACEMENT

A. Promptly repair trees damaged by construction operations to prevent progressive deterioration.

B. Remove and replace dead and damaged trees that the arborist determines to be incapable of restoring to a normal growth pattern.

1. Provide new trees of the same size and species as those being replaced.
2. Provide new trees of 4 inches caliper size and of a species selected by the Owner's Representative when trees over 6 inches in caliper, measured 12 inches above grade, are required to be replaced.

3.6 DISPOSAL OF WASTE MATERIALS

A. Burning is not permitted on the Owner's property.

B. Remove excess excavated material, displaced trees, and excess chips from Owner's property.

END OF SECTION

SECTION 31 14 13

TOPSOIL & WETLAND TOPSOIL STRIPPING & STOCKPILING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This WORK consists of salvaging and stockpiling topsoil and wetland topsoil and excavating suitable topsoil or wetland topsoil from stockpiles, CONTRACTOR sources, available sources, or from the approved natural ground cover to place on designated areas.

1.2 RELATED SECTIONS

A. The following is a list of SPECIFICATIONS that may be related to this section:

1. Section 31 11 00, Clearing and Grubbing.
2. Section 31 23 00, Excavation & Fill.
3. Section 31 25 00 Erosion & Sedimentation Control
4. Section 32 91 13, Topsoil & Wetland Topsoil

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil shall meet the requirements of Section 32 19 13 Topsoil & Wetland Topsoil. Topsoil and Wetland Topsoil shall consist of natural onsite ground cover or hauled material from offsite sources.

B. Erosion and Sedimentation Control for Stockpiles shall meet the requirements of Section 31 25 00, Erosion & Sedimentation Control.

C. Wetland topsoil material shall consist of moist organic soil, including any existing wetland vegetation and seeds. Material shall be excavated from areas as shown on the DRAWINGS, hauled material from offsite sources, or as directed by the ENGINEER. All wetland topsoil materials shall meet the requirements of Section 32 19 13, Topsoil & Wetland Topsoil.

PART 3 - EXECUTION

3.1 TOPSOIL

A. Topsoil within the limits of the PROJECT shall be salvaged before beginning excavating, filling, or hauling, operations by excavating topsoil and stockpiling the material at designated locations on DRAWINGS or as designated by OWNER in a manner that will facilitate measurement, minimize sediment damage, and not obstruct natural drainage.

1. Imported topsoil shall be hauled to the site and stockpiled in locations designated by OWNER.
2. Salvaged topsoil exceeding the quantity required under the CONTRACT shall be disposed of at the CONTRACTOR's expense.

3.2 STOCKPILE

A. No soil stockpile shall exceed 10 feet in height.

B. All topsoil stockpiles shall be protected from sediment transport by surface roughening, watering, and perimeter silt fencing.

C. Any topsoil stockpile remaining longer than 30 days shall be seeded with a sterile temporary cover (such as REGREEN or approved equivalent) or the approved specified final seed mixture.

D. Upon completion of PROJECT or as approved by OWNER or OWNERS REPRESENTATIVE, remove surplus subsoil and topsoil from site. Grade stockpile area as necessary for planting or seeding.

3.3 WETLAND TOPSOIL

A. Wetland topsoil material shall be excavated from areas designated on the DRAWINGS or as approved by ENGINEER to a minimum depth of 18 inches, or as otherwise designated, and placed within 24 hours in the wetland relocation site.

B. CONTRACTOR shall prepare the wetland relocation site to elevations specified in the DRAWINGS or as approved by the ENGINEER before excavating the wetlands topsoil. If ENGINEER determines that this is not possible, then CONTRACTOR shall stockpile wetland topsoil material in an approved area, to remain undisturbed until the relocation site has been prepared.

C. All wetland topsoil stockpiles shall be protected from sediment transport by surface roughening, watering, and perimeter silt fencing.

D. Storage time within the stockpile shall be as short as possible.

E. If deemed necessary by ENGINEER, the stockpile shall be protected in such a manner to preserve the wetland seed bank.

F. Wetland topsoil material shall be placed over the prepared relocation areas to a depth of 18 inches, or as otherwise designated.

END OF SECTION

SECTION 31 22 13

ROUGH GRADING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But is Not Limited To

1. Perform rough grading work required to prepare the site for construction as described in Contract Documents.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials used for fill shall be as specified for backfill in construction plans.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before making cuts, remove topsoil over areas to be cut and filled that were not previously removed by stripping specified in Section 31 10 00. Stockpile this additional topsoil with previously stripped topsoil.

3.2 PERFORMANCE

A. Site Tolerances

1. Maximum variation from required grades shall be 1/10 of one foot.

B. If soft spots, water, or other unusual and unforeseen conditions affecting grading requirements are encountered, stop work and notify Contracting Officer.

C. Do not expose or damage existing shrubs or tree roots.

END OF SECTION

SECTION 31 22 19

FINISH GRADING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work covered by this Section includes the finish grading required to prepare the site for installation of landscaping as described in the Contract Documents.

B. Related Sections

1. General Site Construction Requirements - Section 02 05 00
2. Site Clearing - Section 31 10 00

1.2 REFERENCES

A. American Society for Testing and Materials

1. ASTM 1557-91, 'Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort'
2. ASTM D 422, 'Method for Particle-Size Analysis of Soils'

1.3 SUBMITTALS

A. Quality Control / Assurance

1. Test Results - Gradation, Compaction

PART 2 - PRODUCTS

2.1 MATERIALS

A. Imported Topsoil

1. Fertile, loose, friable soil meets the following criteria -
   a. Chemical Characteristics -
      1) Acidity / alkalinity range - pH 5.5 to 7.7
      2) Soluble Salts - less than 2.0 mmhos/cm
      3) Sodium Absorption Ratio (SAR) - less than 3.0
      4) Organic Matter - greater than one percent

b. Physical Characteristics -
    1) Gradation is defined by the USDA triangle of physical characteristics as measured by hydrometer.
    2) Sand - fifteen to sixty percent
    3) Silt - ten to sixty percent
    4) Clay - five to thirty percent
    5) Clean and free from toxic minerals and chemicals, noxious weeds, rocks larger than one- and one-half inches in any dimension, and other objectionable materials.
    6) Soil shall not contain more than two percent of particles measuring over a one-sixteenth inch in the largest size.
c. All imported fill materials must be certified weed and seed free.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not commence work on this Section until specifications for trenching and backfilling are met.

3.2 PREPARATION

A. Protection: Protect utilities and site elements from damage.

B. Surface Preparation

1. Existing topsoil in most cases will contain weed seeds. The contractor shall refer to contract drawings' general notes for guidance on soil preparation, removal, and stockpile for potential re-use.
2. Before grading, dig out weeds from planting areas by their roots and remove them from the site. Before placing topsoil in landscape areas, remove foreign matter such as building rubble, wire, cans, sticks, concrete, etc.
3. Before placing topsoil, remove imported paving base material present in planting areas down to natural subgrade or other material acceptable to Contracting Officer.
4. Disk, till, or aerate with an approved agricultural aerator to a depth of six inches.

3.3 PERFORMANCE

A. Site Tolerances

1. Total Topsoil Depth:
    a. Lawn Areas - six inches minimum
    b. Shrub Planting Areas - eighteen inches minimum throughout the entire shrub bed area.

2. Elevation of topsoil relative to walks or curbs as indicated in the approved plan set or if not indicated fill topsoil as follows:
    a. Seeded Lawn Areas - one inch below
    b. Shrub Areas - three inches below

B. Do not expose or damage existing shrubs or tree roots.

C. Redistribute approved existing topsoil stored on-site because of work of Site Clearing - Section 31 10 00. Remove organic material and other objectionable materials. Provide additional approved imported topsoil required to bring the surface to a specified elevation relative to the concrete site element.

D. Where topsoil depth is nine inches or greater, place topsoil in layers not to exceed nine inches and, to prevent settling, compact to eighty-five percent relative density following ASTM D 1557. Do not place topsoil whose moisture content makes it prone to compaction during the placement process.

END OF SECTION

SECTION 31 22 19.13

SPREADING & GRADING TOPSOIL

PART 1 – GENERAL

1.1 RELATED SECTIONS

A. Section 31 11 00 - Clearing & Grubbing.

B. Section 31 22 13 - Rough Grading.

1.2 QUALITY ASSURANCE

A. Pre-Installation Meetings: Conduct pre-installation meetings to verify project requirements, installation instructions, and warranty requirements.

B. Qualifications: Provide proof of qualifications when requested by Contracting Officer.

1.3 SOURCE QUALITY CONTROL

A. The contractor is responsible for soil analysis and requirements for amendments to the topsoil as specified.

B. Soil testing by a recognized testing facility for pH, P and K, and organic matter.

PART 2 - PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.

B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.2 STRIPPING OF TOPSOIL

A. Do not manage topsoil while in wet or frozen conditions or in any way in which soil structure is adversely affected.

B. Commence topsoil stripping of areas as indicated after the area has been cleared of brush weeds and grasses and removed from the site.

C. Strip topsoil to depths as indicated. Avoid mixing topsoil with subsoil where textural quality will be moved outside the acceptable range of intended application.

D. Stockpile in locations as directed by Contracting Officer.

E. Disposal of unused topsoil as directed by Contracting Officer.

F. Protect stockpiles from contamination and compaction.

3.3 PREPARATION OF EXISTING GRADE

A. Verify that grades are correct. If discrepancies occur, notify Contracting Officer and do not commence work until instructed by Contracting Officer.

B. Grade soil, eliminating uneven areas and low spots, ensuring positive drainage.

C. Remove debris, roots, branches, stones more than two inches, and other deleterious materials. Remove soil contaminated with calcium chloride, toxic materials, and petroleum products. Remove debris that protrudes more than three inches above the surface. Dispose of removed material off-site.

3.4 PLACING AND SPREADING OF TOPSOIL/PLANTING SOIL

A. Place previously stripped topsoil after Contracting Officer has accepted subgrade.

B. Spread topsoil in uniform layers not exceeding six inches, over unfrozen subgrade free of standing water.

C. Spread topsoil as indicated to the following minimum depths after settlement and 80% compaction:

1. Six inches for seeded areas.

D. Manually spread topsoil/planting soil around trees, shrubs, and obstacles.

E. Avoid spreading or grading in a wet, frozen, or saturated state.

3.5 FINISH GRADING

A. Grade to eliminate rough spots, and low areas, and ensure positive drainage. Prepare the loose friable bed utilizing cultivation and subsequent raking.

B. Consolidate topsoil to required bulk density using equipment approved by Contracting Officer. Leave surfaces smooth, uniform, and firm against deep footprints.

3.6 ACCEPTANCE

A. Contracting Officer will inspect and test topsoil in place and determine acceptance of depth of topsoil and finish grading.

B. Testing of topsoil will be conducted by a testing laboratory hired by a contractor. Soil sampling, testing, and analysis to be per standards.

3.7 RESTORATION OF STOCKPILE SITES

A. Restore stockpile sites acceptable to Contracting Officer.

3.8 SURPLUS MATERIAL

A. Dispose of materials not required where directed by Contracting Officer.

3.9 CLEANING

A. Upon completion of installation, remove surplus materials, rubbish, tools, and equipment barriers.

END OF SECTION

SECTION 31 23 00

EXCAVATION & FILL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Section Includes: Perform all excavation, shoring, dewatering, filling, backfilling, compaction, and grading necessary or required for the construction of the work as covered by these Specifications and indicated on the Drawings. The excavation shall include, without classification, the removal and disposal of all materials of whatever nature encountered, including water and all other obstructions that would interfere with the proper construction and completion of the required work.

B. Soils under and around Ash Mountain's existing lagoons shall be tested by the contractor for sludge contamination and be removed and disposed of by the contractor per state regulatory requirements.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM).

B. California State Department of Transportation (Materials Engineering and Testing Services Manual).

1.3 SUBMITTALS

A. Submit following Section 01 33 23 Submittal Procedures.

B. Submit the following under the Product Information category.

1. Sheeting and Shoring Plan: Refer to Paragraph 1.8 below and Section 01 33 23.
2. Potholing Report as described in Paragraph 3.2
3. Samples and Test Results: Furnish, without additional cost to the Owner, such quantities of import materials as may be required by the Contract Officer for test purposes. Cooperate with the Contract Officer and furnish necessary facilities for sampling and testing of all material and workmanship. Submit test results for import materials. Tests shall be performed within 60 days of the submission. All material furnished and all work performed shall be subject to rigid inspection, and no material shall be delivered to the site until it has been favorably reviewed by the Contract Officer or used in the construction work until it has been inspected in the field by the Contract Officer.

1.4 QUALITY ASSURANCE

A. Source Quality Control: Test import materials proposed for use to demonstrate that the materials conform to the specified requirements. Tests shall be performed by an independent testing laboratory. The Contractor shall be responsible for hiring an independent testing laboratory.

B.

C. Field Quality Control:

1. The Contract Officer will:
   a. Review and test materials proposed for use.
   b. Inspect foundations, site grading, and borrow operations.
   c. Inspect placement and compaction of fill.
2. The contractor shall excavate holes for in-place soil sampling. The contractor shall be responsible for costs of additional inspection and re-testing resulting from non-compliance.

C. Testing Methods:

1. Durability Index: California State Department of Transportation, California Test 229.
2. Specific Gravity: ASTM D854.
3. Laboratory Compaction: ASTM D1557, Method A or C.
4. In-Place Density: ASTM D1556 or ASTM D2922.
5. Particle Size Analysis of Soils: ASTM D422.
6. Plastic Limit and Plasticity Index: ASTM D4318.
7. Soil Classification: ASTM D2487.
8. In-Place Moisture Content: ASTM D3017.

1.5 EXPLOSIVES

A. The use of explosives will not be permitted on this project, unless specifically authorized, in writing, by the Contract Officer.

1.6 SUBSURFACE INVESTIGATIONS

A. Subsurface investigations have been undertaken at the project sites and the final report of findings is included in Appendix A to this specification. The findings apply to both the Ash Mountain and the Buckeye Housing treatment facilities.

B. The bidders may make additional subsurface investigations at the site before the bidding of the project. Before making any drillings or excavations, the bidder shall secure permission from the Owner and property owners if on private property.

1.7 REFERENCE SPECIFICATIONS

A. Whenever the words “Standard Specifications” are referred to, the reference is to the latest edition of the State of California, Department of Transportation, Construction Manual as issued by the Division of Construction.

1.8 ADDITIONAL SAFETY RESPONSIBILITIES

A. The Contractor shall select, install, and maintain shoring, sheeting, bracing, and sloping as necessary to maintain safe excavations. The Contractor shall be responsible for ensuring such measures: 1) comply fully with 29 CFR Part 1926 OSHA Subpart P Excavations and Trenches requirements, 2) provide the necessary support to the sides of excavations, 3) provide safe access for sampling and testing within the excavation, 4) provide safe access for backfill, compaction, and compaction testing, and 5) otherwise maintain excavations in a safe manner that shall not endanger property, life, health, or the project schedule. All earthworks shall be performed in strict accordance with applicable law, including local ordinances, and applicable OSHA requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Trench Foundation: Selected Granular Backfill, 3/4 inch maximum aggregate base, Standard Specifications, Paragraph 00405.11.

B. Bedding Materials: Standard Specifications, Paragraph 00405.12

C. Import Backfill: Class B Backfill, Standard Specifications, Paragraph 00405.14. Imported non-expansive soil with a liquid limit no greater than 40 percent and a plasticity index no greater than 10, free from clods or rocks larger than 1 inch in greatest dimension, and free from organic material.

D. Native Backfill: Class A Backfill, Standard Specifications, Paragraph 00405.14. Native soil is prepared as necessary to be free from clods or rocks larger than 2 inches in greatest dimension, and free from organic material. All native soil excavated as part of the project but not used as native backfill shall be hauled out of the Park to an approved disposal site. When native soil is unsuitable for use, substitute compactible imported silty sand and gravel with a minimum of 20% fines (material passing the US No.200 sieve), and no clods or particles greater than 2 inches in greatest dimension.

E. Impervious Material: Clay with a minimum percentage of material passing the No. 200 sieve of 50 percent. The material shall be free of organics, rocks, or clods greater than 4 inches in diameter.

F. Pond embankment material: Native or imported soil containing at least 25% fines (that portion passing the US No. 200 sieve) with a liquid limit no greater than 45 and a plasticity index no greater than 20, free from rocks larger than 2-inch in greatest dimension and free of organic material.

1. Water: The water used shall be free of objectionable quantities of silt, oil, organic matter, alkali, salts, and other impurities. Water quality must be acceptable to the Contract Officer.

2.2 UTILITY LINE MARKING

A. All utilities shall be marked for location and identified by marking tape and/or locator wire as shown on the construction drawings and following associated specification sections.

PART 3 - EXECUTION

3.1 CONTROL OF WATER

A. Groundwater Influence:

1. If shallow groundwater and saturated soil conditions are encountered at the site, dewatering or underwater construction technique may be required for construction.
2. In addition to the groundwater level, if earthwork is performed during or soon after periods of precipitation, the subgrade soils may become saturated, “pump,” or not respond to densification techniques. Typical remedial measures include disking and aerating the soil during dry weather, mixing the soil with dryer materials, removing and replacing the soil with an approved fill material, or mixing the soil with an approved lime or cement product.
3. The over-excavation bottom may require additional treatment to stabilize the subgrade soil before backfilling. Soft and saturated subgrade soil may be mitigated with a layer of geogrid reinforcement fabric consisting of Tensar® BX 1100
4. Geogrid (or approved equal) and overlain by 12 to 14 inches of compacted aggregate base.

B. The Contractor shall be responsible for furnishing temporary drainage facilities to convey and dispose of surface water falling on or passing over the site.

3.2 EXISTING UTILITIES

A. General: The known existing buried utilities and pipelines except building connections are shown on the Drawings in their approximate location. The Contractor shall exercise care in avoiding damage to all utilities as the Contractor will be held responsible for their repair if damaged. There is no guarantee that all utilities or obstructions are shown, or that the locations indicated are accurate. Utilities are piping, conduits, wire, cable, pull boxes, and the like, located at the project site.

B. Check on Locations (Potholing):

1. Contact all affected utility owners and request them to locate their respective utilities before the start of “potholing” procedures. The utility owner shall be given (7) seven days' written notice before commencing potholing. If a utility owner is not equipped to locate its utility, the Contractor shall locate it.
2. Clearly paint the location of all affected utility underground pipes, conduits, and other utilities on the pavement or identify the location with suitable markers if not on pavement. In addition to the location of metallic pipes and conduits, non-metallic pipes, ducts, and conduits shall also be similarly located using a surface indicator and shall then be similarly marked.
3. After the utility survey is completed, commence “potholing” to determine the actual location and elevation of all utilities where crossings, interferences, or connections to the new pipelines are shown on the Drawing, marked by the utility companies, or indicated by surface signs. Before the preparation of piping shop drawings, or the excavating of any new pipelines or structures, the Contractor shall locate and uncover these existing to a point one foot below the utility. Submit a report identifying each underground utility and its depth and station. Any variation in the actual elevations and the indicated elevation shall be brought to the Contract Officer’s attention.

4. Excavations around underground electrical ducts and conduits shall be performed using extreme caution to prevent injury to workers or damage to electrical ducts or conduits. Similar precautions shall be exercised around gas lines, telephone, and television cables.
5. Excavations shall have a surface dimension of no more than 18”x18”. Backfill after completion of potholing. In existing streets, pave with one inch of cutback.

C. Interferences:

1. If interferences occur at a location other than shown on the Drawings, the Contractor shall notify the Contract Officer, and a method for correction of said interferences shall be supplied by the Contract Officer. Payment of interferences that are not shown on the plans, nor which may be inferred from surface indications, shall be per the provisions of the General Conditions. If the Contractor does not expose all required utilities before shop drawing preparation, the Contractor shall not be entitled to additional compensation for work necessary to avoid interferences, nor for repair to damaged utilities.
2. Any necessary relocation of utilities, whether shown on the Drawing or not, shall be coordinated with the affected utility. The Contractor shall perform the relocation only if instructed to do so in writing by the utility and the Contract Officer.

D. Shutdowns: Planned utility service shutdowns shall be accomplished during the period of minimum use. In some cases, this may require night or weekend work. Such work shall be at no additional cost to the Owner. Program work so that service will be restored in the minimum possible time, and the Contractor shall cooperate with the utility Owner in reducing shutdowns of utility systems to a minimum.

1. Disconnections: No utility shall be disconnected without prior written approval from the utility owner. When it is necessary to disconnect a utility, the Contractor shall give the utility owner not less than 72 hours' notice when requesting written approval. The Contractor shall program his work so that service will be restored in the minimum possible time.

E. Overhead Facilities: There are existing overhead electric and telephone transmission lines within the project area. These overhead utilities are not shown on the Drawings. Extreme caution shall be used when working in the vicinity of overhead utilities. The Contractor shall be required to comply with the applicable provisions of the California Construction Safety Orders when working anywhere on this project.

F. Existing gas, water, sewer, electrical, and telephone house laterals are not specifically shown on the Drawings but do exist within the construction limits. Protect all service laterals from damage due to construction operations. If any laterals are damaged, notify the Contract Officer and the affected utility immediately. The cost of repair shall be borne by the Contractor.

3.3 GENERAL CONSTRUCTION REQUIREMENTS

A. Site Access: Access to the site will be over public improved roads. Exercise care in the use of such roads and repair at own expense any damage thereto caused by Contractor’s operations. Such repair shall be to the satisfaction of the owner or agency having jurisdiction over the road. The Contractor is to take whatever means are necessary to prevent tracking of mud onto existing roads and shall keep roads free of debris.

B. Traffic Regulation: Provide such flaggers, patrols, pilot cars, drivers, lighted barricades, flares, lights, warning signs, and safety devices as may be required for control of traffic adjacent to all areas of work.

C. Barriers: Barriers shall be placed at each end of all excavations and at such places along the excavation as may be necessary to warn all pedestrian and vehicular traffic of such excavations. Lights shall also be placed along excavations from sunset each day to sunrise of the next day until such excavation is entirely restored.

D. Access: Free access must be maintained to all fire hydrants, water valves, and meters.

E. Open Trench Limitations: The Contract Officer shall have the authority to limit the amount of trench to be opened or left open at any one time. In public roads, excavation and pipe laying shall be coordinated to the end that a minimum of interference with public traffic will result. No more than 200 feet of the trench shall be open at any time on any single heading. An open trench shall be defined as any trench which has not been completely backfilled and satisfactorily compacted.

F. Demolition of Pavement: Where trenching or excavation occurs in paved areas, the pavement shall be scored and broken ahead of the trenching or excavation operation. The extent of the paving removed shall be limited to the minimum necessary for the excavation.

G. Dust Control: Take proper and efficient steps to control dust.

H. Storage of Materials: Excavated material unsuitable for backfill shall not be stored on existing streets and shall be disposed of immediately. Neatly place excavated materials far enough from the excavation to prevent stability problems. Keep the material shaped to cause the least possible interference with drainage and the normal use of adjacent properties, structures, or roadways.

3.4 TRENCH EXCAVATION

A. Excavation for pipe shall be in an open cut. The trench shall be as wide as necessary for sheeting and bracing and the proper performance of the work up to the maximum width permitted by the typical cross-sections shown on the Drawings. The sides of the trenches shall be vertical in existing streets. The bottom of the trench shall be constructed to the grades and shapes indicated on the Drawings. Should the Contractor desire to use other equivalent methods, he shall submit his method of construction to the Contract Officer for approval before its use.

B. Take care not to over excavate. Accurately grade the bottom of the trenches to provide uniform bearing and support for each section of the pipe at every point along its entire length, except for the portion of the pipe sections where it is necessary to excavate for bell holes and the proper sealing of pipe joints, and as hereinafter specified. Dig bell holes and depressions for joints after the trench bottom has been graded, and, so that the pipe rest on the bedding for as nearly its full length as practicable, bell holes and depressions shall be only of such length, depth, and width as required for properly making the joint. Remove stones as necessary to avoid point bearing.

C. Backfill and compact over excavations to 90% relative compaction with bedding material. There shall be no additional payment to the Contractor for over excavations not directed by the Contract Officer. Remove unsatisfactory material encountered below the grades shown as directed by the Contract Officer and replace it with bedding material. Payment for removal and replacement of such unsatisfactory material directed by the Contract Officer shall be made following the provisions of the General Conditions.

D. Grade trenches so that they are uniformly sloped between the pipe elevations shown on the Drawings. Comply with the minimum and maximum trench widths shown on the Drawings. Notify the Contract Officer if the trench width exceeds the maximum allowable width for any reason.

E. Provide ladders for access to the trench by construction and inspection personnel.

3.5 EXCAVATION FOR STRUCTURES

A. All excavation for structures shall be done to the dimensions and levels indicated on the Drawings or specified herein. Excavate to such width outside the lines of the structure to be constructed as may be required for proper working methods, the erection of forms, and the protection of the work.

B. Take care to preserve the foundation surfaces shown on the Drawings in an undisturbed condition. If the Contractor over excavates or disturbs the foundation surfaces shown on the Drawings or specified herein, without the written authorization of the Contract Officer, the Contractor shall replace such foundation with concrete fill or other material approved by the Contract Officer in a manner which will show by test an equal bearing value with the undisturbed foundation material. No additional payment will be made for the added quantity of concrete fill or other material used because of over-excavation.

C. Inspection of Excavation: Notify the Contract Officer when excavation for the structure is complete. No forms, reinforcing steel, concrete, or precast structure shall be placed until the excavation has been inspected by the Contract Officer.

D. Where unsatisfactory material is encountered below the grades shown for structural excavations, it shall be removed and replaced with selected material as directed by the Contract Officer and compacted. Payment for removal and replacement of such unsatisfactory material directed by the Contract Officer shall be made following the provisions of the General Conditions.

3.6 BACKFILL AND COMPACTION

A. Place bedding and backfill materials true to the lines, grades, and cross-sections indicated on the Drawings and compacted to the degree specified on the Drawings. Place bedding and backfill materials in horizontal lifts not to exceed 6 inches in thickness measured before compaction. The difference in level on either side of a pipe shall not exceed 4 inches.

B. Backfill material shall not be placed over the pipe until after it has been inspected by the Contract Officer.

C. It shall be incumbent upon the Contractor to protect the pipe from damage during the construction period. It shall be his responsibility to repair broken or damaged pipe at no extra cost to the Owner. Tamping of backfill over the pipe shall be done with tampers, vibratory rollers, and other machines that will not injure or disturb the pipe. Carefully place backfill around and over the pipe and do not allow it to fall directly upon the pipe.

D. Do not allow construction traffic or highway traffic over the pipe trench until the trench backfill has been brought back even with the existing adjacent grade.

E. Add water to the backfill material or dry the material as necessary to obtain the optimum moisture content for the compaction shown on the Drawings or specified. If the Contract Officer determines that the nature of the ground in which the trench lies precludes compaction of the backfill to the specified density, the backfill shall be compacted to the maximum practicable density. Employ such means as may be necessary to secure uniform moisture content throughout the material of each layer being compacted. After the material has been moisture conditioned, compact it with compaction equipment approved by the Contract Officer to achieve specified compaction. The Contractor shall be responsible for obtaining the densities specified. Should the Contractor fail, through negligence or otherwise, to compact to specified density, or to backfill and compact to surface grade, thus permitting saturation of the backfill material from rains or any other source, the faulty material shall be removed and replaced with approved material which shall be compacted to the specified density at optimum moisture content, and no additional payment will be made for doing such work of removal and replacement.

F. Compaction by flooding, ponding, or jetting will not be permitted.

G. For all piping or conduits to be placed in any excavated and backfilled area, such as at manholes or for building connections, the structural backfill shall be first compacted to a level at least 2½ feet from the top of the piping or conduit elevation and then retrenched to pipe grade.

H. Under slabs and foundations, and around foundation walls, place structural fill in layers 8 inches or less thick and to 95% relative compaction.

I. Pavement Support: All subbase and base materials for paved areas shall be compacted to at least 95% relative compaction.

3.7 SUPPORT OF EXCAVATIONS

A. Adequately support excavation for trenches and structures to meet all applicable requirements in the current rules, orders and regulations. Excavation shall be shored, braced, and sheeted so that the earth will not slide or settle and so that all existing structures and all new pipes and structures will be fully protected from damage. Keep vehicles, equipment, and material far enough from the excavation to prevent instability.

B. Take all necessary measures to protect excavations and adjacent improvements from running, caving, boiling, settling, or sliding soil resulting from the high groundwater table and the nature of the soil excavated.

C. The support for excavation shall remain in place until the pipeline, or structure has been completed. During the backfilling of the pipeline or structure, the shoring, sheeting, and bracing shall be carefully removed so that there shall be no voids created and no caving, lateral movement, or flowing of the subsoils.

3.8 FINISH GRADING

A. Except shown otherwise in the Drawings, restore the finish grade to the original contours and the original drainage patterns. Grade surfaces to drain away from structures. The finished surfaces shall be smooth and compacted.

3.9 DISPOSAL OF EXCAVATED MATERIAL

A. Dispose of unsuitable material or excavated material above that needed for backfill offsite per the requirements of Section 01 74 19. Onsite disposal is only allowed with the approval of the Contract Officer. Any onsite disposal allowed will be under the direction of the Contract Officer.

END OF SECTION

APPENDIX A

Geotechnical Exploration Report
Rehabilitate Ash Mountain Wastewater Systems
Sequoia National Park, California

Submitted by:

Golder Associates Inc.
1000 Enterprise Way, Suite 190, Roseville, California, USA 95678

SECTION 31 23 16.10

IMPORTING SOILS & FILL MATERIALS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work of this section consists of requirements and provisions that apply whenever the contractor and NPS determine that an import of soil or fill material is required to meet these specifications.

1.2 RELATED WORK

A. Section 31 23 33 - Utility Excavation & Backfilling

B. Section 32 12 16 - Asphalt Paving

C. Section 32 11 23 - Aggregate Base Courses

1.3 SUBMITTAL

A. As specified in Division 01 Section 01 33 23 “Submittal Procedures.”

B. Commercial Source Certification: If materials are obtained from a commercial source, submit a certification and a gradation report from the supplier certifying that the aggregate base course meets the requirements of this Section.

C. Independent Testing Report and Certification: If a commercial source certification is not available Contractor shall provide a certification and gradation report from independent testing certifying that the aggregate base course meets the requirements of this Section.

D. Certification and gradation report shall be approved by the Contracting Officer before bringing material onsite.

E. Independent Testing Laboratory Qualification: Provide qualifications of independent testing laboratory that are designated to perform laboratory testing as required by this Section.

F. Independent Field Testing Service Qualification: Provide qualifications of independent testing laboratory that are designated to perform field testing as required by this Section.

PART 2 - PRODUCTS

2.1 IMPORT FILL

A. Import fill material, shall meet, but not be limited to, the following standards:

1. Shall be free of organic matter, trash, concrete rubble, and other deleterious material.
2. Shall be uncontaminated by regulated materials

B. Import fill material shall conform to the following chemical requirements:

CONSTITUENT	LIMIT	UNITS
Inorganic Chemical Constituents		
Antimony	5	mg/kg
Arsenic	5.4	mg/kg
Barium	320	mg/kg
Beryllium	10	mg/kg
Cadmium	0.8	mg/kg
Chromium	140	mg/kg
Cobalt	21	mg/kg
Copper	49	mg/kg
Cyanide	2,500	mg/kg
Lead	160	mg/kg
Tetraethyl Lead	0.013	mg/kg
Mercury	0.4	mg/kg
Molybdenum	12	mg/kg
Nickel	110	mg/kg
Selenium	0.5	mg/kg
Silver	2	mg/kg
Thallium	1	mg/kg
Vanadium	74	mg/kg
Zinc	60	mg/kg
Semivolatile Organic Compounds		
Acenaphthene	30	mg/kg
Acenaphthylene	30	mg/kg
Anthracene	30	mg/kg
Benzo (a) anthracene	0.46	mg/kg
Benzo (a) pyrene	0.046	mg/kg
Benzo (b) fluoranthene	0.46	mg/kg
Benzo (g,h,i) perylene	30	mg/kg
Benzo (k) fluoranthene	4.6	mg/kg
BenzylAlcohol	1	mg/kg
Chrysene	30	mg/kg
Dibenzo (a,h) anthracene	0.046	mg/kg
Dibenzofuran	2,200	mg/kg
Fluoranthene	30	mg/kg

CONSTITUENT	LIMIT	UNITS
Fluorene	30	mg/kg
Indeno (1,2,3-cd) pyrene	0.46	mg/kg
2-Methylnaphthalene	30	mg/kg
4-Methylphenol (p-Cresol)	50	mg/kg
Naphthalene	30	mg/kg
n-Nitrosodiphenylamine	20	mg/kg
Pentachlorophenol	3	mg/kg
Phenanthrene	30	mg/kg
Phenol	30	mg/kg
Pyrene	30	mg/kg
Volatile Organic Compounds		
Acetone	0.24	mg/kg
2-Butanone (MEK)	3.8	mg/kg
CarbonDisulfide	200	mg/kg
1,4-Dichlorobenzene	0.59	mg/kg
p-Isopropyltoluene (p-cymene)	130	mg/kg
MethyleneChloride	0.076	mg/kg
1,2,3-Trichlorobenzene	15	mg/kg
1,2,4-Trichlorobenzene	15	mg/kg
Trichlorofluoromethane	80	mg/kg
1,1,1-Trichloroethane	8	mg/kg
Polychlorinated Biphenyls (PCBs), Pesticides, and Herbicides		
PCBs (Arochlor1254)	0.033	mg/kg
Aldrin	0.0039	mg/kg
alpha-BHC	0.062	mg/kg
beta-BHC	0.062	mg/kg
delta-BHC	0.062	mg/kg
Chlordane	0.009	mg/kg
2,4-D	0.025	mg/kg
Dicamba	0.01	mg/kg
4,4'-DDD	0.049	mg/kg
4,4'-DDE	0.098	mg/kg
4,4'-DDT	0.0082	mg/kg
Dieldrin	0.039	mg/kg
Endosulfan	1.1	mg/kg
Endosulfansulfate	1.1	mg/kg
Endrin	0.004	mg/kg
Endrinaldehyde	0.004	mg/kg
Endrinketone	0.004	mg/kg
gamma-BHC (Lindane)	0.01	mg/kg
Heptachlor	0.017	mg/kg
Heptachlorepoxide	0.017	mg/kg
Isodrin	0.0039	mg/kg

CONSTITUENT	LIMIT	UNITS
MCPP	5	mg/kg
Methoxychlor	0.44	mg/kg
Petroleum Hydrocarbons and Constituents		
TPH (asdiesel)	100	mg/kg
TPH (asgasoline)	100	mg/kg
TPH (asfueloil / motoroil)	100	mg/kg
Benzene	0.005	mg/kg
Ethylbenzene	0.005	mg/kg
Toluene	0.005	mg/kg
TotalXylenes	0.005	mg/kg
Dioxins/Furans		
2,3,7,8-TCDD	8.2E-06	mg/kg

C. All proposed testing of potential import material shall be consistent with testing requirements of The California Department of Toxic Substances Control, including the DTSC Fact Sheet, Information Advisory, Clean Imported Fill Material, October 2001.

D. The Contractor shall submit to the Contracting Officer a list of proposed sources for importing fill materials requiring certification 30 calendar days in advance of importing materials. The presence of noxious weed species is grounds for rejection of the source. If exotic weed species are found or suspected, the Contractor may be required to strip the top 12" of the source material and only import sub-surface materials and/or sterilize the materials, at the Contracting Officer's discretion.

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall ensure that all environmental sampling work is conducted and supervised by individuals and/or a subcontracting firm holding the appropriate and applicable technical and professional credentials and/or licenses required by the State of California, as necessary.

B. The Contractor shall ensure that any environmental sampling the contractor conducts follows EPA, California, and American Society of Testing and Materials protocols and guidance.

C. Chemical testing of proposed impart materials shall be conducted consistent with DTSC Soil Guidance cited in Section 2.1C.

D. Material Testing

1. A sampling plan will be prepared and submitted to the CO for approval before collection and analysis of any samples of proposed import materials for all imported materials.

END OF SECTION

SECTION 31 23 17

WATERING

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work of this Section consists of furnishing, hauling, and applying water required for compaction of embankments, backfills, subgrade, and base course, and landscaping, dust control, and other construction operations.

1.2 RELATED REQUIREMENTS

A. Water availability: Temporary Facilities & Controls - Section 01 50 00.

PART 2 - PRODUCTS

2.1 WATER

A. Free of debris, organic matter, and other objectionable substances.

PART 3 - EXECUTION

3.1 WATER TRUCK

A. At least one thousand gallons capacity.

B. Always keep at least one water truck on-site, unless Contracting Officer approves the removal of the truck from the site before completion.

3.2 APPLICATION

A. Use pressure type distributors or a pipeline equipped with a sprinkler system. Provide approved meter devices near points of discharge.

B. Ensure a uniform application of water for optimum moisture content. Avoid excessive runoff and minimize water waste.

C. The Contractor may water excavation areas before excavating. Drill full depth of excavation to make moisture determinations.

D. If overwatering occurs, de-water at no additional expense to the Government.

END OF SECTION

SECTION 31 23 33

UTILITY EXCAVATION & BACKFILL

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work of this section consists of trenching and backfilling for the construction and installation of sewer system improvements.

B. Section Includes: Perform all excavation, shoring, dewatering, backfilling, compaction, and grading necessary or required for the construction of the work as covered by these Specifications and indicated on the Drawings. The Park's preference is for native excavated material to be used as a backfill. The excavation shall include, without classification, the removal and disposal of all materials of whatever nature encountered, including water and all other obstructions that would interfere with the proper construction and completion of the required work.

C. Restrictions to Backfill:

1. See Section 01 11 00 - Summary of Work; Subsection 1.3.C Preservation of Natural Features.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM).

B. The state of California, Department of Transportation, "Caltrans Standard Specifications, 2010 or current edition." (With latest amendments).

C. The state of California, Department of Transportation, Manual of Test (California Test).

D. "Greenbook Standard Specifications, 2015 or current edition"

1.3 RELATED WORK

A. Section 01 12 00 - Natural Features Protection

B. Section 01 35 13.22 - Archeological Protection

C. Section 32 12 16 - Asphalt Paving

D. Section 33 31 13 – Site Sanitary Sewerage Gravity Piping

E. Section 33 32 13.13 - Wastewater Lift Station Pump

F. Section 33 31 23 - Sanitary Sewerage Force Main Piping

G. Section 33 36 31 - Prestressed Concrete Wastewater Storage Tank

1.4 SUBMITTALS

A. As specified in Section 01 33 23 “Submittal Procedures.”

B. Sheeting and Shoring Plan: Refer to 1.6, “Additional Safety Responsibilities”

C. A written description of barricading, shoring, cribbing, bracing, and sloping precautions.

D. A written procedure for trench dewatering and disposal of fluidized materials removed.

E. Potholing Report as described in 3.2, “Existing Utilities”

F. Qualifications of Independent Testing Laboratory

G. Qualifications of Independent Field Testing Service

H. Materials Test Results and Certifications: Submit test results for import materials and certification that the material meets these specifications. Tests shall be performed within 60 days of the submission. All material furnished and all work performed shall be subject to rigid inspection, and no material shall be delivered to the site until it has been favorably reviewed by the Contracting Officer or used in the construction work until it has been inspected in the field by the Contracting Officer.

I. Field Testing Report: Submit a field testing report for materials used in the construction work. Independent Field Testing Service will certify the placement of materials meets the requirements of this specification.

J. A written description of materials proposed for imported backfill shall include the source of proposed materials for review by the COR (in conjunction with the NPS Earth Materials Management working group).

1.5 QUALITY ASSURANCE

A. Source Quality Control: Certify import materials proposed for use conform to the specified requirements of this Section. Working with the Contracting Officer, field test material placement to determine conformance to the specified requirements of this Section. Tests shall be performed by an independent testing laboratory. The Contractor shall be responsible for hiring an independent testing laboratory.

B. Field Quality Control:

1. The Contracting Officer will:
   a. Inspect foundations, site grading, and borrow operations.
   b. Inspect placement of fill.

2. The Contractor shall provide independent testing for field quality control as required by this specification. Working with the Contracting Officer, field test material placement to determine conformance to the specified requirements of this Section. The Contractor shall excavate holes for in-place soil sampling. The Contractor shall be responsible for hiring an independent field testing service. The contractor shall be responsible for costs of additional inspection and re-testing resulting from non-compliance.

C. Testing Methods:

1. Durability Index: Manual of Test, State of California, Department of Transportation.
2. Specific Gravity: ASTM D854.
3. Laboratory Compaction: ASTM D1557, Method A, B, or C (based on material gradation).
4. In-Place Density: ASTM D1556 or ASTM D2922.
5. Particle Size Analysis of Soils: ASTM D422.
6. Plastic Limit and Plasticity Index: ASTM D4318.
7. Soil Classification: ASTM D2487.
8. In-Place Moisture Content: ASTM D3017.

D. Definition:

1. Relative Compaction: In-place dry density divided by the maximum dry density laboratory compaction express as a percentage.

1.6 ADDITIONAL SAFETY RESPONSIBILITIES

A. The Contractor shall select, install, and maintain shoring, sheeting, bracing, and sloping as necessary to maintain safe excavations. The Contractor shall be responsible for ensuring such measures: 1) comply fully with 29 CFR Part 1926 OSHA Subpart P Excavations and Trenches requirements, 2) provide the necessary support to the sides of excavations, 3) provide safe access to the Engineer's sampling and testing within the excavation, 4) provide safe access for backfill, compaction, and compaction testing, and 5) otherwise maintain excavations in a safe manner that shall not endanger property, life, health, or the project schedule. All earthworks shall be performed in strict accordance with applicable law, including local ordinances, applicable OSHA, CalOSHA, California Civil Code, and California Department of Industrial Safety requirements.

B. If any ordinance is found during construction activity, immediately stop construction, and notify Contracting Officer. The construction activities in the area will not begin until the Contracting Officer notifies the Contractor the site is safe.

1.7 PROJECT CONDITIONS

A. Obtain all required permits and licenses before installing utilities under existing roads, other than Park Service roads, and follow the rules and requirements of the authority having jurisdiction.

B. Arrange construction sequences to provide the shortest practical time that the trenches will be opened to avoid hazards to the public, and to minimize the possibility of a trench collapse.

C. If an unknown utility is encountered during construction that conflicts with the proposed construction, the Contractor shall stop work in this area and notify the COR immediately.

1.8 EXCAVATION CLASSIFICATION

A. Regardless of the nature of the material excavated, all excavation will be considered unclassified.

1.9 EXPLOSIVES

A. The use of explosives will not be permitted on this project, unless specifically authorized, in writing, by the Contracting Officer.

1.10 SUBSURFACE INVESTIGATIONS

A. The bidders may make subsurface investigations at the site before the bidding of the project. Before making any drillings or excavations, the bidder shall secure permission from the Government and property owners if on private property.

1.11 HAND EXCAVATION

A. Contracting Officer will direct the performance of hand excavation within areas that are considered sensitive by the NPS including trenches dug within the drip line of trees.

1.12 SOIL CONTAMINATION

A. If the Contractor discovers unnaturally stained or unnaturally odor materials or otherwise suspects contamination, the Contractor shall immediately contact the Contracting Officer and stop work in suspected contamination

1.13 GROUNDWATER

A. The Contractor shall be responsible for the control, removal, and disposal of any groundwater that may be encountered while excavating and backfilling trenches, placing pipes, or constructing any other improvements associated with this project. (See Appendix “A” for the report located at the end of the project specifications.)

PART 2 - PRODUCTS

2.1 GENERAL

A. All backfill material shall be approved and certified weed-free, before use and be free of cinders, ashes, ice, frozen soil, large hard clods, organic debris, or other deleterious items. Trench excavation materials may be used as approved.

B. All material shall be from a source approved by the COR. All imported material must be free of contaminants. See Specification Section 31 23 16.10 “Imported Soils & Fill Materials.”

2.2 MATERIALS (CALTRANS CRITERIA)

A. Coarse Bedding: Class 2, 3/4” maximum aggregate base, per "Caltrans Standard Specifications, 2010 or current edition." Section 217 (with latest amendments).

B. Bedding Materials:

1. Standard Bedding and Pipe Envelope Sand: per "Caltrans Standard Specifications, 2010 or current edition.", Table 217 - 2.4 (with latest amendments).
2. Permeable Material: "Caltrans Standard Specifications, 2010 or current edition.", Table 217 - 4 (with latest amendments).
3. Pea Gravel: River run, rounded pea gravel with a maximum dimension no larger than 1/2”, and with no more than 10% passing the No. 200 sieve. The material shall have a durability index of 40 or higher.

C. Import Backfill: Imported non-expansive soil with a liquid limit no greater than 40% and a plasticity index no greater than 15, free from clods or rocks larger than 2” in greatest dimension, and free from organic material.

D. Native Backfill: Native soil prepared as necessary to be free from clods or rocks larger than 2” in greatest dimension, and free from organic material. All native soil excavated as part of the project but not used as native backfill shall be hauled out of the Park to an approved disposal site.

E. Impervious Material: Clay with a minimum percentage of material passing the No. 200 sieve of 50%. The material shall be free of organics, rocks, or clods greater than 4” in diameter.

F. Water: The water used shall be free of objectionable quantities of silt, oil, organic matter, alkali, salts, and other impurities. Water quality must be acceptable to the Contracting Officer.

G. Furnish required bedding, select backfill, and backfill materials listed under the appropriate types of utility line in the sections to which this work relates. See Specification Section 31 23 16.10 “Imported Soils & Fill Materials.”

2.3 MATERIALS (GREENBOOK CRITERIA)

A. Subbase: Select Imported Borrow meeting the requirements of Section 300-5.2, “Imported Borrow”, "Greenbook Standard Specifications, 2015 or current edition").

B. Aggregate Base: Crushed Surface Top Course (CSTC) meeting the requirements of Section 200, “Rock Materials”, "Greenbook Standard Specifications, 2015 or current edition".

C. Bedding Material: Backfill for Pipe Bedding Zone for water and sewer lines meeting the requirements of Section 217, “Bedding and Backfill Materials”, "Greenbook Standard Specifications, 2015 or current edition".

Commented [KG1]: Specify what bedding goes with what pipe (i.e. sewer bedding X, Water lines and recirc lines, bedding Y.
Need specs for 3/4-inch chip bedding for sewer lines.

D. Trench Backfill: Backfill for Trench Backfill Zone meeting the requirements of Section 217-2, “Trench Backfill” and Section 200, “Rock Materials”, "Greenbook Standard Specifications, 2015 or current edition", if the suitable backfill material is not available on the site of the work, the Contractor will be required to haul in material that is approved.

E. Water: The water used shall be free of objectionable quantities of silt, oil, organic matter, alkali, salts, and other impurities. Water quality must be acceptable to the Contracting Officer.

2.4 SURFACE FINISH MATERIALS

A. Mulch: Mulch, consisting of seed-free wood chippings, shall be used for ground cover identified by the Re-vegetation Plan, and shall be placed 3” thick. Contractor shall replace the existing 6” of topsoil before laying the mulch. Mulch may be obtained through the Conservancy Nursery, if available.

B. Erosion: All erodible slopes shall be protected during construction as identified on the plans. No plastic netting will be allowed for use at the construction site.

C. Sod: The top 6” of soil/sod shall be reused whenever possible.

2.5 UTILITY LINE MARKING

A. All utilities shall be marked for location and identified by marking tapes and/or locator wire as shown on the construction drawings and per Section 33 05 97.16 “Utility Line Marking.”

PART 3 - EXECUTION

3.1 CONTROL OF WATER

A. Groundwater Influence:

1. If shallow groundwater and saturated soil conditions are encountered at the site, dewatering or underwater construction technique may be required for construction.
2. If dewatering is required, a dewatering procedure shall be submitted for approval by the Contracting Officer.
3. In addition to the groundwater level, if earthwork is performed during or soon after periods of precipitation, the sub-grade soils may become saturated, "pump," or not respond to densification techniques. Typical remedial measures include disking and aerating the soil during dry weather; mixing the soil with dryer materials; removing and replacing the soil with an approved fill material; or mixing the soil with an approved lime or cement product.
4. The over-excavation bottom or trench bottom may require additional treatment to stabilize the sub-grade soil before backfilling. Soft and saturated sub-grade soil may be mitigated with a layer of geogrid reinforcement fabric consisting of Tensar® BX 1100 Geogrid (or approved equal) and overlain by twelve to twenty-four inches (12” – 24”) of compacted aggregate base.

B. The Contractor shall be responsible for furnishing temporary drainage facilities to convey and dispose of surface water falling on or passing over the site.

3.2 EXISTING UTILITIES

A. General: The known existing buried utilities and pipelines including building connections are shown on the Drawings in their approximate location. The Contractor shall exercise care in avoiding damage to all utilities as he will be held responsible for their repair if damaged. There is no guarantee that all utilities or obstructions are shown, or that the locations indicated are accurate. Utilities are piping, conduits, wire, cable, pull boxes, and the like, located at the project site.

B. Check on Locations (Potholing):

1. Contact all affected utility owners and request them to locate their respective utilities before the start of "potholing" procedures. The utility owner shall be given 7 days written notice before commencing potholing. If a utility owner is not equipped to locate its utility, the Contractor shall locate it.
2. Clearly paint the location of all affected utility underground pipes, conduits, and other utilities on the pavement or identify the location with suitable markers if not on pavement. In addition to the location of metallic pipes and conduits, non-metallic pipes, ducts, and conduits shall also be similarly located using the surface indicator and shall then be similarly marked.
3. After the utility survey is completed, commence "potholing" to determine the actual location and elevation of all utilities where crossings, interferences, or connections to the new pipelines are shown on the Drawing, marked by the utility companies, or indicated by surface signs. Before the preparation of piping shop drawings, or the excavating of any new pipelines or structures, the Contractor shall locate and uncover these existing to a point one foot below the utility. Submit a report identifying each underground utility and its depth and station. Any variation in the actual elevations and the indicated elevation shall be brought to the Contracting Officer's attention.
4. Excavations around underground electrical ducts and conduits shall be performed using extreme caution to prevent injury to workers or damage to electrical ducts or conduits. Similar precautions shall be exercised around gas lines, telephone, and television cables.
5. Excavations shall have a surface dimension of no more than 18" x 18". Backfill after completion of potholing. In existing streets, pave with one inch of cutback.

C. The Contractor shall pothole the existing water line and other related utilities before construction of new sewer laterals, force mains, and other associated sewer system improvements.

D. Shutdowns: Planned utility service shutdowns shall be accomplished during the period of minimum use. In some cases, this may require night or weekend work. Such work shall be at no additional cost to the Government. Program work so that service will be restored in the minimum possible time, and the Contractor shall cooperate with the Government in reducing shutdowns of utility systems to a minimum.

E. Disconnections: No utility shall be disconnected without prior written approval from the Government. When it is necessary to disconnect a utility, the Contractor shall give the utility Government not less than 7 days' notice when requesting written approval. The Contractor shall program his work so that service will be restored in the minimum possible time.

F. Overhead Facilities: There are existing overhead electric and telephone transmission lines within the project area. These overhead utilities are not shown on the Drawings. Extreme caution shall be used when working in the vicinity of overhead utilities to prevent injury to workers or damage to the utilities. The Contractor shall be required to comply with the applicable provisions of the California Construction Safety Orders when working anywhere on this project.

G. Existing gas, water, sewer, electrical, and telephone house laterals are not specifically shown on the Drawings but do exist along the pipeline routes. Protect all service laterals from damage due to construction operations. If any laterals are damaged, notify the Contracting Officer and the affected utility immediately. The Contractor shall bear the cost of repair.

3.3 USA NOTIFICATION & UTILITY FIELD MEETING

A. The Contractor shall contact Underground Service Alert (USA) (1-800-642-2444) 7 calendar days before the start of each ground-disturbing phase and shall be responsible for maintaining a valid USA location tag through renewal during the construction. The Contractor shall schedule a utility field meeting before any excavation. This shall be so stated in the USA notification. The Contractor shall be responsible to coordinate the utility field meeting at which time he shall explain the limits and impacts to USA member utilities.

B. Most of the utilities within Ash Mountain Portal are owned by NPS. As such, very few utilities will be marked out by USA. It is the Contractor's responsibility to field locate & mark all utilities within the project work area. It is the Contractor's responsibility to coordinate and meet with NPS personnel to field locate & mark all NPS utilities within the project work area. Field location and marking shall be performed a minimum of 3 days before ground disturbance; notify COR upon completion of field location and marking for COR review and approval. No trenching shall be performed before COR approval.

C. The Contractor shall expose (pothole) all crossing existing utilities along the trench alignment at locations where gravity sewer lines and sewer force mains are to be installed and connected before the commencement of the work on the project for the pipeline installation. This is to be done to determine the line and grade of existing utilities, possible conflicts and mismarks and avoid conflicts during pipeline installation and determine the realignment of the new sewer line if needed before sewer line trenching and installation. At all connections, the Contractor shall expose the existing pipeline to determine the depth at which the connection is to be made and verify existing pipe invert elevations, material, and sizes.

3.4 GENERAL CONSTRUCTION REQUIREMENTS

A. Site Access: Access to the site will be over public improved and unimproved roads. Exercise care in the use of such roads and repair at own expense any damage thereto caused by Contractor’s operations. Such repair shall be to the satisfaction of the Government or agency having jurisdiction over the road. Take whatever means are necessary to prevent tracking of mud onto existing roads and shall keep roads free of debris.

B. Traffic Regulation: Provide such flagmen, patrols, pilot cars, drivers, lighted barricades, flares, lights, warning signs, and safety devices as may be required for control of traffic adjacent to all areas of work.

C. Barriers: Barriers shall be placed at each end of all excavations and at such places along with excavations as may be necessary to warn all pedestrian and vehicular traffic of such excavations. Lights shall also be placed along with excavations from sunset each day to sunrise of the next day until such excavation is entirely restored.

D. Access: Free access must be maintained to all fire hydrants, water valves, and meters.

E. Open Trench Limitations: The Contracting Officer shall have the authority to limit the amount of trench to be opened or left open at any one time. In public roads, excavation and pipe laying shall be coordinated to the end that a minimum of interference with public traffic will result. No more than 200' of the trench shall be open at any time on any single heading. An open trench shall be defined as any trench which has not been completely backfilled and satisfactorily compacted.

F. Demolition of Pavement: Where trenching or excavation occurs in paved areas, the pavement shall be scored and broken ahead of the trenching or excavation operation. The extent of the paving removed shall be limited to the minimum necessary for the excavation.

G. Dust Control: Take proper and efficient steps to control dust.

H. Storage of Materials: Excavated materials unsuitable for backfill shall not be stored on existing streets and shall be disposed of immediately. Neatly place excavated materials far enough from the excavation to prevent stability problems. Keep the materials shaped to cause the least possible interference with drainage or the normal use of adjacent properties, structures, or roadways.

3.5 PREPARATION

A. Contractor shall protect concrete structures (i.e., curbs, sidewalks), existing vegetation, and any other existing structures before the start of construction.

B. All Lawn Areas: The Contractor shall remove the top 6" of soil and stockpile it separately for use during surface finish work.

3.6 FIELD QUALITY CONTROL

A. Testing required to determine compliance for the work of this section will be the responsibility of the Contractor, at no additional expense to the Government.

B. ASTM D1557 shall be used to determine maximum density and ASTM D1556-90 or ASTM D2922-96 shall be used to determine in-place density.

C. The Contractor shall perform at least one test within each backfill material zone as described in the "Caltrans Standard Specifications, 2010 or current edition." (With latest amendments) at the following maximum intervals. Testing at more frequent intervals may be required at the discretion of the Contracting Officer:

1. Vehicular Traffic Areas: 50 linear feet of trench.
2. Pedestrian and Gravel Areas: 100 linear feet of trench.
3. Non-traffic Areas: 200 linear feet of trench.

3.7 TRENCH EXCAVATION

A. Trenching, General: Excavate the trench to the approximate level of the top of the utility line to be installed, using adequate trench width and side slopes to safely accommodate worker access. Continue excavating for the utility line, to a width not greater than is shown on the appropriate trench detail.

1. Rocky Trench Bottom: Where ledge rock, hardpan, boulders, or sharp-edged materials are encountered, over-excavate a minimum depth of 6” below the bottom of the utility exterior wall to permit adequate bedding preparation. The installed utility shall have at least 6” of clearance from any rock protrusion.
2. Unstable Trench Bottom: Secure approval of depth of over-excavation and stabilization method. For wet trench construction, use an approved method of dewatering through diversion, damming, and pumping well points, or underdrain systems. Dispose of removed fluidized materials as approved. Use coarse bedding material to build a suitable foundation to within 6” of finished utility grade, before bedding with the specified material. Compact layers to 95% of maximum density is not greater than 6” layers. Do not proceed with utility installation until wet trench and unstable conditions are under control.
3. Backfill and compact over excavations to 95% relative compaction with bedding material. There shall be no additional payment to the Contractor for over excavations not directed by the Contracting Officer. Remove unsatisfactory material encountered below the grades shown as directed by the Contracting Officer and replace it with bedding material. Payment for removal and replacement of such unsatisfactory material directed by the Contracting Officer shall be made per the provisions of the General Conditions.
4. Grade trenches so that they are uniformly sloped between the pipe elevations shown on the Drawings. Comply with the minimum and maximum trench widths shown on the Drawings. Notify the Contracting Officer if the trench width exceeds the maximum allowable width for any reason.
5. Hand Excavation: Perform hand excavation of trenches dug within the drip line of trees. Carefully excavate around all roots 2” in diameter and larger to ensure against damage.
6. Lawn Areas: Where trenches cross established lawn areas, remove turf with approved sod-cutting equipment. Store and maintain the removed sod for later replacement. Cut to the lines shown or as directed.
7. There shall be no additional payment to the Contractor for over excavations not directed by the Contracting Officer. Remove unsatisfactory material encountered below the grades shown as directed by the Contracting Officer and replace it with bedding material. Payment for removal and replacement of such unsatisfactory material directed by the Contracting Officer shall be made per the provisions of the General Conditions.
8. Provide ladders for access to the trench by construction and inspection personnel.

3.8 SHORING AND SHEETING

A. Construct and maintain all shoring, sheeting, and slope lay-back necessary to protect the excavation, as needed for the safety of the employees and as required by applicable State and Federal laws.

B. For trenches over 5’ deep, provide suitable barricades for worker protection. When the work area is left open and unattended by the Contractor, provide suitable barricades for public safety, regardless of trench depth.

C. For trenches over 4’ deep, provide suitable exit means per applicable provisions of OSHA.

D. Do not remove timber or sheeting if it is in a compacted zone. Instead, trim it off at a safe level above that zone.

E. As directed, remove all other sheeting and shoring when safe to do so.

3.9 EXCAVATION FOR STRUCTURES

A. All excavation for structures shall be done to the dimensions and levels indicated on the Drawings or specified herein. Excavate to such width outside the lines of the structure to be constructed as may be required for proper working methods, the erection of forms, and the protection of the work.

B. Take care to preserve the foundation surfaces shown on the Drawings in an undisturbed condition. If the Contractor over excavates or disturbs the foundation surfaces shown on the Drawings or specified herein, without the written authorization of the Contracting Officer, he shall replace such foundations with concrete fill or other material approved by the Contracting Officer in a manner that will show by testing an equal bearing value with the undisturbed foundation material. No additional payment will be made for the added quantity of concrete fill or other material used because of over-excavation.

C. Inspection of Excavation: Notify the Contracting Officer when excavation for the structure is complete. No forms, reinforcing steel, concrete, or precast structure shall be placed until the excavation has been inspected by the Contracting Officer.

D. Where unsatisfactory material is encountered below the grades shown for structural excavations, it shall be removed and replaced with selected material as directed by the Contracting Officer and compacted. Payment for removal and replacement of such unsatisfactory material directed by the Contracting Officer shall be made per the provisions of the General Conditions.

3.10 BACKFILL AND COMPACTION

A. Place bedding and backfill materials true to the lines, grades, and cross-sections indicated on the Drawings. Place bedding and backfill materials in horizontal lifts not to exceed 6” in thickness measured before compaction. The difference in level on either side of a pipe shall not exceed 4”.

B. Backfill material shall not be placed over the pipe until after it has been inspected by the Contracting Officer.

C. Compaction:

1. Use vibratory compactors for sand and gravel (non-cohesive soils).
2. Use mechanical tampers for sand and gravel containing a significant portion of fine-grained material, such as silt and clay (cohesive soils).

3. Hand tamps around pipe or cable to protect the lines until an adequate cushion is attained.
4. Puddling or water flooding for consolidation of backfill or compaction by wheel rolling with construction equipment will not be permitted.

D. Bedding: Compact the specified material to 95% of maximum density, at a moisture content determined to be suitable for such density. Compaction shall be to the finished utility grade.

E. Utility Installation: Shape the trench bottom to ensure uniform contact with the full length of the installed line and remove any sharp-edged materials that might damage the line. Compaction shall be maintained beneath the line.

F. Select Backfill: Fill by hand placement around the utility to just over half depth and compact in a manner to ensure against lateral or vertical displacement. Place select backfill to 12" above the utility line by hand placement is not more than 6" layers. Compact each layer to 95% of maximum density, at a moisture content determined to be suitable for such density.

G. It shall be incumbent upon the Contractor to protect the pipe from damage during the construction period. It shall be his responsibility to repair broken or damaged pipes at no extra cost to the Government. Tamping of backfill over the pipe shall be done with tampers, vibratory rollers, and other machines that will not injure or disturb the pipe. Carefully place backfill around and over the pipe and do not allow it to fall directly upon the pipe.

H. Do not allow construction traffic or highway traffic over the pipe trench until the trench backfill has been brought back even with the existing adjacent grade.

I. Add water to the backfill material or dry the material as necessary to obtain the optimum moisture content for the compaction shown on the Drawings or specified. If the Contracting Officer determines that the nature of the ground in which the trench lies precludes compaction of the backfill to the specified density, the backfill shall be compacted to the maximum practicable density. Employ such means as may be necessary to secure uniform moisture content throughout the material of each layer being compacted. After the material has been moisture conditioned, compact it with compaction equipment approved by the Contracting Officer to achieve specified compaction. The Contractor shall be responsible for obtaining the densities specified. Should he fail, through negligence or otherwise, to compact to specified density, or to backfill and compact to surface grade, thus permitting saturation of the backfill material from rains or any other source, the faulty material shall be removed and replaced with approved material which shall be compacted to the specified density at optimum moisture content, and no additional payment will be made for doing such work or removal and replacement.

J. Compaction by flooding, ponding, or jetting will not be permitted.

K. Backfill: Place and compact the specified material as follows:

1. Compacts backfill for structures to 95% relative compaction.
2. Vehicular Traffic Areas: Fill and compact in 8" maximum layers to 95% of maximum density, at moisture content determined to be suitable for such density.
3. Pedestrian and Gravel Areas: Fill and compact in 8" maximum layers to 90% of maximum density, at moisture content determined to be suitable for such density.
4. Non-traffic Areas: Fill and compact in 8" maximum layers to 90% of maximum density, at moisture content determined to be suitable for such density.

L. For all piping or conduits to be placed in any excavated and backfilled area, such as at manholes or for building connections, the structural backfill shall be first compacted to a level of at least 2½' from the top of the piping or conduit elevation and then retrenched to pipe grade.

M. Under slabs, and around foundation walls, place structural fill in 8" layers and to 95% relative compaction.

N. Pavement Support: All base materials for paved areas shall be compacted to at least 95% relative compaction.

3.11 SUPPORT OF EXCAVATIONS

A. Adequately support excavation for trenches and structures to meet all applicable requirements in the current rules, orders, and regulations. Excavation shall be shored, braced, and sheeted so that the earth will not slide or settle and so that all existing structures and all new pipes and structures will be fully protected from damage. Keep vehicles, equipment, and materials far enough from the excavation to prevent instability.

B. Take all necessary measures to protect excavations and adjacent improvements from running, caving, boiling, settling, or sliding soil resulting from the high groundwater table and the nature of the soil excavated. Attention is directed to Section 832 of the Civil Code of the State of California relating to lateral and subjacent supports, and wherever structures or improvements adjacent to the excavation may be damaged by such excavation, the Contractor shall comply with this law.

C. The excavation support shall remain in place until the pipeline, or structure has been completed. During the backfilling of the pipeline or structure, the shoring, sheeting, and bracing shall be carefully removed so that there shall be no voids created and no caving, lateral movement, or flowing of the subsoils.

3.12 ROCK SUBGRADE UNDER STRUCTURES

A. Place a 6" layer of crushed rock, compacted to ninety percent (90%) relative compaction, under structures.

3.13 SURFACE FINISH WORK

A. Except where shown otherwise in the Drawings, restore the finish grade to the original contours and the original drainage patterns. Grade surfaces to drain away from structures. The finished surfaces shall be smooth and compacted.

B. Gravel Areas: Prepare the area for proper relaying of the previously removed gravel. Remove trench and backfill materials from adjacent gravel areas to permit unhindered and safe operation of equipment.

C. Open and Gravel Areas: Grade all disturbed areas to a finish ordinarily obtained from a blade grader, with no abrupt changes in grade or irregularities that will hold water.

D. Drainage Ditches: Restore drainage ditches to appropriate line and grade, using approved surface erosion prevention techniques.

E. Clean-Up: Before final inspection and acceptance, remove all rubbish and excess material for disposal as approved, and leave the area in a neat, satisfactory condition.

3.14 DISPOSAL OF EXCAVATED MATERIAL

A. Dispose of unsuitable material or excavated material, more than that needed for backfill, offsite per the requirements of Division 01 Section 01 74 19 “Construction Waste Management & Disposal” otherwise disposed of onsite with Contracting Officer’s approval.

END OF SECTION

SECTION 31 23 33.20

RESTORATION OF SURFACES

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work covered by this Section includes restoration to all types of surfaces disturbed, damaged, or destroyed during the performance of the work under or as a result of the operations of the contract.

1.2 RELATED SECTIONS

A. Utility Excavation & Backfill – Section 31 23 33

1.3 SCHEDULE OF RESTORATION

A. A schedule of restoration operations shall be submitted by the Contractor for review.

1. After an accepted schedule has been approved it shall be adhered to unless otherwise revised with the approval of the Contracting Officer.

Deleted: upon

B. The replacement of surfaces at any time, as scheduled or as directed, shall not relieve the Contractor of responsibility to repair damages by settlement or other failures.

PART 2 - PRODUCTS - NOT USED.

PART 3 - EXECUTION

3.1 GENERAL

A. The quality of materials and the performance of work used in the restoration shall produce a surface or feature equal to or better than the condition of each before the work began.

3.2 TEMPORARY PAVEMENT - NOT USED.

3.3 PERMANENT PAVEMENT REPLACEMENT - Section 32 12 16 Asphalt Paving.

3.4 PREPARATION FOR PERMANENT PAVEMENT - Section 32 12 16 Asphalt Paving.

3.5 ASPHALT PAVEMENT - Section 32 12 16 Asphalt Paving.

3.6 GRAVEL AREAS

A. All gravel areas disturbed shall be replaced by the Contractor with material to match the existing surface unless otherwise specified.

1. The depth of the soil, stone, or gravel shall be at least equal to the existing.

B. After compaction, the surface shall conform to the slope and grade of the area being replaced.

3.7 LAWNS (TURF) AND IMPROVED AREAS

A. All lawn or (turf) areas disturbed shall be replaced by the Contractor with material to match the existing planted surface unless otherwise specified.

1. The depth of the topsoil shall be as required per Section – 31 22 19 “Finish Grading” and at least equal to the existing, whichever is greater.

3.8 NATIVE UNDEVELOPED AREAS

A. All native undeveloped areas disturbed by this project’s activities, construction, or otherwise shall be rehabilitated by the Contractor per the directions specified in writing by the Contracting Officer.

1. The depth of the soil, stone, or gravel shall be at least equal to the existing.

B. After compaction, the surface shall conform to the slope and grade of the area being replaced.

3.9 OTHER TYPES OF RESTORATION

A. Watercourses shall be reshaped by the Contractor to the original grade and cross-section and all debris removed. Where required to prevent erosion, the bottom and sides of the watercourse shall be protected.

B. Flow lines indicated on the topographical survey shall not be altered by construction activity. The Contractor is responsible for reestablishing flow lines that have been affected by construction equipment or personnel under the supervision of the Contractor.

C. Trails and slopes shall be restored by the Contractor to their original condition upon completion of construction activity at a given area. The Contractor must ensure that no new channel flow lines or watercourses have been created because of construction activity.

END OF SECTION

SECTION 31 25 00

EROSION & SEDIMENTATION CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. The work under this section consists of furnishing all necessary labor, equipment, and materials, and performing all operations in connection with the construction of erosion and sediment control measures.

B. General

1. All erosion and sediment control measures are to be placed before any disturbance caused by grading and or excavation and shall conform to the requirements of the appropriate regulatory agency for the State.
2. The Contractor shall be solely responsible for ensuring that erosion and sediment control measures are implemented and maintained at the site.
3. Soil disturbing activities include but are not limited to Clearing and grubbing, excavation for utilities and utility structures, trenching in pathways and parking lot drive aisles, construction or modification of site drainage, grading, and preparation for final seeding.

1.2 RELATED SECTIONS

A. Site Clearing.

1. Section 01 57 23 - Temporary Storm Water Pollution Prevention.
2. Section 02 05 00 – Common Work Results for Existing Conditions.
3. Section 02 41 00 - Demolition & Abandonment.
4. Section 31 10 00 - Site Clearing
5. Section 31 23 33 - Utility Excavation & Backfill.
6. Section 31 23 33.20 - Restoration of Surfaces.

1.3 SUBMITTALS

A. As specified in Division 01 Section 01 33 23 “Submittal Procedures.”

B. Quality Assurance/Control - The contractor shall prepare an erosion and sediment control plan for all project areas.

C. The contractor is required to provide all information to the National Park Service (NPS) for the NPS to execute the SWPPP permit. The contractor is responsible for compliance with the permit and permit fees associated with the permit.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Silt Fence

1. Materials used for silt fences consisting of fabric and posts shall be per the Pollution Prevention Concept Plans of the construction drawings.
2. Filter fabric shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of 6 months of expected usable construction life at a temperature range of 0° - 120° F.

B. Straw Wattles

1. The only approved Straw wattles shall be “Weed Free Rice Straw with Burlap Outer Filter.”

PART 3 - EXECUTION

3.1 CONSTRUCTION

A. Install “Excelsior” straw wattles and other stormwater control measures approved by COR at local drainage ways to prevent silt intrusion upon adjacent drainage courses. Remove “Excelsior” straw wattles and other stormwater control measures following the establishment of vegetation cover and utilize them as directed by COR.

B. Before construction, install a silt fence along the downhill construction limits per the erosion control standard detail to prevent silt intrusion upon adjacent land.

C. Install erosion and sediment control measures on the downslope toe of all topsoil stockpiles.

D. Maintain and remove all erosion controls as specified.

E. Rice straw and wattles shall be placed on all exposed surfaces that will not be brought to final grading or permanent cover treatment within 30 days of the exposure to reduce erosion and sedimentation by stabilizing exposed soils. Treated areas shall be checked regularly for bare spots, and washouts, to assure that a good cover of rice straw is being maintained. Recover with rice straw areas that fail to establish stormwater protection as identified by the COR.

3.2 DUST CONTROL

A. In areas subject to the surface and air movement of dust, where on-site or off-site damage is likely to occur, preventive measures shall be per the Pollution Prevention Concept Plans General Notes sheet EC1 under “EROSION AND SEDIMENT CONTROL NOTES”, Items 1 through 9 of the construction drawings plans.

3.3 SILT FENCE

A. Silt fences are appropriate for the following general locations:

1. Immediately upstream of the point(s) of runoff discharged from a site before the flow becomes concentrated. Below disturbed areas where runoff may occur in the form of overland flow.
2. Along the downslope toe of all topsoil stockpiles.
3. Perimeter enclosure of Materials.
4. Maintenance areas.
5. Utilize synthetic filter fabric for sediment barriers with strength that meets or exceeds the strength of materials as specified under Section 2.1 above. The filter fabric shall be purchased in a continuous roll cut to the length of the barrier to avoid the use of joints. When joints are necessary, filter cloth shall be spliced together only at a support post, with a minimum 6" overlap, and securely sealed.
6. The filter fabric shall be stapled or wired to the fence and 6" of the fabric shall be extended into the ground. Filter fabric shall not be stapled to existing trees.
7. Support posts shall be spaced at a maximum of 6 feet and driven securely into the ground for a minimum of 24-inches.
8. The height of a silt fence shall not exceed 36". Higher fences may impound volumes of water sufficient to cause the failure of the structure.
9. Silt fences and filter barriers shall be inspected immediately after each rainfall and at least daily during prolonged rainfall.
10. Silt fences shall be inspected for depth of sediment, tears in the fabric, and to see if the fabric is securely attached to the fence posts, and to see that the fence posts are firmly in the ground. Any deficiencies shall be repaired immediately.
11. Should the fabric on a silt fence of filter barrier decompose or become ineffective before the end of the expected usable life and the barrier still be necessary, the fabric shall be replaced promptly.
12. Sediment deposits should be removed after each storm event and/or when deposits reach approximately 1/3 the height of the barrier or when the sediments limit or prevent the flow of water through the fabric hydraulic.
13. Any sediment deposits remaining in place after the silt fence or filter barrier is no longer required shall be dressed to conform with the existing grade, prepared, and seeded.

3.4 EXCELSIOR STRAW WATTLES EROSION CONTROL FENCE

A. Excelsior straw wattles are appropriate for the following general locations:

1. Sheet flow applications: Straw wattles shall be placed in a single row, lengthwise on the contour with ends of adjacent wattles tightly joined with one another.
2. Channel flow applications: Straw wattles shall be placed in a single row, lengthwise and oriented perpendicular to the direction of flow with ends of adjacent wattles tightly joined with one another. The barrier shall be extended to such a length that the bottoms of the end wattles are higher in elevation than the top of the lowest middle section of wattles to assure that sediment-laden runoff will flow either through or over the barrier but not around it.

3. The barrier shall be entrenched and backfilled. A trench shall be excavated the width of a wattle and the length of the proposed barrier to a minimum depth of 2” and a maximum depth of 4”.
4. Wattles shall be securely anchored by stakes no more than 4’ apart. Stakes or rebar shall be driven a minimum of 12” into the ground or deep enough into the ground to securely anchor the wattles, whichever is greater.
5. There shall be no gaps between wattles. Wattles shall be joined to prevent water from escaping between the wattles. Loose rice straw scattered over the area immediately uphill from a straw wattle barrier tends to increase barrier efficiency.

3.5 MAINTENANCE

A. The inspection shall be frequent, and repair or replacement shall be made promptly as needed.

1. Straw wattle carriers shall be removed when they have served their usefulness, but not before the upslope areas have been permanently stabilized.

END OF SECTION

SECTION 31 37 00

RIPRAP, BOULDERS, SOIL RIPRAP, & BEDDING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. The WORK includes excavation, grading, and installation of riprap, boulders, soil riprap, and bedding placed at the locations shown on the Drawings. The materials to be used and the construction of such structures shall be as specified herein.

1.2 RELATED SECTIONS

A. The following is a list of SPECIFICATIONS, which may be related to this section:

l. Section 31 23 33, Utility Excavation & Backfill.

1.3 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. American Association of State Highway and Transportation Officials (AASHTO):
   a. T85, Standard Method of Test for Specific Gravity and Absorption of Coarse Aggregate.
   b. T96, Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
   c. T103, Standard Method of Test for Soundness of Aggregates by Freezing and Thawing.
   d. T I04, Standard Method of Test for Soundness of Aggregate by Use
   e. of Sodium Sulfate or Magnesium Sulfate.
   f. T248, Reducing Field Samples of Aggregate Test Size.
2. ASTM International (ASTM): D698, Standard Test Method s for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3).

1.4 SUBMITTALS

A. The contractor shall cooperate with the Engineer in obtaining and providing samples of all specified materials.

B. The contractor shall submit certified laboratory test certificates for all items required in this section.

PART 2 PRODUCTS

2.1 MATERIALS

A. Riprap

1. Riprap used shall be the type designated on the Drawings and shall conform to the following:

Riprap Designation	% Smaller Than Given Size by Weight	Intermediate Rock Dimension (inches)	d_{50}* (inches)
Type VL	70 - 100 50 - 70 35 - 50 2 - 10	12 9 6 2	6**
Type L	70 - 100 50 - 70 35 - 50 2 - 10	15 12 9 3	9**
Type M	70 - 100 50 - 70 35 - 50 2 - 10	21 18 12 4	12**
Type H	70 - 100 50 - 70 35 - 50 2 - 10	30 24 18 6	18
Type VH	70 - 100 50 - 70 35 - 50 2 - 10	41 33 24 9	24
d_{50} = Mean Particle Size ** Mix VL, Land M riprap with 35% topsoil (by volume) and bury it with 4 to 6 inches of topsoil, all vibration compacted, and revegetate.			

2. The riprap designation and the total thickness of the riprap shall be as shown on the Drawings. The maximum stone size shall not be larger than the thickness of the riprap.
3. Neither the width nor thickness of a single stone of riprap shall be less than 1/3 of its length.
4. The specific gravity of the riprap shall be 2.5 or greater.

6. Riprap-specific gravity shall be according to the bulk-saturated, surface-dry basis, following AASHTO T85.
7. The bulk density for the riprap shall be 1.3 ton/cy or greater.
8. The riprap shall have a percentage loss of not more than 40% after 500 revolutions when tested following AASHTO T96.
9. The riprap shall have a percentage loss of not more than 10% after 5 cycles when tested following AASHTO T104 for ledge rock using sodium sulfate.
10. The riprap shall have a percentage loss of not more than 10% after 12 cycles of freezing and thawing when tested following AASHTO T103 for ledge rock, procedure A.
11. Rock shall be free of calcite intrusions.
12. Gradation:
    a. Each load of riprap shall be reasonably well graded from the smallest to the largest size specified.
    b. Stones smaller than the 2 to 10% size will not be permitted in an amount exceeding 10% by the weight of each load.
    c. The control of gradation shall be by visual inspection. However, in the event Engineer determines the riprap to be unacceptable, the Engineer shall pick 2 random truckloads to be dumped and checked for gradation.
        1) Mechanical equipment and labor needed to assist in checking gradation shall be provided by the Contractor at no additional cost.
13. Color:
    a. The color shall be consistent on the entire Project and shall match the color of the rock to be used for all other portions s of the work.
14. Broken concrete or asphalt pavement shall not be acceptable for use in the work.
15. Rounded riprap (river rock) is not acceptable unless specifically designated on the Drawings.

B. Boulders

1. Boulders used shall be the type designated on the Drawings and shall conform to the following:

Boulder Classification	Nominal Size (inches)	Range in Smallest Dimension of Individual Rock Boulders (inches)	Maximum Ratio of Largest to Smallest Rock Dimension of Individual Boulders
Bl8	18	17-20	1.50
B24	24	22 -26	1.50
B30	30	28-32	1.50
B36	36	34- 38	1.50
B42	42	40 - 44	1.50
B48	48	45- 51	1.50

2. The specific gravity of the boulders shall be 2.5 or greater.
3. Boulder specific gravity shall be according to the bulk-saturated, surface-dry
4. basis, following AASHTO T85.
5. The bulk density for the boulder shall be 1.3 ton/cy or greater.
6. The boulders shall have a percentage loss of not more than 40% after 500 revolutions when tested following AASHTO T96.
7. The boulders shall have a percentage loss of not more than 10% after 5 cycles when tested following AASHTO T104 for ledge rock using sodium sulfate.
8. The boulders shall have a percentage loss of not more than 10% after 12 cycles of freezing and thawing when tested following AASHTO Tl 03 for ledge rock, procedure A.
9. Rock shall be free of calcite intrusions.
10. Color:
    a. The color shall be consistent on the entire Project and shall match the color of rock to be used for all other portions of the WORK.

C. Soil Riprap

1. Rock requirements are to comply with riprap as specified in Article Materials.
2. The soil material shall be native or topsoil and mixed with 65% riprap and 35% soil by volume.
3. Soil riprap shall consist of a uniform mixture of soil and riprap without voids.

D. Bedding

1. Gradation for Granular Bedding:

	Percent by Weight Passing Square-Mesh Sieves	
U.S. Standard Sieve Size	Type I (CDOT Sect. 703.01)	Type II (CDOT Sect. 703.09 Class A)
3 inches	-	90 - 100
1 1/2 inches	-	-
3/4 inch	-	20 -90
3/8 inch	100	-
No.4	95 - 100	0 - 20
No. 16	45 - 80	-
No. 50	10 - 30	-
No. 100	2 - 10	-
No. 200	0 -2	0- 3

2. Granular bedding designation and the total thickness of bedding shall be as shown on the Drawings.
3. Granular bedding shall meet the same requirements for specific gravity, absorption, abrasion, sodium sulfate soundness, calcite intrusion, and freeze-thaw durability as required for riprap.
    a. Broken concrete asphalt pavement or sledge, shall not be acceptable for use in the Work. Rounded river rock is not acceptable unless specifically designated on the Drawings.
    b. The requirements for the wear test in AASHTO T96 shall not apply.

E. Feature Boulders - Not Used.

PART 3 - EXECUTION

3.1 PREPARATION

A. Channel slope, bottom, or other areas that are to be protected with riprap, boulders, or soil riprap shall be free of brush, trees, stumps, and other objectionable material and be graded to a smooth compacted surface as shown on the Drawings.

B. The contractor shall excavate areas to receive riprap to the subgrade as shown on the Drawings accounting for granular bedding.

C. The contractor shall excavate areas to receive boulders or soil riprap to the specified depth (bedding material is not required for boulders and soil riprap).

D. Subgrade Materials:

1. The subgrade materials shall be stable.
2. If unsuitable materials are encountered, they shall be removed and replaced as Muck Excavation per Section 31 23 00, Utility Excavation & Backfill, for subgrade that has been excavated in undisturbed soil.

E. Additional Compaction:

1. Additional compaction shall not be required unless specified by Engineer.
2. When subgrade is built up with embankment material it shall be compacted to 95% maximum density (ASTM 0698).

F. Bedding:

1. After an acceptable subgrade is established, bedding shall be immediately placed and leveled to the specified elevation on the Drawings.
2. Immediately following the placement of the bedding material, the riprap shall be placed.
3. If bedding material is disturbed for any reason, it shall be replaced and graded at the Contractor's expense.

4. Contamination:
    a. In-place bedding materials shall not be contaminated with soils, debris, or vegetation before the riprap is placed.
    b. If contaminated, the bedding material shall be removed and replaced at the Contractor's expense.

3.2 PLACEMENT

A. Riprap

1. Following acceptable placement of granular bedding, riprap placement shall commence as follows:
    a. Machine Placed Riprap:
        1) Riprap shall be placed on the prepared slope or channel bottom areas in a manner that will produce a well-graded mass of stone with the minimum practicable percentage of voids.
        2) Riprap shall be machine placed unless otherwise stipulated in the Drawings or Specifications.
        3) These Specifications intend to produce compact riprap protection in which all sizes of material are placed in their proper proportions. Unless otherwise authorized by the Engineer, the riprap protection shall be placed in conjunction with the construction of the embankment or channel bottom with only sufficient delay in construction of the riprap protection, as may be necessary, to allow for proper construction of the portion of the embankment and channel bottom which is to be protected.
    b. Slope Placement:
        1) When riprap is placed on a slope, placement shall commence at the bottom of the slope working up the slope.
    c. The entire mass of riprap shall be placed on either channel slope or bottom to be in conformance with the required gradation mixture and to the line, grade, and thickness shown on the Drawings.
    d. Riprap shall be placed to full course thickness at one operation and in such a manner as to avoid displacing the underlying bedding material. Placing of riprap in layers, or by dumping into chutes, or by similar methods shall not be permitted.
    e. All material used for riprap protection for channel slope or bottom shall be placed and distributed such that there shall be no large accumulations of either the larger or smaller sizes of stone. Some hand placements may be required to achieve this distribution.
    f. The basic procedure shall result in larger materials flush to the top surface with faces and shapes arranged to minimize voids, and smaller materials below and between larger materials.
    g. The surface grade shall be a plane or as indicated, but projections above or depressions under the finished design grade by more than ten percent (10%) of the rock layer thickness shall not be allowed.
    h. The smaller rock shall be securely locked between the larger stone. The material between the larger stones must not be loose or easily displaced by flow or by vandalism.

i. The stone shall be consolidated by the bucket of the backhoe or other means that will cause interlocking of the material.
j. All rock is to be placed in a dewatered condition beginning at the toe of the slope or other lowest point.
k. CONTRACTOR shall maintain the riprap protection until accepted. Any material displaced for any reason shall be replaced to the lines and grades shown on the Drawings at no additional cost to the Owner. If the bedding materials are removed or disturbed, such material shall be replaced before replacing the displaced riprap.

2. Hand Placed Riprap:
   a. Hand placed riprap shall be performed during machine placement of riprap and shall conform to all the requirements of PART 2, above.
   b. Hand placed riprap shall also be required when the depth of riprap is less than 2 times the nominal stone size, or when required by the DRAWINGS or SPECIFICATIONS.
   c. After the riprap has been placed, hand placing or rearranging of individual stones by mechanical equipment shall be required to the extent necessary to secure a flat uniform surface and the specified depth of riprap, to the lines and grades as shown on the Drawings.
3. Soil Replacement Over Riprap:
   a. Where riprap is designated to be buried, place onsite excavated material that is free from trash and organic matter in riprap voids by washing and rodding.
   b. Prevent excessive washing of material into the stream.
   c. When voids are filled and the surface accepted by the Engineer, place a nominal 6 inches of topsoil over the area, or as designated on the Drawings.
   d. Fine grade, seed, and mulch per the specifications.

B. Boulders

1. Following excavation and acceptance of subgrade by ENGINEER Boulder placement shall commence as follows:
   a. Boulders shall be placed on the prepared subgrade in a manner that will minimize voids.
   b. Voids between boulders exceeding 4” shall be chinked.

C. Soil Riprap

1. Adjacent stockpiles of riprap and soil shall be created and mixing done at the stockpile location, not at the location where soil riprap is to be placed.
2. Mix 35% soil by volume with stockpiled riprap, using additional moisture and control procedures that ensure a homogenous mixture, where the soil fills the inherent voids in the riprap without displacing riprap.
3. With prior approval of the Engineer, layering the riprap and soil instead of premixing may be allowed if the native soil is granular.
4. Place the first layer of smaller soil riprap of approximate d_{50} thickness. Then place the top layer with surface rocks that are d_{50} or greater, filling voids as necessary with smaller planted riprap. Create a smooth plane as described in Paragraph A.
5. The mixture shall be consolidated by large vibratory equipment or backhoe bucket to create a tight, dense interlocking mass.
6. The soil shall be further wetted to encourage void filling with soil.

7. Any large voids shall be filled with rock and small voids filled with soil.
8. Excessively thick zones of soil prone to washing away shall not be created (for example, no thicknesses greater than 6 inches).
9. For buried soil riprap, the top surface shall be covered with 4 inches of topsoil such that no rock points are protruding.
10. The final surface shall be thoroughly wetted for good compaction, smoothed, and compacted by vibrating equipment; the surface shall then be hand raked to receive planting or seeding.

D. Feature Boulders - Not Used

3.3 REJECTION OF WORK AND MATERIALS:

A. The engineer will reject placed riprap, boulders, soil riprap, and bedding that do not conform to this section. The contractor shall immediately remove and re-lay the riprap, boulders, soil riprap, and bedding to conform to Specifications.

B. Riprap, boulder s, soil riprap, and bedding shall be rejected, which is either delivered to the job site or placed, that does not conform to this section.

C. Rejected riprap, boulders, soil riprap, and bedding shall be removed from the Project site by the Contractor at the Contractor's expense.

END OF SECTION

DIVISION 32

EXTERIOR

SECTION 32 11 17

UNDERSLAB CAPILLARY BREAK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including Division 1 Specification apply to work of this Section.

1.2 SECTION INCLUDES

A. Underslab Capillary Break under concrete slabs on grade and site concrete slabs.

1.3 REFERENCES

A. All references shall be the latest adopted edition.

B. ASTM D698 - Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3)

C. ASTM D1557 - Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3).

D. ASTM C33 - Standard Specification for Concrete Aggregates

1.4 SUBMITTALS

A. Refer to Division 1 of the specifications for submittal procedures.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Underslab Capillary Break: Crushed rock coarse aggregate, clean washed and free of fines, conform to ASTM C33, Size Number 5, (1" to ½").

PART 3 - EXECUTION

3.1 COORDINATION

A. Review, coordinate and accommodate the work of other Sections that interface with, affect, or are affected by the work of this Section to facilitate the execution of the overall Work of this project in a coordinated and efficient manner.

3.2 EXAMINATION

A. Identify required lines, levels, contours, and datum locations.

B. Inspect subgrade for conformance with specified compaction and required surface elevation.

C. Do not start installation until the underslab electrical conduit has been installed.

D. Do not start installation until the subgrade condition is acceptable, the start of installation indicates acceptance of subgrade.

3.3 PREPARATION

A. Before placing any underslab capillary break, remove any standing water and unsuitable wet subgrade soil (soil that is over optimum moisture content and has become plastic, mushy or disturbed and cannot be recompacted to specified density). Remove unsuitable soil off-site.

B. Until ready to place underslab capillary break, maintain excavations and prevent loose soil from falling into the excavation.

3.4 PLACEMENT

A. Place underslab capillary break to uniform 4 inches compacted depth under concrete slabs on grade and site concrete slabs.

B. Grade/rake surface or capillary break level and smooth.

C. Fully compact underslab capillary break using self-propelled vibrating equipment with a minimum of 2 passes.

D. The compacted surface shall be level, tight, flat, and free of ridges, divots, or unevenness.

3.5 FIELD QUALITY CONTROL

A. See Division 31 for general requirements for field inspection and testing.

B. Results will be evaluated with a compaction curve determined by testing uncompacted material per ASTM D698 ("Standard Proctor").

C. If tests indicate work does not meet specified requirements, remove work, replace, and retest.

3.6 PROTECTION

A. After placement, keep capillary break clean and protect from contamination with site soil or construction debris.

END OF SECTION

SECTION 32 11 23

AGGREGATE BASE COURSES

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work of this Section consists of furnishing and placing aggregate, and filler if required, on a prepared subgrade.

1.2 REFERENCES

A. California Department of Transportation "Caltrans Standard Specifications, 2010 or current edition." (With latest amendments).

B. American Society for Testing and Materials:

1. ASTM C 88-13 - A Standard Test method for soundness of aggregates by use of sodium sulfate or magnesium sulfate.
2. ASTM D422-63(2007) - A Standard Test method used for gradation analysis.
3. ASTM D4318-10e1 - A Standard Test method used for the determination of plasticity index.

1.3 SUBMITTALS

A. As specified in Division 01 Section 01 33 23 “Submittal Procedures.”

B. Commercial Source Certification: If materials are obtained from a commercial source, submit a certification and a gradation report from the supplier certifying that the aggregate base course meets the requirements of this Section.

C. Independent Testing Report and Certification: If a commercial source certification is not available Contractor shall provide a certification and gradation report from independent testing certifying that the aggregate base course meets the requirements of this Section.

1. Certification and gradation report submittals shall be approved by the Contracting Officer before bringing material onsite.

D. Independent Testing Laboratory Qualification: Provide qualifications of independent testing laboratory that are designated to perform laboratory testing as required by this Section.

E. Independent Field Testing Service Qualification: Provide qualifications of independent testing laboratory that are designated to perform field testing as required by this Section.

F. Quality Control Submittals:

1. Sub-base Materials: Name and location of the source, stockpile number, California test 217, and test 301 results.
2. Base Materials: Name and location of the source, stockpile number, and California test 217, test 301, and test 229 results

1.4 QUALITY ASSURANCE

A. Quality Control: Certify import materials proposed for use conform to the specified requirements of this Section. All material furnished and all work performed shall be subject to rigid inspection, and no material shall be delivered to the site until it has been favorably reviewed by the Contracting Officer or used in the construction work until it has been inspected in the field by the Contracting Officer. Tests shall be performed by an independent testing laboratory. The Contractor shall be responsible for hiring an independent testing laboratory.

B. Working with the Contracting Officer, field test material placement to determine conformance to the specified requirements of this Section. Tests shall be performed by an independent field-testing service. The Contractor shall be responsible for hiring an independent field-testing service.

PART 2 - PRODUCTS

2.1 AGGREGATE MATERIALS

A. Class 2 Aggregate Sub-base (AS): Aggregate for Class 2 sub-base must be clean and consist of any combination of the following:

1. Broken stone
2. Crushed gravel
3. Natural rough-surfaced gravel
4. Sand
5. Reclaimed processed asphalt concrete, PCC, LCB, or CTB

B. When tested under California Test 202, aggregate must comply with the grading requirements for the sieve sizes shown in the following table:

Aggregate Grading

Sieve size	Percentage passing	
	Class 2	
	Operating range	Contract compliance
3"	100	100
2 1/2"	90-100	87-100
No. 4	40-90	35-95
No. 200	0-25	0-29

C. Aggregate must comply with the quality requirements for the classes shown in the following table:

Property	California Test	Class 2	
		Operating range	Contract compliance
Sand equivalent (min)	217	21	18
Resistance (R-value) (min)	301	--	50

1. If the aggregate grading test results, the sand equivalent test results, or both comply with contract compliance requirements but not operating range requirements, you may continue placing AS for the remainder of the workday. Do not place additional AS until you demonstrate to the Contracting Officer the AS to be placed complies with the operating range requirements.
2. If the aggregate grading test results, sand equivalent test results, or both do not comply with contract compliance requirements, remove the AS, or request a payment deduction. If your request is authorized, $2.00/cu yd is deducted for each non-compliant test result. An aggregate grading and a sand equivalent test represent up to 1) 500 cubic yards or 2) One day's production if less than 500 cubic yards.

D. Class 2 Aggregate Base (AB): Aggregate for Class 2 base must be clean and consist of any combination of the following:

1. Broken stone
2. Crushed gravel
3. Natural rough-surfaced gravel
4. Sand
5. Reclaimed processed asphalt concrete, PCC, LCB, or CTB

E. Use either 1½" or 3/4" aggregate grading. Do not change your selected aggregate grading without authorization.

F. If the aggregate grading test results, sand equivalent test results, or both comply with contract compliance requirements but not operating range requirements, you may continue placing AB for the remainder of the workday. Do not place additional AB until you demonstrate to the Contracting Officer the AB to be placed complies with the operating range requirements.

G. If the aggregate grading test results, sand equivalent test results, or both do not comply with contract compliance requirements, remove the AB, or request a payment deduction. If your request is authorized, $2.00/cu yd is deducted. If AB is paid by weight, the Contracting Officer converts tons to cubic yards to reduce payment for noncompliant AB left in place. An aggregate grading and a sand equivalent test represent up to 1) 500 cubic yards or 2) One day's production if less than 500 cubic yards.

H. When tested under California Test 202, aggregate must comply with the grading requirements for the sieve sizes shown in the following table:

Aggregate Grading

Sieve sizes	Percentage passing			
	1-1/2 inches maximum		3/4 inch maximum	
	Operating range	Contract compliance	Operating range	Contract compliance
2"	100	100	--	--
1-1/2"	90-100	87-100	--	--
1"	--	--	100	100
3/4"	50-85	45-90	90-100	87-100
No. 4	25-45	20-50	35-60	30-65
No. 30	10-25	6-29	10-30	5-35
No. 200	2-9	0-12	2-9	0-12

I. Aggregate must comply with the quality requirements shown in the following table:

Aggregate Quality

Property	California Test	Operating range	Contract compliance
Resistance (R-value) (min)	301	--	78
Sand equivalent (min)	217	25	22
Durability index (min)	229	--	35

J. Aggregate samples must not be treated with lime, cement, or chemicals before testing for durability index. Aggregate from untreated reclaimed processed asphalt concrete, PCC, LCB, or CTB is not considered treated.

2.2 FILLER

A. Finely divided mineral matter such as rock or slag dust, hydrated lime, hydraulic cement, or other suitable mineral matter free from organic impurities and clay.

PART 3 - EXECUTION

3.1 PLACING

A. If the required compacted depth of the aggregate base course exceeds 6”, place the course in 2 or more layers of approximately equal thickness. The maximum compacted thickness of any 1 layer shall not exceed 6”.

3.2 MIXING

A. Mix the aggregate by any one of the three following methods.

1. Stationary Plant Method: Mix aggregate base course and the appropriate amount of water for compaction in an approved mixer. After mixing, transport aggregate to the job site while it contains the proper moisture content and place it on the roadbed with an approved aggregate spreader. Before compaction, remove excess moisture.
2. Travel Plant Method: After the material for each layer has been placed through an aggregate spreader or windrow sizing device, it shall be uniformly mixed by a traveling mixing plant.
3. Road Mix Method: After placing each layer, mix materials at optimum moisture content using motor graders or other approved equipment until the moisture is uniform throughout.

B. When commercial binders or fillers are used with aggregate, mix with a central mixing plant of the twin-Pugmill type. Other methods that ensure a thorough and homogenous mixture may be used on written approval.

3.3 COMPACTION

A. Compact each layer to a density of not less than 95% of the maximum density, as determined by ASTM D1557. The contractor shall provide an independent field tester to determine density in-place, following ASTM D6938-15, or other recognized method. Random tests for compacted depth will be made during the progress of the work. The Contracting Officer may designate specific test locations.

3.4 SURFACE FINISHING

A. Use a smooth steel wheel roller for the final rolling of the top surface base course. Water surface and evenly spread loose stones before final rolling. Make a minimum of 2 complete passes over the area to embed stones. Correct soft spots developed during rolling.

B. The compacted base course surface shall be smooth and free from waves and other irregularities. Unsatisfactory portions of the base course shall be torn up, reworked, re-laid, and rerolled, at no additional expense to the Government.

3.5 MATERIAL ACCEPTANCE REQUIREMENTS

A. Acceptance will be based on independent testing to the requirements of this section, to be taken following mixing and before laying.

3.6 TOLERANCES

A. Surface: The Contracting Officer will test the finished surface of the base course with a 10' straightedge or another device. The variation between any 2 contacts with the surface shall not exceed 1/2". Any areas not complying with these tolerances shall be reworked to obtain conformity.

B. Width: Plan dimension, plus or minus 2".

C. Thickness: Plan dimension, plus or minus 1/2".

3.7 MAINTENANCE

A. Maintain base course in a satisfactory condition until surfaced or until final acceptance.

END OF SECTION

SECTION 32 12 16

ASPHALT PAVING

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work of this Section consists of performing all operations necessary to replace pavement where required by the construction of pipelines and other sewer system improvements.

1.2 QUALITY ASSURANCE

A. Testing required to determine compliance with the work of this section will be the responsibility of the Contractor. See Section 01 40 00 “Quality Requirements.” An independent testing laboratory shall be used to sample and test asphalt concrete. One test shall be taken for each paving period and at least one test every 4 hours. As a minimum, the results of the tests shall include items A, B, and C of the job mix formula submittal.

1.3 SUBMITTALS

A. As specified in Division 01 Section 01 33 23 “Submittal Procedures.”

B. Qualifications of Independent Testing Laboratory.

C. Qualifications of Independent Field Testing Service

D. Certificates and Laboratory Testing Results:

1. Aggregate base rock analysis report.
2. Certification from the supplier that asphalt cement is of the correct type and meets the requirements of this Section.
3. Compaction test results.
4. The contractor shall furnish certified lab results of the job mix formula of percent voids, stabilometer, and aggregate gradation analysis for the asphalt concrete.

1.4 PROJECT CONDITIONS

A. Apply mixture only during hours of daylight; when the air temperature is 50 °F or higher; when surfaces to be paved are dry and free of frost, snow, or ice; and when precipitation is not imminent.

PART 2 - PRODUCTS

2.1 ASPHALT CONCRETE

A. Work under this item shall be following the "Caltrans Standard Specifications, 2010 or current edition." (With latest amendments), Sections 39 and 92 unless otherwise shown. Asphalt Concrete Cal Trans Hot Mix Asphalt HMA 3/8" Type A, performance grade PG 64 – 10. The percent of asphalt cement by weight shall be 6%. The thickness of asphalt concrete required shall be a minimum of 2". Asphalt concrete must be obtained from a State DOT certified batch plant (#109 certification).

B. Changes from one mix design to another shall not be made during the progress of the work unless permitted by the Contracting Officer. However, changes in proportions to conform to the approved mix design shall not be considered changes in the mix design.

PART 3 - EXECUTION

3.1 EQUIPMENT

A. Hauling Equipment: Trucks used for hauling bituminous mixtures shall have tight, clean, smooth metal beds which have been thinly coated with a minimum amount of paraffin oil, lime solution, or other approved material to prevent the mixture from adhering to the beds. Each truck shall have a cover of canvas or other suitable material of such size as to protect the mixture from the weather.

B. Bituminous Pavers:

1. Bituminous pavers shall be self-contained, power-propelled units, provided with an activated screed or strike-off assembly, heated if necessary, and capable of spreading and finishing courses of bituminous plant mix material in widths applicable to the specified typical section and thicknesses are shown on the drawings.
2. The paver shall be equipped with a receiving hopper having sufficient capacity for a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed.
3. The paving machine shall be equipped with an automatic control system that will control the elevation of the screed, and which is automatically actuated by a system of sensor-operated devices which sense and follow reference lines or surfaces on one or both sides of the machine as required.
4. Maintain screed at the proper elevation at each end by controlling the elevation of one end and automatically controlling the transverse slope or by controlling the elevation of each end independently, as directed.
5. The screed or strike-off assembly shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture. The paver shall be capable of being operated at forwarding speeds consistent with the satisfactory laying of the mixture.

C. Rollers:

1. Rollers shall be of the steel-wheel, vibratory, pneumatic tire type, or combination, capable of reversing without backlash. Steel-wheel rollers other than vibrating shall be capable of exerting a force of not less than 250 lbs. per inch of width of the roller. Vibrating steel-wheel rollers shall have a minimum weight of 6 tons.
2. Pneumatic-tired rollers shall have smooth tread tires of equal size that will provide a uniform compaction pressure for the full width of the roller and shall be capable of exerting a ground pressure of at least 80 lbs./in^2.

3.2 PREPARATION

A. Before placement of the base material, the existing pavement shall be neatly saw-cut a minimum of 12" on each side of the trench or disturbed surface.

B. Conditioning of Existing Surface:

1. When the surface of the existing pavement or old base is irregular, it shall be brought to uniform grade and cross-section as directed.
2. Paint contact surfaces of curbing, gutters, manholes, and other structures with a thin, uniform coating of bituminous material before placing the bituminous mixture against them.

C. The top 6" of material below the aggregate base grade shall be loosened, scarified, water added, if ordered by the Contracting Officer, and then compacted to not less than 95%.

D. Transport and place the bituminous mixture on the roadway in a manner that will minimize segregation. Remove segregated areas behind the paver immediately and replace the segregated material with specification material before the initial rolling has taken place. The removal and replacement of non-specification material or unacceptable work shall be accomplished at no additional expense to the Government.

3.3 PREPARATION OF AGGREGATES

A. Aggregates for Pugmill mixtures shall be dried and heated to the required temperature.

B. Properly adjust the flame to avoid damage to the aggregate and to avoid soot on the aggregate.

C. Untreated aggregates for dryer-drum mixtures will not require prior preparation other than gradation control, except that those containing gravitational water shall be stockpiled and allowed to drain before mixing. Moisture in the final mixture shall be limited to 3% maximum.

3.4 MIXING

A. Combine aggregates in the mixer in the amount of each fraction of aggregates required to meet the job-mix formula. The bituminous material shall be measured or gauged and introduced into the mixer in the amount specified by the job-mix formula.

B. After the required amounts of aggregate and bituminous material have been introduced into the mixer, the materials shall be mixed until a complete and uniform coating of the particles is secured.

C. The bituminous material and aggregate for Pugmill mixtures shall be introduced into the mixer within 35°F of each other. The temperature of Pugmill mixtures shall be controlled between 225° - 300°F.

D. Material delivered to the paver shall not be less than 248°F.

3.5 AGGREGATE SUB-BASE (Per Section 31 23 33)

A. The sub-base shall be compacted to 95% and shall be a minimum thickness of 9" of 6-inch-minus pit run material.

3.6 AGGREGATE BASE COURSE (Per Section 31 23 33)

A. The base shall be compacted to 95% and shall be a uniform thickness of at least 6".

3.7 SPREADING AND FINISHING MIX

A. The mixture shall be laid upon an approved surface, spread, and struck off to the grade and elevation established. Use bituminous pavers to distribute the mixture either over the entire width or over such partial width as may be practicable.

B. The longitudinal joint in 1 layer shall offset that in the layer immediately below by approximately 6".

C. Where paving operations are on the present traveled roadway, and where the thickness of pavement course being placed is greater than 1", the Contractor shall arrange his paving operation so that there will be no exposed longitudinal joint between adjacent travel lanes at the end of a day's run.

D. In areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impracticable, the mixture shall be spread, raked, and luted by hand tools. For such areas, the mixture shall be dumped, spread, and screeded to give the required compacted thickness.

E. Transport and place the bituminous mixture on the roadway in a manner that will minimize segregation. Remove segregated areas behind the paver immediately and replace the segregated material with specification material before the initial rolling has taken place. The removal and replacement of non-specification material or unacceptable work shall be accomplished at no additional expense to the Government.

F. Place bituminous material as continuously as possible. Rollers shall not pass over the unprotected end of a freshly laid mixture unless authorized by the Contracting Officer. Form transverse joints by cutting back on the previous run to expose the full depth of the course. When directed, use a coat of bituminous material on the contact surfaces of all joints just before the additional mixture is placed against the previously rolled material.

3.8 COMPACTING MIX

A. After the bituminous mixture has been spread and struck off, and surface irregularities have been adjusted, thoroughly and uniformly compact the mixture by rolling.

B. Roll surface when the mixture is in the proper condition and when the rolling does not cause undue displacement, cracking, or shoving.

C. The number, weight, and type of rollers furnished shall be sufficient to obtain the required compaction while the mixture is in a workable condition.

D. Begin rolling at the sides and proceed longitudinally parallel to the road centerline, each trip overlapping 1/2 the roller width, gradually progressing to the crown of the road. When paving in the echelon or abutting a previously placed lane, roll the longitudinal joint first, then follow the regular rolling procedure. On super-elevated curves begin rolling at the low side and progress to the high side by overlapping longitudinal trips parallel to the centerline.

E. Continue rolling until all roller marks are eliminated and the minimum density specified has been obtained.

F. Any displacement occurring as a result of the reversing of the direction of a roller, or from other causes, shall be corrected at once by the use of rakes and the addition of fresh mixture when required. Care shall be exercised in rolling not to displace the line and grade of the edges of the bituminous mixture.

G. To prevent adhesion of the mixture to the rollers, keep wheels properly moistened with water or water mixed with very small quantities of detergent or other approved material. Excess liquid will not be permitted.

H. Along with forms, curbs, headers, walls, and other places not accessible to the rollers, thoroughly compact mixture with hand tampers or mechanical tampers.

I. Remove mixture that becomes loose and broken, mixed with dirt, or is in any way defective, and replace with fresh hot mixture; compact to conform with the surrounding area.

3.9 ACCEPTANCE REQUIREMENTS

A. Surface Tolerance: The final elevation of the paved surface shall match the adjoining existing pavement, follow the slope of the existing paved surface, and allow proper drainage. Correct all humps or depressions by removing defective work and replacing it with new material at no additional expense to the Government.

B. Density: Acceptable density of the in-place bituminous concrete pavement shall be 95% of the optimum values as determined from the job-mix formula. Field sampling and density determination will be made by the independent field tester, engaged by the Contractor, following ASTM D6938-15, or an acceptable nuclear procedure.

C. A uniform compacted thickness shall be obtained for each course equal to or greater than the thickness shown. Individual tests shall not vary by more than plus or minus 1/4".

D. Temperature: Unless lower temperatures are directed by the Contracting Officer, all mixtures except Open Graded asphalt concrete, shall be spread, and the first coverage of initial or breakdown compaction shall be performed when the temperature of the mixture is not less than 248°F, and all breakdown compactions shall be completed before the temperature of the mixture drops below 203°F. Open Graded asphalt concrete shall be spread at a temperature of not less than 203°F, and not more than 248°F, measured in the hopper of the paving machine. Open Graded asphalt concrete shall be compacted as soon as possible after spreading.

E. Mix Tolerances: The following tolerances for the job-mix formula will be allowed per single test:

Sieve Designation	Percent Passing
No. 8 and larger sieves	+8
Smaller than No. 8 to larger than No. 200 sieve	+6
No. 200 sieve	+3
Asphalt content, weight percent total mix	+0.5

END OF SECTION

SECTION 32 13 13.06

PORTLAND CEMENT CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including Division 1 Specification Sections, apply to work of this Section.

1.2 SECTION INCLUDES

A. Exterior site concrete flatwork including concrete paving, sidewalks, ramps, and stairs.

1.3 REFERENCES

A. All references shall be the latest adopted edition.

B. ACI 117 - Standard Specifications for Tolerance for Concrete Construction and Materials

C. ACI 330.1-03 - Specifications for Unreinforced Concrete Parking Lots; American Concrete Institute

D. ACI 304R - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete; American Concrete Institute

E. ACI 305R - Hot Weather Concreting; American Concrete Institute

F. ACI 306R - Cold Weather Concreting; American Concrete Institute

G. ASTM A185 - Standard Specification for Welded Steel Wire Fabric, Plain, for Concrete Reinforcement

H. ASTM C33 - Standard Specification for Concrete Aggregates

I. ASTM C143 - Standard Test Method for Slump of Hydraulic-Cement Concrete

J. ASTM C150 - Standard Specification for Portland Cement

K. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

L. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete

M. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

N. ASTM A615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

O. ASTM C94 - Standard Specification for Ready-Mixed Concrete

P. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (non-extruding and Resilient Bituminous Types)

1.4 QUALITY ASSURANCE

A. Perform work following ACI 330.

B. Obtain concrete materials from the same source throughout.

C. Test for alkali-silica reactivity (ASR) using ASTM C 1260.

D. Conform to ACI 305R when concreting during hot weather.

E. Conform to ACI 306R when concreting during cold weather.

1.5 SUBMITTAL

A. Refer to Division 1 of the specifications for submittal procedures.

B. Product Data: For each type of manufactured material and product indicated.

C. Design Mixes: For each concrete mix, submit proposed mix designs a minimum of 15 days in advance of placing operations for each type of concrete. The submitted mix designs shall include the following:

1. Supporting test data for mixes that are not more than 12 months old. Include enough tests and conduct statistical analysis in compliance with ACI 301.
2. Gradation of fine and coarse aggregates, not more than 90 days old showing compliance with ASTM C33.
3. Proportions of all ingredients, including all admixtures added either at the time of batching or at the job site. Aggregate weights shall be based upon saturated surface dry conditions.
4. Water/cement ratio.
5. Slump as measured according to ASTM C143. Provide slump test for each mix.
6. Air content of freshly mixed concrete as measured according to ASTM C231.
7. Strength measured at 7 and 28 days. Provide strength test for each mix at a frequency of both the 7th and 28th day.
8. Certifications that all ingredients in each mix are compatible.
9. Locations or intended use of each mix design.
10. Source of all materials.

1.6 JOB CONDITIONS

A. Weather Conditions:

1. Do no paving work when raining or when subgrade or base has free water on the surface or does not meet compaction requirements; suspend operations until surfaces are dry.
2. Apply no cementitious materials when the ambient temperature is below 45 degrees F.

B. Subgrade Conditions: Subgrade shall be unyielding, free of ponded water, frozen earth, or any organic material.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Wood form material, profiled to suit conditions.

2.2 REINFORCEMENT

A. Welded Steel Wire Fabric: Plain type, ASTM A185; in flat sheets; unfinished.

2.3 CONCRETE MATERIALS/MIX

A. For exterior walks, ramps, stairs, curbs, and other miscellaneous exterior slabs furnish 4,000 psi (minimum) 28-day strength concrete from the following materials:

1. Cement: Type I or II Portland cement conforming to ASTM C150, gray color.
2. Concrete Aggregate: Sand and gravel aggregate conforming to ASTM C33.
3. Fly Ash: Type F, comprising between 15%-35% cementitious materials. Conform to ASTM C 618
4. Water: Clean, potable, free of any substances or contaminants adversely affecting concrete.
5. Air Entrainment: 5 to 7 percent (by volume) using air entrainment admixture conforming to ASTM C260.
6. Admixtures: Water reducing agents are permitted, and calcium is not allowed.
7. Maximum Water/Cement Ratio: 0.45
8. Maximum Slump: Shall not exceed 4” for paving placed with other than slipform equipment or 1-1/2” for paving placed with slipform equipment per ACI 330
9. LEEDTM Requirements: Work specified in this Section may contribute to LEEDTM points for Construction Waste Management MRc2.1 & MRc2.2, Recycled Content MRc4.1 & MRc4.2, Local/Regional Materials MRc5.1 & MRc5.2 and Construction IAQ Management Plan EQc3.1 & EQc3.2 which are the Contractor’s responsibility to identify, coordinate and document
    a. Heat Island Effect Credit SSc7.1: Exterior pavement shall be highly light-reflective having a Solar Reflectance Index of at least 29.

b. Recycled Content Credit MRc4.1 & MRc4.2: Pre-consumer recycled content based on the amount of slag in the concrete mix; replace a minimum of 23% up to a maximum of 30% of cement content with slag.
c. Local/Regional Materials Credits MRc5.1 & MRc5.2: Concrete shall be extracted, processed, and manufactured regionally within 500 miles of the project site.

2.4 MIXING

A. Transit Mixers: Comply with ASTM C94.

2.5 JOINTS

A. Expansion/Isolation Joints: Furnish resilient bituminous type, Sternson Ltd. "Flexcell", Grace Construction Products "Fiber", Homosote Co. "Homex 300", Old North Mfg. Co., Inc. "Gray-Flex", or similar, non-extruding type, full depth of slab as required to bring the top to within 1/4 inch of the surface of the slab, conforming to ASTM D1751.

1. Conform to detail on drawings.
2. Furnish of 1/2 inch thickness for expansion/isolation joints located within walk and ramp slabs and for expansion/isolation joints located between walks and ramps and adjacent building and retaining walls.

B. Control Joints at Sidewalks and Curbs: Tool formed joints in wet concrete or saw cut joints to provide shrinkage crack control. Conform to detail on drawings.

2.6 ACCESSORIES

A. Curing Compound: Clear, membrane forming, conform to ASTM C309, Type I, Class B; curing compound shall not permanently discolor concrete.

PART 3 - EXECUTION

3.1 COORDINATION

A. Review, coordinate, and accommodate work of other Sections that interface with, affect, or are affected by the work of this Section to facilitate the execution of the overall Work of this project in a coordinated and efficient manner.

3.2 EXAMINATION

A. Verify compacted subgrade is acceptable and ready to support paving and imposed loads.

B. Verify gradients and elevations of the base are correct.

3.3 PREPARATION

A. Moisten base to minimize absorption of water from fresh concrete.

3.4 FORMING

A. Place and secure forms to correct location, dimension, profile, and gradient.

B. Confirm that top of form and screed elevations will provide positive water drainage off completed concrete work.

C. Assemble formwork to permit easy stripping and dismantling without damaging the concrete.

D. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

3.5 REINFORCEMENT

A. Place reinforcement at mid-height of slabs-on-grade.

B. Install reinforcement bars as noted on the Drawings.

C. Interrupt reinforcement at expansion joints. Provide dowels at joint locations indicated on the Drawings.

D. Reinforcement shall be placed per the Concrete Reinforcing Steel Institute's Manual of Standard Practice.

E. Welded wire reinforcement shall be placed per the following:

1. Concrete Reinforcing Steel Institute's Manual of Standard Practice
2. Wire Reinforcement Institute's Manual of Standard Practice

F. Reinforcement will be detailed following ACI Building Code Requirements for Structural Concrete and ACI 315 Detailing of Concrete Reinforcement.

3.6 PLACING CONCRETE

A. Place concrete following ACI 304R.

B. Ensure reinforcement, inserts, embedded parts, and formed joints are not disturbed during concrete placement.

C. Place concrete continuously over the full width of the panel and between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.

3.7 JOINTS

A. Locate expansion and control joints as shown on drawings or as directed by Contracting Officer. Layout joints for equal spacing except where specifically dimensioned otherwise on Drawings.

B. Place 1/2 inch wide expansion joints at maximum 30-foot intervals and separate paving from vertical surfaces and other components.

3.8 FINISHING

A. Exterior Concrete Walks and Pavement:

1. Broomed Finish: Medium-light broom finish to match existing; direction of texturing shall be as shown on Drawings or as directed by Contracting Officer.
2. Expansion and Dummy Joints: Tool edges to match existing

B. Place curing compound on exposed concrete surfaces immediately after finishing. Apply at the application rate required to achieve restriction of water loss not less than required by ASTM C309 per manufacturer's instructions.

3.9 TOLERANCES

A. All slabs and sidewalks shall slope away from the building and not pond water.

3.10 PROTECTION

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

B. Do not permit pedestrian traffic over pavement for 7 days minimum after finishing.

C. Do not permit vehicular traffic over pavement until concrete paving has developed minimum strength of 3,000 psi.

END OF SECTION

SECTION 32 15 00

AGGREGATE SURFACING

PART 1 - GENERAL

1.1 UNIT PRICE

A. Measurement

1. Measure the quantity of aggregate surface course completed and accepted, as determined by the Contracting Officer, in cubic yards. The volume of aggregate surface course in-place and accepted will be determined by the average job thickness obtained per paragraph LAYER THICKNESS and the dimensions shown on the drawings.

B. Payment

1. Quantities of aggregate surface course, determined as specified above, will be paid for at the respective contract unit prices, which will constitute full compensation for the construction and completion of the aggregate surface course.

C. Waybills and Delivery Tickets

1. Submit copies of waybills and delivery tickets during the progress of the work. Before the final payment is allowed, file certified waybills and certified delivery tickets for all aggregates used.

1.2 REFERENCE

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

B. AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 180	(2017) Standard Method of Test for Moisture-Density Relations of Soils Using a 10-lb Rammer and an 18-in. Drop
AASHTO T 224	(2010) Standard Method of Test for Correction for Coarse Particles in the Soil Compaction Test

C. ASTM INTERNATIONAL (ASTM)

ASTM C117	(2017) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C131/C131M	(2020) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

ASTM C136/C136M	(2019) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM D75/D75M	(2019) Standard Practice for Sampling Aggregates
ASTM D1556/D1556M	(2015; E 2016) Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method
ASTM D1557	(2012; E 2015) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3)
ASTM D2167	(2015) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D4318	(2017; E 2018) Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D6938	(2017a) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM E11	(2020) Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves

1.3 DEGREE OF COMPACTION

A. The degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum laboratory dry density obtained by the test procedure presented in ASTM D1557 abbreviated as a percent of laboratory maximum dry density.

B. Since ASTM D1557 applies only to soils that have 30 percent or less by weight of their particles retained on the 3/4 inch sieve, the degree of compaction for material having more than 30 percent by weight of their particles retained on the 3/4 inch sieve will be expressed as a percentage of the laboratory maximum dry density following AASHTO T 180 Method D and corrected with AASHTO T 224.

1.4 SUBMITTALS

A. Government approval is required for submittals with a "G" or "S" classification.

B. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval for information only.

C. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following Section 01 33 23 SUBMITTAL PROCEDURES.

1.5 EQUIPMENT, TOOLS, AND MACHINES

A. All plant, equipment, and tools used in the performance of the work will be subject to approval by the Contracting Officer before the work is started.

B. Maintain all plant, equipment, and tools in satisfactory working condition always. Submit a list of proposed equipment, including descriptive data.

C. Provide adequate equipment having the capability of minimizing segregation, producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

1.6 QUALITY ASSURANCE

A. Sampling and testing are the responsibility of the Contractor. Perform sampling and testing using a laboratory approved following Section 01 40 00 - QUALITY REQUIREMENTS.

B. Work requiring testing will not be permitted until the testing laboratory has been inspected and approved.

C. Test the materials to establish compliance with the specified requirements and perform testing at the specified frequency. The Contracting Officer may specify the time and location of the tests.

D. Furnish copies of test results to the Contracting Officer within 24 hours of completion of the tests.

E. Sampling

1. Take samples for laboratory testing in conformance with ASTM D75/D75M. When deemed necessary, the sampling will be observed by the Contracting Officer.

F. Testing

1. Sieve Analysis
   a. Perform sieve analysis in conformance with ASTM C117 and ASTM C136/C136M using sieves conforming to ASTM E11.
2. Liquid Limit and Plasticity Index
   a. Determine liquid limit and plasticity index following ASTM D4318.
3. Moisture-Density Determinations
   a. Determine the laboratory maximum dry density and optimum moisture content per paragraph 1.3 - DEGREE OF COMPACTION.
4. Field Density Tests
   a. Measure field density in accordance with ASTM D1556/D1556M, ASTM D2167 or ASTM D6938.
      1) For the method presented in ASTM D1556/D1556M use the base plate as shown in the drawing.
      2) For the method presented in ASTM D6938 check the calibration curves and adjust them, if necessary, using only the sand cone method as described in paragraph Calibration, of the ASTM publication. Tests performed following ASTM D6938 result in a wet unit weight of soil and ASTM D6938 will be used to determine the moisture content of the soil. Also, check the calibration curves furnished with the moisture gauges along with density calibration checks as described in ASTM D6938.

3) Make the calibration checks of both the density and moisture gauges using the prepared containers of the material method, as described in paragraph Calibration of ASTM D6938, on each different type of material being tested at the beginning of a job and intervals as directed. Submit calibration curves and related test results before using the device or equipment being calibrated.

5. Wear Test
   a. Perform wear tests on aggregate surface course material in conformance with ASTM C131/C131M.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Perform construction when the atmospheric temperature is above 35 degrees F. It is the responsibility of the Contractor to protect, by approved method or methods, all areas of surfacing that have not been accepted by the Contracting Officer. Bring surfaces damaged by a freeze, rainfall, or other weather conditions to a satisfactory condition.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. Provide aggregates consisting of clean, sound, durable particles of natural gravel, crushed gravel, crushed stone, sand, slag, soil, or other approved materials processed and blended or naturally combined.

B. Provide aggregates free from lumps and balls of clay, organic matter, objectionable coatings, and other foreign materials.

C. The Contractor is responsible for obtaining materials that meet the specification and can be used to meet the grade and smoothness requirements specified hereinafter all compaction and proof rolling operations have been completed.

D. Coarse Aggregates

1. The material retained on the 5 mm No. 4 sieve is known as coarse aggregate. Use only coarse aggregates that are reasonably uniform in density and quality.
   1) Use only coarse aggregate having a percentage of wear not exceeding 50 percent after 500 revolutions as determined by ASTM C131/C131M.
   2) The amount of flat and/or elongated particles must not exceed 20 percent.
   3) A flat particle is one having a ratio of width to a thickness greater than three; an elongated particle is one having a ratio of length to width greater than three.
   4) When the coarse aggregate is supplied from more than one source, aggregate from each source must meet the requirements set forth herein.

E. Fine Aggregates

1. The material passing the 5 mm No. 4 sieve is known as fine aggregate. Fine aggregate consists of screenings, sand, soil, or other finely divided mineral matter that is processed or naturally combined with the coarse aggregate.

F. Gradation Requirements

1. Gradation requirements specified in TABLE 1 apply to the completed aggregate surface. It is the responsibility of the Contractor to obtain materials that will meet the gradation requirements after mixing, placing, compacting, and other operations.
2. TABLE I shows permissible gradings for granular material used in aggregate surface roads and airfields. Use sieves conforming to ASTM E11.

TABLE 1. GRADATION FOR AGGREGATE SURFACE COURSES
Percentage by Weight Passing Square-Mesh Sieve

Sieve Designation (mm)	No. 1	No. 2	No. 3	No. 4
25 1 inch	100	100	100	100
9.5 3/8 inch	50-85	60-100	--	--
4.7 No. 4	35-65	50-85	55-100	70-100
2.00 No. 10	25-50	40-70	40-100	55-100
0.425 No. 40	15-30	24-45	20-50	30-70
0.075 No. 200	8-15	8-15	8-15	8-15

2.2 LIQUID LIMIT AND PLASTICITY INDEX

A. The portion of the completed aggregate surface course passing the 0.425 mm No. 40 sieve must have a maximum liquid limit of 35 and a plasticity index of 4 to 9.

2.3 TESTS, INSPECTIONS, AND VERIFICATIONS

A. Initial Tests

1. Perform one of each of the following tests, on the proposed material before commencing construction, to demonstrate that the proposed material meets all specified requirements when furnished. Complete this testing for each source if materials from more than one source are proposed.
   a. Sieve Analysis.
   b. Liquid limit and plasticity index.
   c. Moisture-density relationship.
   d. Wear.

B. Submit certified copies of test results for approval not less than 30 days before material is required for the work.

C. Approval of Material

1. Tentative approval of material will be based on initial test results.

PART 3 - EXECUTION

3.1 OPERATION OF AGGREGATE SOURCES

A. Perform clearing, stripping, and excavating. Operate the aggregate sources to produce the quantity and quality of materials meeting these specification requirements in the specified time limit.

B. Upon completion of the work, leave aggregate sources on Government property in a satisfactory condition so that they readily drain.

C. Finalize aggregate sources on private lands in agreement with local laws or authorities.

3.2 STOCKPILING MATERIAL

A. Prior to stockpiling the material, clear and level the storage sites. Stockpile all materials, including approved material available from excavation and grading, in the manner and at the locations designated.

B. Stockpile aggregates in such a manner that will prevent segregation. Stockpile aggregates and binders obtained from different sources separately.

3.3 PREPARATION OF UNDERLYING COURSE

A. Clean the underlying course and shoulders of all foreign substances. Do not construct the surface course on an underlying course that is frozen material.

B. Correct ruts or soft yielding spots in the underlying course, areas having inadequate compaction, and deviations of the surface from the requirements set forth herein by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade, and recompacting to density requirements specified in Section 31 00 00 EARTHWORK.

C. Do not allow traffic or other operations to disturb the completed underlying course and maintain it in a satisfactory condition until the surface course is placed.

3.4 GRADE CONTROL

A. During construction, maintain the lines and grades including crown and cross slope indicated for the aggregate surface course utilizing line and grade stakes placed by the Contractor.

3.5 MIXING AND PLACING MATERIALS

A. Mix and place the materials to obtain uniformity of the material and uniform optimum water content for compaction.

B. Adjust in mixing, placing procedures, or in equipment to obtain the true grades, minimize segregation and degradation, obtain the desired water content, and ensure a satisfactory surface course.

3.6 LAYER THICKNESS

A. Place the aggregate material on the underlying course in layers of uniform thickness. Compact the completed aggregate surface course to the thickness indicated. No individual layer may be thicker than 6 inches nor be thinner than 3 inches in compacted thickness.

B. Compact the aggregate surface course to a total thickness that is within 1/2 inch of the thickness indicated. Where the measured thickness is more than 1/2 inch deficient, correct such areas by scarifying, adding new material of proper gradation, re-blading, and recompacting as directed. Where the measured thickness is more than1/2 an inch thicker than indicated, the course will be considered as conforming to the specified thickness requirements.

C. The average job thickness will be the average of all thickness measurements taken for the job and must be within 1/4 inch of the thickness indicated. Measure the total thickness of the aggregate surface course at intervals of one measurement for every 500 square yards of the surface course. Measure total thickness using 3 inches diameter test.

3.7 COMPACTION

A. Degree of compaction is a percentage of the maximum density obtained by the test procedure presented in ASTM D1557 abbreviated herein as percent laboratory maximum density.

1. Compact each layer of the aggregate surface course with approved compaction equipment, as required in the following paragraphs.
2. Maintain the water content during the compaction procedure at optimum or at the percentage specified by the Contracting Officer.
3. Compact the mixture with mechanical tampers in locations not accessible to rollers.
4. Continue compaction until each layer through the full depth is compacted to at least 100 percent of laboratory maximum density.
5. Remove any materials that are found to be unsatisfactory and replace them with satisfactory material or rework them to produce a satisfactory material.

3.8 PROOF ROLLING

A. In addition to the compaction specified above, proof roll the designated areas by application of 30 coverages of a heavy rubber-tired roller having four tires abreast with each tire loaded to 30,000 pounds and tires inflated to 150 psi.

B. In the areas designated, proof roll the top lift of the layer on which the surface course is laid and to each layer of the surface course. Maintain the water content of the lift of the layer on which the surface course is placed and each layer of the aggregate surface course at optimum or at the percentage directed from the start of compaction to the completion of a proof rolling.

C. Remove and replace materials in the aggregate surface course or underlying materials indicated to be unacceptable by the proof rolling with acceptable materials as directed.

3.9 EDGES OF AGGREGATE SURFACE COURSE

A. Place approved material along the edges of the aggregate surface course in such quantity as to compact to the thickness of the course being constructed. Simultaneously roll and compact at least 1 foot of shoulder width with the rolling and compacting of each layer of the surface course when the course is being constructed in two or more layers.

3.10 SMOOTHNESS TEST

A. Construct each layer so that the surface shows no deviations more than 3/8 inch when tested with a 10 feet straightedge applied both parallel with and at right angles to the centerline of the area to be paved.

B. Correct deviations exceeding this amount by removing material, replacing it with new material, or reworking existing material and compacting, as directed.

3.11 FIELD QUALITY CONTROL

A. In-Place Tests

1. Perform each of the following tests on samples taken from the placed and compacted aggregate surface course. Take samples and test at the rates indicated.
   a. Perform density tests on every lift of material placed and at a frequency of one set of tests for every 250 square yards, or portion thereof, of completed area.
   b. Perform sieve analysis on every lift of material placed and at a frequency of one sieve analysis for every 500 square yards, or portion thereof, of the material placed.
   c. Perform liquid limit and plasticity index tests at the same frequency as the sieve analysis.
   d. Measure the thickness of the aggregate surface course at intervals providing at least one measurement for every 500 square yards of base course or part thereof. Measure the thickness using test holes, at least 3 inches in diameter through the aggregate surface course.

B. Approval of Material

1. Final approval of the materials will be based on tests for gradation, liquid limit, and plasticity index performed on samples taken from the completed and full compacted aggregate surface course.

3.12 MAINTENANCE

A. Maintain the aggregate surface course in a condition that will meet all specification requirements until accepted.

END OF SECTION

SECTION 32 31 13

CHAIN LINK FENCES & GATES

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But is Not Limited To

1. Furnish and install complete fence and gate(s) as described in Contract Documents.

1.2 REFERENCES

A. American Society for Testing and Materials

1. ASTM A 123-00, 'Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
2. ASTM A 153-98, 'Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
3. ASTM A 392-96, 'Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric'
4. ASTM A 570-98, 'Standard Specification for Steel, Sheet, and Strip, Carbon, Hot-Rolled, Structural Quality
5. ASTM A 1011-01, 'Standard Specification Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability'
6. ASTM C 1107-99, 'Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)'
7. ASTM F-668, Class 2b, ‘Standard Specification for Polymer-Coated Steel Chain Link Fence’
8. ASTM F 1043-00, 'Standard Specification for Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework'
9. ASTM F 1083-97, 'Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures

1.3 SUBMITTALS

A. Quality Assurance/Control

1. Fabric - Manufacturer’s certificate showing compliance with specification requirements
2. Posts - Manufacturer’s certificate showing compliance with specification requirements
3. Rails - Manufacturer’s certificate showing compliance with specification requirements
4. Shop Drawings & Engineering Data shall be submitted following the requirements of Section 01 33 23 – SUBMITTAL PROCEDURES.

PART 2 PRODUCTS

2.1 COMPONENTS

A. Fabric

1. Chain link - Color Fused Bonded Vinyl Coated Wire fabric of 9-gauge core with the 8-gauge finish, galvanized before weaving with 1.2-ounce zinc coating conforming to requirements of ASTM A 392, Class I, 2-inch mesh.
2. Selvages will be per the requirements of ASTM F 668 Class 2b requirements.

B. Framework

1. Posts and rails
   a. Shall be roll-formed, self-draining shapes meeting strength requirements of ASTM F 669, Table 3, and with 2-ounce zinc coating per sq ft of surface area conforming to ASTM A 123.
2. Line Posts
   a. 2.375 inches outside diameter Schedule 40 pipe weighing 3.65 pounds per lineal foot meeting requirements of ASTM F 1083.
3. Terminal and Corner Posts
   a. 2.875 inches outside diameter Schedule 40 pipe weighing 5.79 pounds per lineal foot meeting requirements of ASTM F 1083.
4. Gate Posts
   a. 4.0 inch outside diameter Schedule 40 pipe weighing 9.12 pounds per lineal foot meeting requirements of ASTM F 1083.
5. Top and Brace Rail
   a. 1.660 inches outside diameter Schedule 40 pipe weighing 2.27 pounds per lineal foot meeting requirements of ASTM F 1083.
6. Fittings
   a. Pressed steel or malleable iron, hot-dip galvanized conforming to ASTM A 153. Tie wires shall be 12 ga minimum galvanized steel or 9-gauge minimum aluminum wire.
7. Tension Wire
   a. 7 ga minimum galvanized spring steel.

2.2 MIXES

A. Post Foundation Concrete

1. Cast-in-place Concrete: Class 3000 minimum per Section 03 30 00 - CAST-IN-PLACE CONCRETE SITE ELEMENTS.
2. Mix thoroughly before placing.

PART 3 EXECUTION

3.1 INSTALLATION

A. Fence shall be installed by workers skilled and experienced in erecting fences of this type and per Contract Documents.

1. When general ground contour is to be followed, make changes of grade in a gradual, rolling manner.
2. Evenly space posts in line of the fence a maximum of 10 feet center to center.

B. Post Foundations

1. Except atop retaining walls set posts with concrete post foundations as specified below:
   a. Line Posts: Diameter 8 inches - Depth 24 inches
   b. Gate, End, And Corner Posts: Diameter 12 inches - Depth 36 inches
   c. In native areas, set the top of post foundation below grade sufficient to allow for placing of native forest duff.
   d. Where fences are incorporated into slabs, measure post foundation depth from the top of the slab. Extend the bottom of the slab footing sufficient to allow the specified amount of concrete around the post. At existing slabs, install a fence outside the perimeter of the slab.

C. Fence

1. After posts have been permanently positioned and concrete cured for one-week minimum, install the framework, braces, and top rail. Join top rail with 6-inch minimum couplings at not more than 21-foot centers.
2. Stretch fabric by attaching one end to the terminal post and supplying sufficient tension to the other end of stretch so slack is removed.
   a. Fasten fabric to line posts with tie wires. Pass ties over one strand of fabric and hook under line post flange.
   b. Place one tie as close to the bottom of the fabric as is possible with additional ties equally spaced between top and bottom band on equal spacings not to exceed 12 inches on center.
   c. Attach the fabric to roll-formed terminals by weaving fabric into integral lock loops formed in the post. Attach the fabric to tubular terminals with tension bars and bands.
   d. Hold fabric approximately 2 inches above the finish grade line.
   e. On the top rail, space tie wires at no more than 24 inches on center.
   f. Securely attach fittings and firmly tighten nuts.

3.2 CLEANING

A. Spread dirt from foundation excavations evenly around the surrounding area unless otherwise directed. Leave the area free of excess dribbles of concrete, pieces of wire, and other scrap materials.

END OF SECTION

SECTION 32 31 26

WIRE FENCES & GATES

PART 1 - GENERAL

1.1 SCOPE

A. The work shall consist of furnishing materials and installing either barbed, smooth, or woven wire or combinations thereof, and must be constructed to be equal to or exceed, in strength and durability, the fencing requirements that will address resource concerns, improve livestock distribution, handling, feeding, watering, and movement of the type of livestock managed and include wire spacing to be adequate for the movement of the types of native wildlife in the area.

1.2 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

B. AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA U1	(2021) Use Category System: User Specification for Treated Wood

C. ASTM INTERNATIONAL (ASTM)

ASTM A116	(2011; R 2016) Standard Specification for Metallic-Coated, Steel Woven Wire Fence Fabric
ASTM A121	(2019) Standard Specification for Metallic-Coated Carbon Steel Barbed Wire
ASTM A153/A153M	(2016a) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A702	(2013; R 2018) Standard Specification for Steel Fence Posts, Hot Wrought
ASTM A780/A780M	(2020) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM C94/C94M	(2021b) Standard Specification for Ready-Mixed Concrete
ASTM D4541	(2017) Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
ASTM F626	(2014; R 2019) Standard Specification for Fence Fittings
ASTM F883	(2013) Standard Performance Specification for Padlocks
ASTM F900	(2011; R 2017) Standard Specification for Industrial and Commercial Swing Gates
ASTM F1043	(2018) Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework
ASTM F1083	(2018) Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
ASTM F1184	(2016) Standard Specification for Industrial and Commercial Horizontal Slide Gates

ASTM F1665 (2008; R 2018) Standard Specification for Poly(Vinyl Chloride) (PVC) and Other Conforming Organic Polymer-Coated Steel Barbed Wire Used With Chain-Link Fence

D. U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS RR-F-191/3 (Rev E; Am 1) Fencing, Wire and Post, Metal (Chain-Link Fence Posts, Top Rails, and Braces)

1.3 SUBMITTALS

A. Submit the following per Section 01 33 23 SUBMITTAL PROCEDURES:

1. Shop Drawings for the installation
2. Product Data for:
   a. Fence Fabric
   b. Woven Wire Barbed Wire
   c. Gates
   d. Posts
   e. Braces and Rails

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site in an undamaged condition.

B. Store materials off the ground to provide protection against oxidation caused by ground contact.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Provide a fencing system as described herein and as shown on the drawings.

B. Submit Installation Drawings clearly indicating fence installation, location of gates, corners, ends, and pull posts; gate assembly, gate hardware, catalog data, and accessories.

2.2 COMPONENTS

A. Fence Fabric: Provide fence fabric conforming to the following requirements.
   1. Barbed Wire: ASTM A121 zinc-coated, Type Z, Class 3 with 12.5 gauge wire with 14 gauge or heavier, round, 2-point barbs spaced no more than 5 inches apart.
   2. Standard Smooth Wire: ASTM A854 zinc-coated, Type Z, Class 3 with 12.5 gauge wire
   3. Wire clips should be 12 to 12.5 gauge galvanized and similar to the strength of the fence wire.

B. Gates
   1. Provide gate type and swing shown on the drawings conforming to ASTM F900 or ASTM F1184, ASTM A153/A153M.
   2. Wire gates shall be made of the same materials of the same kind, grade and size specified for the field fence, and stays will not exceed a 4-foot spacing.
   3. Provide gate frames conforming to strength and coating requirements of ASTM F1083 for Group IA, steel pipe, nominal pipe size (NPS) 1-1/2.
   4. Provide gate leaves more than 8 feet wide with either intermediate members and diagonal truss rods or tubular members as necessary to provide rigid construction, free from sag or twist.
      a. Provide gate leaves less than 8 feet wide with truss rods or intermediate braces.
      b. Provide intermediate braces on all gate frames with an electro-mechanical lock.

   5. Attach gate fabric to the gate frame by method standard with the manufacturer. Welding is not permitted.
      a. Furnish latches, hinges, stops, keepers, rollers, and other hardware items as required for the operation of the gate. Arrange latches for padlocking so the padlock is accessible from both sides of the gate.
      b. Provide stops for holding the gates in the open position.

C. Posts
   1. Metal Posts for Farm Style Fence: Provide metal line posts of high carbon steel weighing at least 1.33 lbs/ft with an anchor plate and studded, embossed, or punched for wire attachment conforming to ASTM A702 with an enamel paint finish, T- or U-section, length as indicated to allow for minimum setting depth and fence height plus at least 2 inches of the post above the top wire, and accessories conforming to ASTM A702.
   2. T-posts should be placed at 13 – 20 feet intervals, depending on topography and site conditions. If they are placed from 13-15' spacing a stay is not required. If they are placed at any distance greater than 15', a stay is required.
   3. Provide FS RR-F-191/3 Steel pipe end and corner posts: Class 1, steel pipe, Grade A Regular Strength, in minimum sizes listed in FS RR-F-191/3 for each class and grade.
   4. Wood Posts: Provide wood posts cut from sound and solid trees free from short or reverse bends in more than one plane. Make tops convex rounded or inclined. Provide posts free of ring shake, season cracks more than 1/4 inch wide, splits in the end, and unsound knots. Provide posts of the size and shape indicated allowing for required buried depth and fence height plus at least 2-inches of the post above the top wire for wire fences. Treat posts following AWPA U1.

D. Braces and Rails
   1. Braces determine the structural soundness and longevity of any fence line. Corners are braces that are located where there are changes in fence direction due to slope and alignment changes in the fence line. If any brace fails, there is a loss of wire tension and fence effectiveness.
   2. Bracing of anchor (pull) posts are required at all corners, gates, and ends of the fence line. They are also needed for slope and alignment changes of the fence lines.
   3. Design and spacing are determined by factors such as the number of wires used, type of wire, soil type, terrain, and animals to be restrained.
      a. In-Line Pull Post assemblies are located in straight sections at lengths not greater than 1320 feet (length of a spool of wire) or where there are sudden elevation changes, such as at the bottom and top of steep slopes.
      b. Available types include Single Post Pull Assembly, H-Brace Pull Assembly, or

Three-Post Welded Pull Assembly

c. On wood single H-Braces, a minimum of a 4-inch top diameter of treated timber or durable wood listed above for upright post and a 4-inch diameter for the horizontal cross-post.

d. On steel single H-Braces, a minimum 2-3/8 inches outside diameter (OD) metal pipe or equivalent. Steel cross-post must be a minimum of 2-3/8 inches OD.

4. Corner braces are required at all points where the fence alignment has a change of 20 degrees or more and the pull is from two directions.

5. End braces are required where the fence ends and on both sides of gate openings.

a. Wood - (Pressure treated or durable wood) shall have a minimum top diameter of 5 inches, 7 ft. in length, and be set firmly 3 ft. in the ground. Cross-post will have a minimum 4-inch top diameter.

b. Steel - Minimum 2-3/8 inch steel pipe or equivalent, 7 ft. in length, set 3 ft. in the ground. Steel cross-posts must be a minimum 2-inch diameter.

c.

2.3 MATERIALS

A. Concrete: Per ASTM C94/C94M, using 3/4 inch maximum size aggregate, and having a minimum compressive strength of 3000 psi at 28 days.

B. Provide grout consisting of one part portland cement to three parts clean, well-graded sand and the minimum amount of water to produce a workable mix.

C. All steel posts will be backfilled with concrete. When backfilled with concrete, posts will be centered in a hole that is a minimum of 12 inches in diameter. The hole will be filled and crowned (mounded) at the post base to prevent water from ponding around the post at ground level.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clearing: Clear the area on each side of the fence as indicated in the plans along the fence boundaries. Remove brush, loose rocks, trees, and tall grass from the fence line. Fence construction time is considerably reduced when the fence line is well cleared ahead of time.

B. Line and Grade: Install a fence to the lines and grades indicated. Space line posts are equidistant at intervals not exceeding 10 feet. Set terminal (corner, gate, and pull) posts at abrupt changes in vertical and horizontal alignment. Provide continuous fabric between terminal posts; however, ensure runs between terminal posts do not exceed 500 feet. Repair any damage to galvanized surfaces, including welding, with paint containing zinc dust following ASTM A780/A780M.

1. Excavation: Clear loose material from all post holes. Spread waste material where directed. Eliminate ground surface irregularities along the fence line to the extent necessary to maintain a 2-inch clearance between the bottom of the fabric and finish grade.

3.2 INSTALLATION

A. Installation: Install fence system per approved installation drawings. All posts shall be placed to the required depth and shall be firmly embedded so that there is less than 1 inch of horizontal movement at the top of the post when a horizontal force of 80 lbs. is applied.

B. Post: For wood posts (Farm Style Fence), excavate to the depth indicated and brace the post until backfill is completed. Place backfill in layers of 9 inches or less, moistened to optimum condition, and compacted with hand tampers or other approved methods. Set posts plumb and in proper alignment. Drive metal posts or set them in concrete as indicated. All posts will be vertically leveled upon placement

C. Line (Brace) Post: To maintain the strength and life of the practice, line posts (wood or steel) should be placed at intervals suitable for the site conditions. On the flat ground with little stress on the wires, buried posts can be placed after 20 t-posts. When topography is sloped and the fence following the slope, brace posts should be placed more frequently and may need to be located at the end of every 5 t-posts. Additionally, the brace posts should be placed at every low point on undulating topography, with an earth-anchor used to add strength.
   a. Horizontal Braces (H Brace) are the most commonly used design in the construction of post braces.
   b. Placement of the Horizontal brace should be a minimum of 2/3 height of the top wire height and no higher than 8 inches from the top of the post.
   c. Diagonal braces will be attached to the brace post a minimum of 6 feet from the anchor post and set into concrete as specified for steel pipe posts or attached to a steel-reinforced concrete block.

D. For standard wire fences, line wires will be attached to anchor (pull) posts by two complete wraps around the post, stapled (wood posts) or wired (steel posts), and ends tightly twisted around the stretched wire at least six times.

E. Barbed Wire: Install wire on the side of the post indicated. Pull wire taut to provide a smooth uniform appearance, free from sag before fastening to posts. Fasten the wire to line posts at the intervals noted in the drawings.
   a. Temperature variations must be considered (wire will tighten in cold weather and expand in hot weather).

F. Smooth Wire: Install wire on the side of the post indicated. Pull wire taut to provide a smooth uniform appearance, free from sag before fastening to posts.

G. Tension/Brace (Guy) Wires (where applicable) should be two complete loops of 9-gauge smooth wire, 12½ gauge double-strand barbed or smooth wire, or 12½ gauge high tensile smooth wire. The wire will be twisted or strained to provide necessary rigidity with a twist rod that should be 18-24 inches long and will remain in place approximately midway along the brace wire. For horizontal braces, brace wire will be double wrapped and stapled to brace post at a height 4-6 inches above brace member and anchor (pull) post at a point 4 inches above the ground level.

H. Stays: When line post spacing exceeds the maximum without stays, stays will be included and spaced at equal distances between posts with spacing not to exceed the maximum specified of 13-15 feet without stays or 15-20 feet with one stay mid-way between posts.

Length of stays will be fence height plus 2 inches and installed so that stays swing free of the ground and allow the fence to move when touched by an animal.

I. Wire splices
   a. Standard Wire: Western union splices shall have a minimum of 8 wraps on each side of the center, tightly wound and closely spaced. This is the preferred method.
   b. Compression fittings or splice sleeves will have a tensile strength of not less than 80% of the wire. Ends of wire will be overlapped at least 2 inches with sleeves crimped and installed according to manufactures specifications. Two 3/8 in. sleeves or one ¾ in. sleeve will be installed at each splice.
   c. The standard wire may also have "loop" splices where the wire has a minimum of 8 wraps on each side.

J. Gate Assembly: For farm-style fencing, provide standard metal gate assemblies with frame and fittings necessary for complete installation or wood gates as shown.

K. Allow newly-installed braces and assemblies to settle and/or pack dirt sufficiently around all posts; do not over-tighten wires.

3.3 CLEAN UP

A. Remove waste fencing materials and other debris from the work site daily.

B. The completed job shall be workmanlike and present a good appearance.

END OF SECTION

SECTION 32 84 24

IRRIGATION SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 REFERENCE

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

B. AMERICAN PETROLEUM INSTITUTE (API)

API Std 598	(2009) Valve Inspecting and Testing

C. AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 189.1	(2014) Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings

D. AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.2	(1983; Errata 1992; R 2017) Gages and Gaging for Unified Inch Screw Threads
ASME B16.3	(2016) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B40.100	(2013) Pressure Gauges and Gauge Attachments
ASME B16.1	Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250
ASME B31.3	Process Piping
ASME B16.15	(2018) Cast Copper Alloy Threaded Fittings Classes 125 and 250
ASME B16.18	(2018) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.22	(2018) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B40.100	(2013) Pressure Gauges and Gauge Attachments

E. AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1010	(2004) Performance Requirements for Water Hammer Arresters (ANSI approved 2004)
ASSE 1020	(2020) Performance Requirements for Pressure Vacuum Breaker Assemblies
ASSE Series 5000	(2015) Cross-Connection Control Professional Qualification Standard

F. AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C500	(2019) Metal-Seated Gate Valves for Water Supply Service
AWWA C511	(2017) Reduced-Pressure Principal Backflow Prevention Assembly
AWWA C651	(2014) Standard for Disinfecting Water Mains
AWWA M14	(2015) Manual: Recommended Practice for Backflow Prevention and Cross-Connection Control
AWWA C104/A21.4	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
AWWA C105/A21.5	Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110/A21.10	Ductile-Iron and Gray-Iron Fittings
AWWA C111/A21.11	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C150/A21.50	Thickness Design of Ductile-Iron Pipe
AWWA C151/A21.51	Ductile-Iron Pipe, Centrifugally Cast
AWWA C153/A21.53	Ductile-Iron Compact Fittings
AWWA C600	Installation of Ductile-Iron Water Mains and Their Appurtenances.

G. ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M	(2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM B32	(2020) Standard Specification for Solder Metal
ASTM A48/A48M	Standard Specification for Gray Iron Castings
ASTM B43	(2020) Standard Specification for Seamless Red Brass Pipe, Standard Sizes
ASTM B88	(2020) Standard Specification for Seamless Copper Water Tube
ASTM B88M	(2020) Standard Specification for Seamless Copper Water Tube (Metric)
ASTM D1785	(2015; E 2018) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D2241	(2015) Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D2287	(2019) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
ASTM D2464	(2015) Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2466	(2017) Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D2564	(2020) Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D2774	(2021) Underground Installation of Thermoplastic Pressure Piping
ASTM D2855	(2015) Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D3261	(2016) Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM F441/F441M	(2020) Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80

H. FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

FCCCHR List	List of Approved Backflow Prevention Assemblies

I. MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-85	(2011) Gray Iron Globe & Angle Valves Flanged and Threaded Ends

J. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2	(2000; R 2020) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures

K. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code

L. NSF INTERNATIONAL (NSF)

NSF/ANSI 14	(2020) Plastics Piping System Components and Related Materials

M. U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-51145	(Rev D; Notice 1; Notice 2; Notice 3) Flux, Soldering, Non-Electronic, Paste, and Liquid

N. UNDERWRITERS LABORATORIES (UL)

UL 651	(2011; Reprint Mar 2020) UL Standard for Safety Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings

1.2 SYSTEM DESCRIPTION

A. This system is designed with a water pressure maximum of 70.0 psi at the connection of the force main to the irrigation field header and a minimum of 16.0 psi at the last head in each sprinkler line.

B. Provide system pressure calculations and irrigation requirements of the area. If pressure falls above or below indicated values, the Contractor shall notify Contracting Officer. For Irrigation Sprinkler System, indicate the following:

1. Head, piping, valve layout. Provide separate hydrazones for plant materials with different water requirements.
2. Pipe, valve, backflow preventer, and controller.

3. Invert elevations. Indicate obstructions interfering with operation.
4. Water source equipment, including existing mains, piping, valves, and meters.
5. System and supply pressures.
6. Indicate wiring diagram between existing power source and controller/water pump.
7. Number and extent of control valve circuits.
8. Provide details of all irrigation components and accessories.

1.3 SUBMITTALS

A. Submittals shall be per Section 01 33 23 SUBMITTAL PROCEDURES.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Delivery

1. Deliver materials in original rolls, packages, cartons, and containers with the name of manufacturer, brand, and model. Inspect materials delivered to the site for damage.

B. Storage

1. Store materials on-site in enclosures or under protective coverings.
2. Do not store materials directly on the ground. Keep inside of pipes and fittings free from dirt and debris.

C. Handling

1. Handle and carry pipe, fittings, valves, and accessories in such a manner as to ensure delivery to trench in sound undamaged condition. Do not drag pipe.

1.5 EXTRA STOCK

A. 5 additional sprinkler heads (nozzles, bodies, screens, pressure compensating devices) of each size and type.

B. 2 valve keys for operating manual valves.

C. 2 wrenches for removing and installing each type of head.

1.6 QUALITY ASSURANCE

A. Submit tests signed by an authorized official of a testing laboratory of the sprinkler head, valve, automatic controller, emitter heads, and vacuum breaker.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Ductile Iron Tubing and Associated Fittings

1. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast
2. AWWA C104/A21.4 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
3. AWWA C153/A21.53 - Ductile-Iron Compact Fittings.
4. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings.
5. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
6. Pressure rating for 12 inches and smaller: 250 psig.

B. Steel Pipe and Associated Fittings

1. Pipe: ASTM A53/A53M, Schedule 40.
2. Fitting: ASME B16.3, Class 150 fitting.

C. Polyvinyl Chloride (PVC) Pipe, Fittings, and Solvent Cement (Not Used)

2.2 IRRIGATION AND DRIP SPRINKLER HEADS

A. Fixed Riser Irrigation Heads

1. Single-stream, water-lubricated, bronze spring arm impact sprinkler type capable of covering 9.5 to 12.0 m radius with a distribution rate of 0.09-0.29 LPS. Part circle sprinkler with an adjustable arc coverage of 30 to 360 degrees.

B. Manufacturer

1. WADE RAIN: WR-23 LA 1/2" Low Ang Bronze Sprinkler w/ nozzle.

2.3 VALVES

A. Plug Valves

1. Manufacturers:
   a. M and H: Anniston, AL
   b. Henry Pratt Company; Aurora, IL
   c. DeZurick; Sartell, MN
   d. Val-Matic; Elmhurst, IL
   e. Or approved equal
2. Description:
   a. Type:
      1) Non-lubricated.
      2) Eccentric.
      3) 90 Degree Turn
      4) Resilient faced Plug

b. Working Pressure: 600 psig. (Class 600) for valves 1-1/2” through 12” and 300 psig. (Class 300) for valves for 14” through 72”.
c. Ports:
1) Configuration: Rectangular.
2) Minimum Port Area: 100 percent of nominal pipe area for valves.
d. Stem Bearings: Self-lubricating.
e. Stem Seals:
1) Type: V-ring.
2) Material: Neoprene.
f. Packing and Gland: Accessible and externally adjustable.
g. End Connections:
1) Flanged: Comply with ANSI 125/150 lb. Standard
2) Mechanical Joint

B. Materials:

1. Body:
a. Cast iron, ASTM A126 Class B.
b. Lining: As recommended by valve manufacturer for service conditions.
2. Plug:
a. Ductile iron, ASTM A126 Class B.
b. Lining: Synthetic Viton compound of a minimum of 70 durometer hardness.
3. Seats: 1/8”, welded, 90% pure Nickel.
4. Stem: Type 316 stainless steel.
5. Stem Bearings: Type 316L stainless steel.
6. Seals: Buna-N.
7. Connecting Hardware: Type 316 stainless steel.

C. Drain Valves

1. MSS SP-80, Type 3, Class 150 threaded ends for sizes less than 2 1/2 inches. MSS SP-85, Type II, Class 250 threaded ends for sizes 65 mm 2 1/2 inches and larger.

D. Valve Box

1. Plastic valve box for each plug valve and drain valve. Provide box sizes that are suitable and adjustable for valve use.
2. Cast the word "IRRIGATION" on the cover.

2.4 ACCESSORIES AND APPURTENANCES

A. Head Accessories

1. Riser Adapters
a. Ductile iron or steel material threaded to attached drip heads to rigid piping.

2. Tubing Stakes
    a. Steel angle metal bracket to secure tubing.
3. Concrete Pads
    a. Cast-in-place reinforced concrete construction for the sprinkler head bracket, as indicated on the Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install sprinkler system after removal of the old system components, and the site clearing and grubbing have been completed.

B. Piping System Installation

1. Install irrigation piping as indicated on the Drawings. Before installation ream pipe. Cut threads as specified in ASME B1.2. Make joints with pipe joint compound applied to male end only.

C. Fixed Riser Sprinkler Heads

1. Bury piping and supporting bracket with native soil as indicated in Drawings. Nozzle mounted on fixed riser minimum 15 inches and maximum 39 inches above grade across the site.

D. Valves

1. Plug Valves: Install in a valve box extending from grade to below valve body, with a minimum of 4 inches cover measured from finish grade to top of the valve stem.
2. Drain Valves: The entire system shall be manually or automatically drainable. Equip the low point of each underground line with a drain valve draining into an excavation containing gravel. Cover gravel with building paper. Backfill with excavated material and 6 inches of topsoil.

E. Accessories

1. Connection To Existing 4-inch PVC Piping force main to new Sprayfield Header main
    a. Excavate to the PVC force main connection at the lower end of the header pipe.
    b. Disconnect the main and cap the header pipe.
    c. Install elbow riser to the surface and fittings to install a continuation of the force main to the north end of the header pipe as noted on the drawings.
    d. Reconnect the force main to the header main.
    e. Notify Contracting Officer in writing at least 15 days before the date the connections are required; receive approval before any service is interrupted.
    f. Provide materials required to make connections into the existing force main supply system and perform excavating, backfilling, and other incidental labor as required for making the actual connections to the existing system.

2. Valve Boxes and Lids
    a. Install with one cu ft pea gravel sump below the valve.
    b. Support valve box with brick.
    c. Provide wire screen between gravel sump and bottom of valve body for rodent protection.
    d. For turf areas, install flush with finish grade.
    e. For planter beds, install 50 mm 2 inches above finish grade.
    f. For sloped conditions, install valve box level with the terrain.

F. Flushing

1. After piping, risers, and valves are in place and connected, but before installation of sprinkler heads and valves, flush the piping system under a full head of water. Maintain flushing for 3 minutes.

G. Adjustment

1. After grading, plant installation, and rolling of planted areas, adjust sprinkler heads by providing new standpipes of the proper length to position the sprinkler at the desired elevation above the ground surface.

3.2 FIELD QUALITY CONTROL

A. The Contractor will conduct, and the Contracting Officer and the QC representative will witness field inspections and field tests specified in this section. Perform field tests, and provide labor, equipment, and incidentals required for testing.

B. Pressure Test

1. Duration
    a. During the pressure test, maintain a hydrostatic pressure of 150 psi without pumping for one hour with an allowable pressure drop of 5 psi before backfilling the system.
2. Leaks
    a. Correct leaks. Make necessary corrections to stop leakage.
3. Retest
    a. Retest the system twice until pressure can be maintained for the duration of the test.

C. Operation Test

1. Accessories
    a. After the pressure test, install sprinkler heads and test the entire system for operation under normal operating pressure. Make necessary corrections or adjustments to raise or lower pressure for each system if tests results do not match pressure requirements.
2. Acceptance
    a. Operation test is acceptable if the system operates through at least one complete cycle for areas to be sprayed.

END OF SECTION

SECTION 32 91 19.13

TOPSOIL PLACEMENT & GRADING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This work consists of placing topsoil upon constructed cut and fill slopes or in designated areas after grading operations are complete.

1.2 RELATED SECTIONS

A. Section 01 57 23 - Temporary Storm Water Pollution Prevention

B. Section 02 41 19 - Selective Demolition

C. Section 31 11 00 - Clearing and Grubbing

D. Section 31 14 13 - Topsoil & Wetland Topsoil Stripping & Stockpiling

E. Section 31 22 13 - Rough Grading.

F. Section 31 23 00 - Excavation & Fill

G. Section 31 25 00 - Erosion & Sediment Control

1.3 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. ASTM International (ASTM):
2. D2974, Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils.
3. D5268, Standard Specification for Topsoil Used for Landscaping Purposes.

1.4 SOURCE QUALITY CONTROL

1. Advise Owner of sources of topsoil to be utilized 7 working days in advance of stating time.
2. The contractor is responsible for soil analysis and requirements for amendments to supply topsoil as specified.
3. Soil testing by a recognized testing facility for pH, P and K, and organic matter.

1.5 QUALITY ASSURANCE

A. Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.

B. Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

C. Pre-Installation Meetings: Conduct pre-installation meetings to verify project requirements, installation instructions, and warranty requirements.

D. Qualifications: Provide proof of qualifications when requested by the Owner.

E. Contractor Qualifications:

1. Landscape Contractor: to be a Member in Good Standing of Landscape Newfoundland Green for Life (LNL).
2. Landscape Supervisor: Landscape Horticulturist Journeyperson or Landscape Industry Certified Technician with Softscape Installation designation or equivalent.

1.6 SUBMITTALS

A. Informational Submittals:

1. Certified Topsoil Analysis Reports:
   a. Indicate quantities of materials required to bring onsite
   b. Provide certification of topsoil compliance with gradation requirements.
   c. Provide certification of topsoil compliance with Chemical attribute requirements. Provide certification of topsoil compliance with minimum ammonium bicarbonate DPTA (chelate) extractable nutrient requirements.

PART 2 - PRODUCTS

2.1 TOPSOIL

A. Topsoil for seeded areas: a mixture of natural, friable, sandy loam mineral particulates, microorganisms, and organic matter which provides a suitable medium for supporting intended plant growth.

1. Topsoil shall have the following characteristics: resulting from a current agronomic and full textural class analysis of a topsoil sample collected from the actual soil proposed to be used. The results of the tests shall be submitted to the ENGINEER and must include the sample date and reference to the collection location.

2. Composition shall be in general accordance with ASTM D5268 subject to the following:
   a. Gradation

Texture Class	% of Total Weight	Average %
Sand (0.05-2.0 mm dia. range)	25 - 75	50
Silt (0.002-0.05mm dia. range)	15 - 40	27.5
Clay (< 0.002 mm dia. range)	15 - 30	22.5

   b. Chemical Attributes

Chemical Attribute	Range
pH	6.8 - 7.5
Organic Matter	1% - 3%
Salinity	EC < 2 mmhos/cm

   c. Topsoil shall contain the following minimum ammonium bicarbonate DPTA (chelate) extractable nutrients.

Nutrient	Concentration
Nitrogen	5 ppm air-dried basis
Phosphorous	5 ppm
Potassium	30 ppm
Iron (Fe)	5 ppm

B. Contain no toxic elements or growth-inhibiting materials.

C. Free from:

1. Debris and stones over 50 mm in diameter.
2. Course vegetative material, 10 mm diameter and 100 mm length, occupying more than 2% of soil volume.

D. Consistency: friable when moist.

2.2 SOIL AMENDMENTS

A. Fertilizer:

1. Fertility: major soil nutrients are present in the following amounts:
2. Nitrogen (N): 20 to 40 micrograms of available N per gram of topsoil.

3. Phosphorus (P): 40 to 50 micrograms of phosphate per gram of topsoil.
4. Potassium (K): 75 to 110 micrograms of potassium per gram of topsoil.
5. Calcium, magnesium, sulfur, and micro-nutrients present in balanced ratios to support germination and/or establishment of intended vegetation.
6. pH value: 6.5 to 8.0.

B. Peatmoss:

1. Derived from partially decomposed species of Sphagnum Mosses.
2. Elastic and homogeneous, brown in color.
3. Free of wood and deleterious material which could prohibit growth.
4. Shredded particle minimum size: 5 mm.
5. pH range of 3.5 to 6.5.

C. Sand: washed coarse silica sand, medium to coarse-textured.

D. Limestone:

1. Ground agricultural limestone.
2. Gradation requirements: percentage passing by weight, 90% passing 1.0 mm sieve, 50% passing 0.125 mm sieve.
3. Fertilizer: industry-accepted standard medium containing nitrogen, phosphorous, potassium, and other micro-nutrients suitable to specific plant species or applications or defined by a soil test.

PART 3 - EXECUTION

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.

B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.2 STRIPPING OF TOPSOIL

A. Do not handle topsoil while in wet or frozen conditions or in any manner in which soil structure is adversely affected.

B. Commence topsoil stripping of areas as indicated after the area has been cleared of brush weeds and grasses and removed from the site.

C. Strip topsoil to depths as indicated. Avoid mixing topsoil with subsoil where textural quality will be moved outside the acceptable range of intended application.

D. Stockpile in locations as directed by Owner. Stockpile height not to exceed 2.0 m.

E. Disposal of unused topsoil as directed by Owner.

F. Protect stockpiles from contamination and compaction.

3.3 PREPARATION OF EXISTING GRADE

A. Verify that grades are correct. If discrepancies occur, notify the Owner and do not commence work until instructed by the Owner.

B. Grade soil, eliminating uneven areas and low spots, ensuring positive drainage.

C. Remove debris, roots, branches, stones more than 2 inches in diameter, and other deleterious materials. Remove soil contaminated with calcium chloride, toxic materials, and petroleum products. Remove debris that protrudes more than 3 inches above the surface. Dispose of removed material off-site.

D. Courses cultivate the entire area which is to receive topsoil to a minimum depth of 4 inches. Cross cultivate those areas where equipment used for hauling and spreading has compacted soil.

3.4 PLACING AND SPREADING OF TOPSOIL/PLANTING SOIL

A. Place topsoil after the Owner has accepted the subgrade.

1. Do not place topsoil when subsoil or topsoil is frozen or excessively wet. Spread topsoil in uniform layers not exceeding 6 inches, over unfrozen subgrade free of standing water.

B. Topsoil shall be placed directly upon completed cut and fill slopes whenever conditions and progress of construction permit.

1. Before the final placement of topsoil, any areas compacted by construction activities shall be de-compacted to at least 85 Proctor by repeated ripping in rows 12” or less, apart, to a depth of 12”. All subsoil areas, including any graded areas or cut slopes, should be roughened with furrows 4”-6” deep to key the topsoil into the subsoil

C. Water shall be applied to the topsoil in a fine spray by nozzles or spray bars so the topsoil areas will not be washed or eroded.

D. Uniformly distribute topsoil to within 1/2 inch of final grades. Fine grade topsoil eliminating rough or low areas and maintaining levels, profiles, and contours of subgrade.

E. Material shall be free from objects larger than 1-1/2 inches maximum dimension including hard clods of heavy clay, shale, decomposed shale or other subsoils, noxious weed parts (roots, seeds, or shoots), grass, refuse, stumps, roots, brush, other foreign matter, hazardous or toxic substances, and deleterious material that may be harmful to plant growth or may hinder grading, planting, or maintenance.

F. Placed topsoil shall be stabilized immediately by installing perimeter silt fence and/or straw wattles, NPS will perform final seeding of the sites after notification that the topsoil placement and preparation are completed by the contractor.

3.5 FINISH GRADING

A. Grade to eliminate rough spots and low areas and ensure positive drainage. Prepare the loose friable bed employing cultivation and subsequent raking.

B. Consolidate topsoil to required bulk density using equipment approved by the Owner. Leave surfaces smooth, uniform, and firm against deep footprinting.

3.6 ACCEPTANCE

A. The owner will inspect and test topsoil in place and determine acceptance of material, depth of topsoil, and finish grading. Approval of topsoil material subject to soil testing and analysis.

B. Testing of topsoil will be carried out by a testing laboratory designated by the Owner.

3.7 RESTORATION OF STOCKPILE SITES

A. Restore stockpile sites acceptable to Owner.

3.8 SURPLUS MATERIAL

A. Dispose of materials not required where directed by Owner.

3.9 CLEANING

A. Upon completion of installation, remove surplus materials, rubbish, tools, and equipment barriers.

END OF SECTION

DIVISION 33

UTILITIES

SECTION 33 00 00

PIPE & PIPE FITTINGS: GENERAL STATEMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work in this Section includes process piping systems, utility piping systems, plumbing piping systems, pipe pressure testing, and pipe cleaning.

1.2 RELATED SECTIONS

A. Water Piping & Appurtenances - Section 33 14 00

B. Valves General Statement - Section 33 12 00

C. Water Utility Distribution Valves - Section 33 12 16

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO)

1. M252, Standard Specification for Polyethylene Corrugated Drainage Tubing
2. M294, Corrugated Polyethylene Pipe, 12” - 24” diameter

B. American National Standards Institute (ANSI)

1. B16.3, Malleable Iron Threaded Fittings
2. B16.5, Pipe Flanges and Flanged Fittings
3. B16.9, Factory-Made Wrought Steel Butt-welding Fittings
4. B16.12, Cast Iron Threaded Drainage Fittings
5. B16.22, Wrought Copper, and Copper Alloy Solder Joint Pressure Fittings
6. B31.1, Power Piping
7. B31.3, Chemical Plant and Petroleum Refinery Piping
8. B31.9, Building Services Piping
9. B40.1, Gauges - Pressure Indicating Dial Type - Elastic Element

C. American Society for Testing and Materials (ASTM)

1. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
2. A74, Standard Specification for Cast Iron Soil Pipe Fittings
3. A106, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service

4. A197, Standard Specification for Cupola Malleable Iron
5. A234, Standard Specification for Pipe Fittings of Wrought Carbon Steel Alloy Steel for Moderate and Elevated Temperatures
6. A269, Standard Specification for Seamless and Welded Austenitic Stainless-Steel Tubing for General Service
7. A518, Corrosion - Resistant High - Silicon Iron Castings
8. A774, As-Welded Wrought Austenitic Stainless-Steel Fittings for General Corrosive Service at Low and Moderate Temperatures
9. A778, Welded, Unannealed Austenitic Stainless Steel Tubular Products
10. B86, Standard Specification for Zinc
11. B88, Standard Specification for Seamless Copper Water Tube
12. B306, Copper Drainage Tube CDWV
13. C76, Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
14. C361, Standard Specification for Reinforced Concrete Low Head Pressure Pipe
15. C443, Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
16. C564, Rubber Gaskets for Cast Iron Soil Pipe and Fittings
17. C924, Standard Practice for Testing Concrete Sewer Lines by Low Air Pressure Test Methods
18. C1103, Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
19. D1248, Polyethylene Plastics Molding and Extension Materials
20. D1785, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
21. D2241, Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
22. D2466, Socket Type PVC Plastic Pipe Fittings, Schedule 40
23. D2467, Standard Specification for Socket-Type Poly (Vinyl Chloride)
24. D2997, Standard Specification for Centrifugally Cast Thermosetting Plastic Pipe
25. D3034, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
26. D3350 - Continuous Outdoor Use (UV)
27. D4101, Polypropylene Plastic Injection and Extrusion Materials
28. F1417, Installation Acceptance of Plastic Gravity Sewer Lines Using Low Pressure Air
29. F438, Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
30. F439, Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedule 80
31. F441, Standard Specification for Chlorinated Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40 and 80
32. F679, Standard Specifications for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
33. F794, Standard Specification for Poly (Vinyl Chloride) (PVC) Rubber Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
34. F1417, Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low Pressure Air
35. F2164, Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure.
36. F2206 - Standard Specification for Fabricated Fittings of Butt-Fused Polyethylene (PE) Plastic Pipe, Fittings, Sheet Stock, Plate Stock, or Block Stock

D. American Water Works Association (AWWA)

1. C104, Cement - Mortar Lining for Ductile-Iron Pipe and Fittings for Water
2. C110, Ductile Iron and Gray Iron Fittings, three inches through forty-eight inches for Water and Other Liquids
3. C111, Rubber Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fitting
4. C115, Flanged Ductile Iron Pipe with Threaded Flanges
5. C151, Ductile Iron Pipe, Centrifugally Cast, in Metal Molds or Sand-Lined Molds for Water or Other Liquids
6. C153/A21.53 - American National Standard for Ductile Iron Compact Fittings, three inches through twenty-four inches and fifty-four inches through sixty-four inches, for Water Service.
7. C200, Steel Water Pipe 6 inches and Larger
8. C203, Coal Tar Protective Coatings and Linings for Steel Water Lines - Enamel and Tape - Hot Applied
9. C205, Cement Mortar Lining and Coating for Steel Water Pipe four inches and Larger, Shop Applied
10. C207, Steel Pipe Flanges for Waterworks Service - Sizes four inches through one hundred forty-four inches.
11. C208, Dimensions for Fabricated Steel Water Pipe Fittings
12. C210, Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
13. C214, Tape Coating Systems for the Exterior of Steel Water Pipelines
14. C600-99, Installation of Ductile-Iron Water Mains and Their Appurtenances
15. C605-94, Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
16. C606, Grooved and Shouldered Joints
17. C651, Disinfection of Water Mains
18. C900, Polyvinyl Chloride (PVC) Pressure Pipe four inches through twelve inches for Water
19. C905, Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters fourteen inches through thirty-six inches
20. C906 - Polyethelene (PE) Pressure Pipes and Fitting (Revised to Incorporate PE4710)
21. M11, Steel Pipe - A Guide for Design and Installation
22. Cast Iron Soil Pipe Institute (CISPI)
23. CISPI301, Hubless Cast Iron Sanitary System with No Hub Pipe and Fittings
24. CISPI310, Coupling for Use in Connection with Hubless Cast Iron and Fittings for Sanitary and Stormdrain, Waste, and Vent Piping Applications

E. Plastic Pipe Institute - Handbook of PE Pipe, 2nd Edition.

1. To include Technical Reports and Technical Notes (http://www.plasticpipe.org/publications/pe_handbook.html)
   a. Technical Notes #46, “Guidance for Field Hydrostatic Testing of High-Density Polyethylene Pressure Pipelines: Owner’s Considerations, Planning, Procedures, and Checklists TN-46/2013”.

F. National Electric Manufacturer’s Association (NEMA)

1. ICS6, Enclosures for Industrial Controls and Systems

G. National Fire Protection Association (NFPA)

1. 54, National Fuel Gas Code

1.4 SUBMITTALS

A. Shop Drawings consistent with Submittals - Section 01 33 23 and including:

1. Schedule showing pipe type, size, schedule of pipe, appurtenances, type of linings and coatings, and cathodic protection.
2. Exterior yard piping drawings (minimum scale one inch equals ten feet) with information including:
   a. Dimensions of piping lengths
   b. Invert elevations of piping crossings
   c. Acknowledgment of bury depth requirements
   d. Details of fittings, tapping locations, thrust blocks, restrained joint segments, harnessed joint segments, hydrants, and related appurtenances
   e. Acknowledgment of designated valve or gate tag numbers, instrument tag numbers, pipe, and line numbers
   f. Line slopes and vents
3. Copies of any manufacturer's written directions regarding material handling, delivery, storage, and installation
4. Technical product data on piping appurtenances

B. Certifications and testing consistent with Contractor Quality Control - Section 01 40 00 and including:

1. Certification that products used to meet standards referenced
2. Certification of all welders
3. Reports defining results of dielectric testing and corrective action taken
4. Qualifications of lab performing disinfection analysis on water systems
5. Disinfection test report
6. Notification of time and date of piping pressure tests
7. Copies of pressure test results on all piping systems, using the forms at the end of this Section

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect pipe coating during handling using methods recommended by the manufacturer. Use of bare cables, chains, hooks, metal bars, or narrow skids in contact with a coated pipe is not permitted.

B. Prevent damage to the pipe during transit. Repair abrasions, scars, and blemishes. If repair of satisfactory quality cannot be achieved, replace damaged material immediately.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Furnish piping, fittings, and appurtenances per the Pipe Schedule as shown on the Drawings.

B. Non-HDPE Pipe sizes indicated are nominal inside diameter.

C. Use straight, round pipe.

D. For temporary piping not specifically addressed in Piping Schedule, utilize materials, joints, and fittings equal to those specified for similar applications of permanent construction.

2.2 COMPONENTS AND ACCESSORIES

A. Couplings Restraint

1. Provide mechanical restraint for all couplings.
2. Assure couplings and restraint match test pressure rating of the piping system.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before installation, inspect and verify the condition of piping and appurtenances. Installation constitutes the installer’s acceptance of product conditions for satisfactory installation.

3.2 PREPARATION

A. Correct defects or conditions which may interfere with or prevent a satisfactory installation.

3.3 EXTERIOR PIPING ERECTION/INSTALLATION/APPLICATION

A. Unless otherwise shown on the Drawings, provide a minimum of thirty inches of earth cover over exterior buried piping systems and appurtenances conveying water, fluids, or solutions subject to freezing.

B. Laying Pipe in Trench

1. Excavate and backfill trench per Utility Excavation & Backfill - Section 31 23 33.
2. Clean each pipe length thoroughly and inspect for compliance with Specifications.
3. Grade trench bottom and excavate for pipe bell and lay pipe on trench bottom or bedding material.

4. Provide gasket or joint material according to manufacturer's directions after joints have been thoroughly cleaned and examined.
5. Except for the first 2 joints, before making final connections of joints, 2 full sections of pipe shall have been previously installed with earth tamped alongside pipe of final bedding material placed.
6. Lay pipe in only suitable weather with good trench conditions. Never lay pipe in water except approved by Contracting Officer.

C. Lining-up Push-on Joint Piping

1. Lay piping on route lines shown on the Drawings.
2. Deflect from straight alignments or grades by vertical or horizontal curves.
3. The maximum offset between extended centerlines of any 2 adjacent pipe lengths is in strict accordance with the pipe manufacturers published literature on deflections and offsets.
4. Provide special bends when specified or where required alignment exceeds allowable deflections stipulated.
5. Provide shorter lengths of pipe in such length and number that angular deflection of any joint, as represented by specified maximum deflection, is not exceeded.

D. Anchorage and Blocking

1. Provide reaction blocking, anchors, joint harnesses, or other acceptable means for preventing movement of piping caused by forces at buried or exposed piping tees, wye branches, plugs, or bends.
2. Size thrust block as detailed on the Drawings.
3. Place concrete blocking so that it extends from fitting into a solid undisturbed earth wall. Concrete blocks shall not cover pipe joints.
4. Provide a bearing area of concrete per details on the Drawings.
5. Provide insulating components where dissimilar metals are joined together.

3.4 CONNECTIONS WITH EXISTING PIPING

A. Where the connection between new work and existing work is made, use suitable and proper fittings to suit conditions encountered.

B. Perform connections with existing piping at the time and under conditions that will least interfere with service to those affected by such operation.

C. Undertake connections in a fashion which will disturb the existing system as little as possible.

D. Utilize suitable equipment and facilities to dewater, drain, and dispose of liquid removed without damage to adjacent property.

E. Where connections to existing systems necessitate the employment of past installation methods not currently part of trade practice, utilize necessary special piping components.

F. Where connection involves potable water systems, provide disinfection methods as prescribed in these specifications.

3.5 FIELD QUALITY CONTROL

A. General

1. Utilize pressures, media, and pressure test durations as specified on Piping Schedules.
2. Isolate equipment that may be damaged by the specified pressure test conditions.
3. Perform pressure tests using calibrated pressure gauges and calibrated volumetric measuring equipment to determine leakage rates. Select each gauge so that the specified test pressure falls within the upper half of the gauge's range. Notify the Engineer 24 hours before each test.
4. Completely assemble and test new piping stems before connection to existing pipe systems.
5. Acknowledge satisfactory performance of test and inspections in writing to Engineer before final acceptance.
6. Provide all necessary equipment and perform all work required in connection with the test and inspections.
7. Bear the cost of all testing and inspecting, locating, and remedying of leaks and any necessary retesting and reexamination.

3.6 CLEANING AND DISINFECTION

A. Cleaning

1. The clean interior of piping systems thoroughly before installation.
2. Maintain pipe in clean condition during installation.
3. Before jointing piping, thoroughly clean and wipe joint contact surfaces, and then properly dress and make joint.
4. Immediately before pressure testing, clean and remove grease, metal cuttings, dirt, or other foreign materials which may have entered the system.
5. At the completion of work and before final acceptance, thoroughly clean work is installed under these specifications. Clean equipment, fixtures, pipe, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated by operation of the system, from testing, or other causes. Repair any stoppage of discoloration or other damage to parts of the building, its finish, or furnishings, due to failure to properly clean the piping system, without cost to the Government.

END OF SECTION

SECTION 33 01 30.14

HYDROSTATIC TESTING OF NON-HDPE PRESSURE SEWER PIPE

PART 1 – GENERAL

1.1 SCOPE

A. For HDPE sewer force mains, test piping per Section 33 11 00.10 - Testing of HDPE Water Lines & Sewer Force Main Lines.

B. All pipelines complete with valves, fittings, and other facilities shall be hydrostatically tested meeting AWWA Specification C600-87 or AWWA Specification C900-97, C905-97, C909-98, and AWWA C906-90 dependent upon the type of pipe material being utilized. The pipelines shall be tested after they have been installed and filled with water for a minimum period of 24 hours. The test pressure shall be at 150 psi or 50 percent greater than the operating pressure at the lowest point in the pipeline being tested, whichever is greater. The hydrostatic tests shall include all piping in its entirety. All materials necessary to conduct the hydrostatic testing shall be the responsibility of the Contractor and must be approved by the Contracting Officer. The same main line leakage maximum shall include all services, taps, and cut-ins installed by the Contractor. All hydrostatic tests shall be conducted in the presence of the Contracting Officer for approval.

C. The hydrostatic test shall be made after backfilling has been completed but before placement of any required surface repair. A test shall be made only after a part, or all backfilling has been completed and at least 7 days after the last concrete thrust block has been cast with standard cement. The duration of the hydrostatic test shall be 2 hours unless otherwise directed by the Contracting Officer.

1.2 SUBMITTALS

A. The contractor shall provide Contracting Officer with written notice 24 hours before hydrostatic testing. The contractor shall furnish a written test report to the Contracting Officer upon completion of successful testing.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Potable Water

PART 3 - EXECUTION

3.1 WORKMANSHIP

A. Procedure. Each section of the pipeline shall be slowly filled with water, and the specified test pressure shall be applied to utilize a pump connected to the pipe in a manner satisfactory to the Contracting Officer. The Contractor shall provide the complete means of conducting the hydrostatic test including pumps and all related equipment. Pressure testing shall be properly scheduled with the Contracting Officer to allow for test observation and recording of results.

B. During the filling of the pipe and before the application of the specified test pressure, all air shall be expelled from the pipeline, if necessary, utilizing taps at the point of highest elevation, and, after completion of the test, the taps shall be tightly plugged, unless otherwise specified. During the test, all exposed pipes, fittings, valves, hydrants, and couplings shall be carefully examined. All locations with visible leakage shall be repaired to the satisfaction of the Contracting Officer. All cracked or defective elements shall be removed and replaced by the Contractor at his expense. The test shall then be repeated until the results are satisfactory to the Contracting Officer.

C. Overall Leakage. No pipe installation will be accepted until or unless the leakage for the section of the pipeline being tested is less than the rate of allowable leakage specified. Allowable leakage shall be calculated using the following formula in which L is the allowed leakage in gallons/hour.

$$L = \frac{NDr}{7{,}400}$$

Where:	L	=	Allowable Leakage	gallons/hour
	N	=	Number of Joints in Tested Line - including fittings	number
	D	=	Nominal Pipe Diameter	inches
	P	=	Test Pressure	psi, gauge

D. If the leakage in any section of the pipeline tested is greater than the allowable leakage, the Contractor shall locate and repair the defective joints and repeat the test at his own expense until the leakage is within the permitted allowance.

END OF SECTION

SECTION 33 01 30.40

SEWER & MANHOLE TESTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This is a general specification, which applies to the furnishing of all labor, materials, tools, and equipment to perform all operations in connection with leakage testing for completed manholes and gravity sewer pipe and deflection testing for flexible sewer pipe.

1.2 GENERAL

A. The Contractor shall supply all water for the tests, all equipment, and labor necessary to convey the water into the sewer, the necessary transportation to transport test plugs and risers from one test site to another, and such labor and equipment as may be required in installing test plugs, and other incidental work in conducting the tests and the cost thereof shall be included in the price for constructing the sewer, including furnishing the test plugs.

1.3 SUBMITTALS

A. The contractor shall provide Contracting Officer with written notice 24 hours before hydrostatic testing. The contractor shall furnish a written test report to the Contracting Officer upon completion of successful testing.

PART 2 - PRODUCTS

2.1 TESTING REQUIREMENTS

A. Manhole Testing: After completion of manhole construction, wall sealing, or rehabilitation, test manholes for leakage using Vacuum Testing or, if pre-approved by the Contracting Officer, Exfiltration Testing Procedures as specified herein.

1. General - Plug influent and effluent lines, including service lines, with suitably sized pneumatic or mechanical plugs. Ensure plugs are properly rated for pressures required in this test; follow the Manufacturer’s safety and installation recommendations. Place plugs a minimum of 6 inches outside of manhole walls.
2. Vacuum Testing
    a. To perform a vacuum test, all lift holes and exterior joints shall be plugged with a non-shrink grout and all pipes entering a manhole shall be plugged.
    b. No grout must be placed in horizontal joints before testing.

c. Stub-outs, manhole boots, and pipe plugs must be secured to prevent movement while a vacuum is drawn.
d. The contractor shall use a minimum 60 in/lb torque wrench to tighten the external clamps that secure a test cover to the top of a manhole.
e. A test head must be placed at the inside of the top of a cone section, and the seal inflated per the manufacturer's recommendations.
f. There must be a vacuum of 10" of mercury inside a manhole to perform a valid test.
g. A test does not begin until after the vacuum pump is off.
h. A manhole passes the test if after 2 minutes and with all valves closed, the vacuum is at least 9" inches of mercury.

3. Hydrostatic Testing
   a. The maximum leakage for hydrostatic testing or any alternative test method is 0.025 gallons per foot diameter per foot of manhole depth per hour.
   b. Seal all wastewater pipes coming into a manhole with an internal pipe plug, fill the manhole with water up to the manhole cover and maintain the test for at least one hour.
   c. A test for concrete manholes may use a 24-hour wetting period before testing to allow saturation of the concrete.

2.2 GRAVITY PIPE LEAKAGE TESTING

A. General - Tests shall be made by the low-pressure air test, the infiltration test, or the joint test. The infiltration test shall be used when the groundwater level is at least 2' above the crown of the pipe measured at the upstream manhole. The joint test shall be used for pipe sections greater than 36" inside diameter. The Contractor may use the joint test for pipe with a 27" - 36" average inside diameter at the approval of the Contracting Officer or his representative. The low-pressure air test, the infiltration test, and the exfiltration test shall be conducted from manhole to manhole. Trenches shall be completely backfilled, and the sewer line should be free of debris before testing. Plug all pipe outlets including laterals and secure plugs to prevent leakage blowout due to testing pressure.

B. Infiltration Test

1. Performance: The total infiltration, as determined by a hydrostatic head test, shall not exceed 50 gallons per inch of diameter per mile of pipe per 24 hours at a minimum test head of 2' above the crown of a pipe at an upstream manhole. For construction within the 100-year flood plain, the total infiltration shall not exceed ten gallons per inch of diameter per mile of pipe per 24 hours.

NORMAL CONSTRUCTION SIZE OF PIPE ALLOWABLE LEAKAGE*

	Gal/Min/100 Ft.
6”	0.0039
8”	0.0053
10”	0.0066
12”	0.0079
15”	0.0099
18”	0.0118
21”	0.0138
24	0.0158
27”	0.0178
30”	0.0197
36”	0.0237

* Equivalent to 50 gal. per inch diameter per mile per 24 hours

CONSTRUCTION WITHIN 100 YR FLOOD PLAIN SIZE OF PIPE ALLOWABLE LEAKAGE *

	Gal/Min/100 Ft.
6”	0.0008
8”	0.0011
10”	0.0013
12”	0.0016
15”	0.0020
18”	0.0024
21”	0.0028
24	0.0032
27”	0.0036
30”	0.0039
36”	0.0047

* Equivalent to 10 gal. per inch diameter per mile per 24 hours

The total leakage in cubic inches shall be the total cross-sectional area in square inches of the inside of the two risers and any stacks in the sewer multiplied by the drop in water level in inches. For diameters not listed in the chart, multiply the square of the diameter by the following chart value for 1" diameter.

2. Execution: Stop all dewatering operations and allow the groundwater to return to its normal level and allow it to remain so for at least 24 hours. Leakage shall be determined by measuring the flow through the opening in the downstream plug for at least 15 minutes. Five separate measurements shall be made. The average of the measurements shall be used, discarding any one of the five measurements except the last that varies by more than 50% from the average of the other four. If the results of the tests are otherwise satisfactory, but the last of the five measurements show leakage more than that permitted, the tests shall be continued to determine if additional leaks may have developed during testing.
3. Air Test
   a. Performance: The pipe shall be pressurized to 5 psig greater than the pressure exerted by groundwater above the pipe. Once the pressure is stabilized, the minimum time allowable for the pressure to drop 1.0 psig shall be 5 minutes per every 100' pipe plus 5 minutes per each service connection. Pipe sizes larger than 27" shall be tested as per TCEQ requirements. The test may be stopped if no pressure loss has occurred during the first 25% of the calculated testing time. If any pressure loss or leakage has occurred during the first 25% of the testing period, then the test shall continue for the entire test duration as outlined in this subparagraph or until failure.
   b. Execution: Add air until the internal air pressure of the sewer line is raised to approximately 5.5 psig. Allow the air pressure to stabilize. The pressure will normally drop until the temperature of the air in the line stabilizes.

DIAMETER OF RISER OR STACK VOLUME PER INCH OF DEPTH

	Cubic Inch	Gallon
1"	0.7854	.0034
2"	3.1416	.0136
2 ½"	4.9087	.0212
3"	7.0686	.0306
4"	12.5664	.0544
5"	19.6350	.0850
6"	28.2743	.1224
8"	50.2655	.2176

When the pressure has stabilized and is at or above the starting test pressure of 5 psig, commence the test by allowing the gauge pressure to drop to 5 psig at which point the time recording is initiated. Record the drop in pressure for the test period.

4. Joint Test - The joint test may be conducted by an air test or water test. The joint and the pipe segment shall be visually inspected immediately after testing.
    a. Performance: The pipe is to be pressurized to 3.5 psig greater than the pressure exerted by groundwater above the pipe. Once the pressure has stabilized, the minimum time allowable for the pressure to drop from 3.5 psig to 2.5 psig shall be ten seconds. If the groundwater pressure is equal to or greater than 3.5 psig, and the sewer line or joint is not leaking the sewer line or joint is acceptable and no additional testing is required. If one or more joints are leaking, but the total amount of leakage in the sewer line being tested is equal to, or less than, the allowable leakage specified, the line is acceptable, and no additional testing is required provided visible leaks are repaired. Moisture or beads of water appearing on the surface of the joint will not be considered visible leakage.
    b. Execution: Review proper operation, safety, and maintenance procedures as provided by the manufacturer of the joint test apparatus. Move the joint test apparatus into the sewer line to the joint to be tested and position it over the joint. Make sure the end element sealing tubes straddle both sides of the joint and the hoses are attached. For the water test, the bleed-off petcock must be located at the top dead center. Inflate end element sealing tubes with air per equipment and manufacturer's instructions.
        1) Air Test - Pressurize the void volume with air to 3.5 psig greater than the pressure exerted by groundwater above the pipe. The pressure drop shall be measured over ten seconds. Five separate measurements shall be made. The average of the measurements shall be used, discarding any one of the five measurements except the last that varies by more than 50% from the average of the other four. If the results of the tests are otherwise satisfactory, but the last of the five measurements show leakage more than that permitted, the tests shall be continued to determine if additional leaks may have developed during testing.
        2) Water Test - Introduce water into void volume until water flows evenly from the open petcock. Close the petcock and pressurize with water to 3.5 psig above the pressure exerted by groundwater. The pressure drop shall be measured over ten seconds. Five separate measurements shall be made. The average of the measurements shall be used, discarding any one of the five measurements except the last that varies by more than 50% from the average of the other four. If the results of the tests are otherwise satisfactory, but the last of the five measurements show leakage more than that permitted, the tests shall be continued to determine if additional leaks may have developed during testing.

2.3 DEFLECTION TESTING

A. Deflection tests shall be performed on all flexible pipes. For pipelines with inside diameters less than 27", a rigid mandrel shall be used to measure the deflection. For pipelines with an inside diameter 27" and greater, a method pre-approved by the Contracting Officer shall be used to test for vertical deflections. Other methods shall provide a precision of 0.2% deflection. The test shall be conducted after the final backfill has been in place for at least 30 days. No pipe shall exceed a deflection of 5.0%. If a pipe should fail to pass the deflection test, the problem shall be corrected, and a second test shall be conducted after the final backfill has been in place for an additional 30 days. The tests shall be performed without mechanical pulling devices.

1. Mandrel Sizing - The rigid mandrel shall have an outside diameter (O.D.) equal to 95% of the inside diameter (I.D.) of the pipe. The inside diameter of the pipe, to determine the outside diameter of the mandrel, shall be the average outside diameter minus two minimum wall thicknesses for O.D. controlled pipe and the average inside diameter for I.D. controlled pipe. All dimensions shall be per appropriate standard. Statistical or other "tolerance packages" shall not be considered in mandrel sizing.
2. Mandrel Design - The rigid mandrel shall be constructed of a metal or rigid plastic material that can withstand 200 psi without being deformed. The mandrel shall have nine or more "runners" or "legs" as long as the total number of legs is odd. The barrel section of the mandrel shall have a length of at least 75% of the inside diameter of the pipe. A proving ring shall be provided and used for each size mandrel in use.
3. Method Options - Adjustable or flexible mandrels are prohibited. A television inspection is not a substitute for the deflection test. A deflectometer may be approved for use on a case-by-case basis. Mandrels with removable legs or runners may be accepted on a case-by-case basis. Mechanical devices will not be used to pull the mandrel.

2.4 TV CAMERA INSPECTION

A. T.V. Camera Inspection shall be performed on all sewer pipes installed before acceptance. When the Contractor performs the inspection, the Contracting Officer shall be notified one working day prior so that he can view the procedure. The inspection shall be in digital video format, saved to a DVD or CD (enclosed within a protective case), and shall be given to the Contracting Officer for review and final records. The lines shall be filled with potable water between manholes to fill the service connections and drained before T.V. Camera Inspection. The line shall be cleaned before T.V. inspection. All dirt/debris, including grease, in the line which could cover a defect, shall be removed. The line should be cleaned before being filled with water. Jetting of the lines in conjunction with the T.V. Inspection is prohibited. If the line to be televised is discovered to contain foreign material, which prohibits an acceptable T.V. inspection, the line shall be jetted and televised again. Select and use closed-circuit television equipment that will produce a color digital video. Produce and use closed-circuit television equipment using a panorama tilt, radial viewing, pipe inspection camera that pans plus and minus 75 degrees, rotates 360 degrees, and has optical zoom from 6 or fewer inches to infinity. The camera must have an accurate footage counter accurate to within 1’ per 500’ of pipe. The footage shall be continuously displayed on the video at all times. The camera operator shall pause at each tee, tilt the camera and view up into the branch for inspection of joints and fittings maintaining a clear in-focus picture at all times while zooming to the full extent of the camera. The camera operator shall stop at each fitting and change in pipe type and complete a 360-degree view of the fitting slow enough to identify all defects. Glare shall be avoided and shall not interfere with viewing the pipe segment. The maximum rate of travel for the camera shall be 30’ per minute. DVDs or CDs shall be continuous from pipe segments between manholes. Provide DVDs or CDs with labels indicating project number, segment number, date televised, date submitted, starting manhole number, ending manhole number, pipe diameter, pipe length, and street name. The T.V. inspection shall be used to identify defective construction such as sags, debris, separated joints, etc. The Contracting Officer shall make all final determinations if the severity of the defect constitutes failure and subsequent removal of the segment in question.

2.5 RETESTS

A. Manholes or sewers which fail to meet the testing requirements shall be repaired and retested by the Contractor. All repairs and retesting shall be performed at the expense of the Contractor.

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall notify the Contracting Officer when the manholes and line are ready to be tested. After the Contracting Officer concurs that the line is ready to be tested, the Contractor may proceed with testing. The Contractor will supply and set up the test plugs and risers for the test and will perform the test in the presence of the Contracting Officer.

B. Contractor shall take such precautions as required to prevent damage to lines and appurtenances being tested. Damage resulting from tests shall be repaired at the Contractor's expense.

END OF SECTION

SECTION 33 01 30.41

SANITARY SEWER CLEANING & INSPECTION (ASH MOUNTAIN ONLY)

PART 1 – GENERAL

1.1 SUMMARY

A. The work of this section consists of cleaning gravity sewers and sewer force mains using rodding, jetting, root cutting heads, and other non-destructive methods. The contractor shall provide all traffic control for working within the streets and roadways required for this project. The contractor shall provide all the necessary labor, equipment, safety equipment, confined space testing, and entry equipment as required by OSHA to perform sewer cleaning, removal of debris, and disposal of all debris resulting from the cleaning of sanitary sewer line segments and manholes included in this project. The contractor shall also perform the Closed Circuit Television Inspection (CCTV) on all project sewer line segments for this project. The CCTV inspection shall be done after the sewer line cleaning and debris removal has been completed for each section.

B. This work also includes bypass pumping, closed-circuit television inspection, and spill prevention.

1.2 SUBMITTALS

A. As specified in Division 01, Section 01 33 23 “Submittal Procedures.”

B. Submit the following data for the Equipment to be used:

1. List of cleaning equipment to be used, including types of heads, pressure ratings, flow volumes, and condition (new, slightly used, and used).
2. Vacuum truck specifications, including haul volume and condition.
3. List of roots cutting equipment, including capabilities.
4. List of equipment for bypass pumping.
5. List of equipment for spill containment and cleanup.
6. Procedure for cleaning and debris removal.

C. Record Drawings depicting any field observations as to the location of heavy debris, broken pipe, rocks, obstructions, sags, or other useful information shall be submitted after the work. Record Drawings shall be the Contract Drawings with observations marked in RED INK.

D. The contractor shall have a minimum of 5 years of experience in sewer line cleaning. The contractor shall provide a list of at least 3 customers who have had similar work completed.

E. The contractor shall submit a sample DVD recording and inspection report for review and approval before any CCTV inspection. The sample DVD recording and Inspection Report shall represent the quality of the video inspection and test to be provided by the contractor.

F. The CONTRACTOR shall provide a safety plan. The plan shall have at a minimum:

1. Confined Space Entry
2. Personal Protective Equipment
3. Traffic Control
4. Roadway Safety

G. Completed CCTV DVDs and report documents with all field observations as to location, identification, numbering, or other useful information shall be submitted after each segment of lines inspected. The line segment documents will be provided within 2 workdays from the date of completion to the Contracting Officer.

1.3 CLOSED CIRCUIT TELEVISION (CCTV) INSPECTION SCHEDULE

A. The Contractor shall complete a color CCTV inspection immediately after the following cleaning to allow clear viewing of the gravity sewer and sewer force main condition by the camera. A cleaned pipe reach shall be CCTV inspected within 24 hours elapsed time from being cleaned. The pipeline reach shall be re-cleaned if subsequent CCTV inspection reveals that solids such as sand and gravel have not been completely removed, or if materials in the line obstruct the camera view. Re-cleaning shall be at no additional cost to the Government.

B. Manholes shall be thoroughly cleaned of all solid debris. Debris shall not be pushed down the line from segment to segment. CCTV inspection videos shall show clean manholes, or the line shall be re-cleaned and reassessed at no expense to the Government.

1.4 MANHOLE CLOSURE

A. All existing manholes are equipped with a solid well-fitting cast iron cover and may include a PVC infiltration lid beneath the cast iron cover. The Contractor shall reinstall the infiltration lid and cover the following cleaning.

1.5 SPILL PREVENTION AND RESPONSE PLAN IMPLEMENTATION AND SEWER BYPASS PLAN

A. The work of this Section includes the preparation of a site-specific Spill Prevention and Response Plan (SPRP) and implementation for each line segment as directed per contract SPRP document guidelines and requirements in specification Section 01 50 00, “Temporary Facilities & Controls”.

1. The contractor is responsible for the preparation, installation, and maintenance of a sewer bypass plan. The Contractor shall have a sewer bypass plan, approved by the Contracting Officer, and in place before working on any active sewer. (Bypass Plan requires Regional Water Quality Control Board (RWQCB) approval. RWQCB review requires a 14-business day minimum review period.
2. The Contractor shall have an approved sewer spill prevention and response plan in place before working on any active sewer.
3. The contractor shall maintain on-site and have placed in all vehicles a copy of the Spill Prevention and Response Plan. All personnel shall be trained in the conditions of the plan and shall be fully knowledgeable of the reporting requirements and procedures.

B. The contractor shall assess each pipeline segment for spill potential and analyze spill flow paths. The spill potential assessment shall also include the potential spillage of flushed materials and water that are present in the bypass pipe or force main during removal. Additionally, each line shall be assessed for bypass pumping needs. A site-specific SPRP shall be developed, and mitigation measures installed to include sandbags and liners, plugging culverts, mobilizing bypass equipment, and other spill prevention and response measures, equipment, and materials, as required, before proceeding with the work. The site-specific SPRP development and implementation shall be approved by the Contracting Officer before proceeding with the work. The SPRP will be submitted per contract SPRP document guidelines and requirements. An additional 10 days of review is required for the SPRP.

C. Equipment and materials shall be available as identified in the site-specific SPRP. Equipment and material shall be standing by and ready immediately in the event of a spill.

1.6 MINIMUM EQUIPMENT ON-SITE

A. The contractor shall maintain a minimum of 2 working root cutting heads and pneumatic plugs on-site for all pipeline sizes to be inspected at all times.

1.7 MANHOLE AND SANITARY SEWER LINE SEGMENT CLEANING

A. The contractor shall be solely responsible for the means and methods of sewer system cleaning. Cleaning of the sewer shall consist of the removal of all sludge, dirt, sand, grease, silt, solids, rags, roots, and other debris from the manholes and sewer line segments, including debris within any sags of the sewer line segments. Selection of cleaning equipment and the cleaning method shall be based on the condition and/or pipe material of the sewer segment at the time work commences and shall be approved by the Contracting Officer. FLUSHING OF ANY SANITARY SEWER TO FACILITATE CLEANING ACTIVITIES WITHOUT THE CAPTURE OF SOLIDS AND DEBRIS IS EXPRESSLY PROHIBITED. The contractor shall dewater as required. Passing debris material from the sewer segment to the sewer segment shall not be permitted. If sludge, dirt, sand, rocks, grease, and other solid or semisolid material or debris resulting from the cleaning operations are observed and/or detected by COR as passing to downstream sewer segment(s), the contractor shall be responsible for cleaning such downstream sewer segment(s) at no additional cost to the Park.

B. The contractor shall be responsible for the handling, hauling, and disposal of all debris, silt, and accumulated solids removed from the sewer. All debris, silt, and solids removed by the contractor shall be disposed of at a facility licensed for the handling and disposal of such materials per all-appropriate codes, rules, and regulations for handling and disposal of such materials. Under no circumstances shall the removed sewage or solids be dumped onto streets or into ditches, catch basins, storm drains, or otherwise improperly disposed of. If sewage is unintentionally spilled, discharged, leaked, or otherwise deposited in the open environment, the contractor shall be responsible for any clean-up and disinfection of the affected area. The contractor shall comply with all local, State, and Federal regulatory requirements regarding spills. Improper disposal of sewage or solids removed from the sewer system may subject the contractor to fines imposed by the regulatory agency. In addition, the contractor may be subject to civil and/or criminal penalties for improper disposal of removed materials under the law. Liquid can be decanted back into the sewer system.

C. The contractor shall be solely responsible for providing any traffic control that is needed. The traffic control personnel shall be trained by qualified traffic control person(s).

1.8 CLOSED CIRCUIT TELEVISION INSPECTION (CCTV)

A. The contractor shall provide all the necessary labor, equipment, safety equipment, confined space testing, and entry equipment as required by OSHA to perform a CCTV. This inspection shall be done after the sewer system cleaning and debris removal has been completed for each manhole and line segment. The CCTV intends to identify the location of all sewer services, the extent of sewer line defects, and to verify that the sewer line(s) has been cleaned to the cleaning specification in preparation for rehabilitation work.

B. The contractor shall CCTV all sewer line segments identified in this project. The CCTV shall be conducted to determine the interior condition of the sewer pipe. The inspection shall be done one sewer line section (i.e., manhole to manhole) at a time and the section being inspected shall be suitably isolated from the remainder of the sewer system. The Contracting Officer representative shall witness all inspections.

C. Digital Videodisc (DVD) recordings shall be made of the television inspection. Inspection logs shall be complete and digital photographs of problem areas shall be taken. DVD recordings, photographs, and inspection logs shall be supplied to the Government.

D. CCTV inspection equipment shall include video cameras, video monitors, digital camera cables, power sources, and all equipment necessary to perform a CCTV inspection.

E. The video camera used for the inspection shall be one specifically designed and constructed for sewer line CCTV inspection. Lighting for the camera shall be suitable to allow a clear picture of the entire periphery of the pipe. The camera shall be operative in 100% humidity conditions. The video camera, the digital camera, monitor, and other components of the video system shall be capable of producing picture quality to the satisfaction of the Contracting Officer. A pan and tilt camera must be used for all CCTV inspections.

F. Each service connection must be looked at by panning and tilting the camera so that every edge of the connection is clearly shown. The camera shall travel through the line in either direction at a slow and uniform rate, stopping when necessary to ensure proper documentation of the sewer's condition but in no case shall the television camera travel at a speed greater than 30 fpm. Manual winches, power winches, TV cable, and powered rewinds or other devices that do not obstruct the camera view or interfere with proper documentation of the sewer conditions shall be used to move the camera through the sewer line. If during the inspection operation, the television camera will not pass through the entire sewer line section, the equipment shall be removed and repositioned in a manner so that the inspection can be performed from the opposite manhole. If again, the camera fails to pass through the entire sewer line section, the inspection shall be considered complete, and no additional inspection work will be required.

G. Whenever non-remote powered and controlled winches are used to pull the television camera through the line, telephones, radios, or other suitable means of communication shall be set up between the two manholes of the sewer line being inspected to ensure that good communications exist between members of the crew.

H. The accuracy of the measurements cannot be stressed too strongly. Measurement for the location of defects shall be above ground utilizing a metering device. Marking on cable, or the like, which would require interpolation for depth of manhole, shall not be allowed. Measurement meters shall be accurate to two-tenths of a foot over the length of the sewer line section being inspected. The accuracy of the measurement meters shall be checked daily by use of a walking meter, roll-a-tape, or another suitable device.

I. The video inspection shall be recorded in color on a DVD. The inspection report shall be in the Microsoft Access format database and recorded onto compact discs (CDs). All original recordings and inspection reports shall become the property of the Parks.

J. Television Inspection logs: Each segment inspected shall have a separate inspection report. The inspection report shall be recorded onto a CD, in a Microsoft Access or Excel format that shall be given to the Contracting Officer. The report(s) shall be printed and become the property of the Park. The report shall be clear and concise for the reader.

1. It shall clearly show the location, of adjacent manholes, of each source of inflow and infiltration, and other data of significance including the locations of house service connections, joints, unusual conditions, roots, cracked or collapsed sections, presence of scale and corrosion, sewer line sections that the camera failed to pass through and reasons for failure and other discernible features shall be recorded.
2. During the CCTV inspection, the camera shall stop at all significant observations to ensure a clear and focused view of the pipe condition. At this point, an instantaneous photograph shall be taken. The contractor shall provide the Contracting Officer with a CD with all the photographs on it.

3. The purpose of the DVD recording shall be to supply a visual and audio record of the location and condition of the sewer service entrances and problem areas of the sewer lines that are to be replaced. The CCTV recording may be replayed for analysis by the contractor and Park. DVD recording playback shall be at the same speed that it was recorded. The CONTRACTOR shall be required to have all DVDs and necessary playback equipment readily accessible for review by the Contracting Officer during the project. After the project, the CONTRACTOR shall furnish all the original DVD recordings to the Contracting Officer. The CONTRACTOR shall keep a copy of all the DVDs for 90 days after the completion of the project.

PART 2 - PRODUCTS

2.1 BYPASS PUMP ASSEMBLY

A. The contractor shall maintain a minimum of 2 bypass pump assemblies at the site in sound operating condition. Bypass pumps and equipment shall be mobilized to each work location and ready to operate as a bypass immediately in the event of a blockage.

B. Each bypass pump assembly shall include the pump, engine drive, starters, battery starter, valving, suction hose, and appurtenances, such that the equipment is fully functional and equipped for use as a bypass pump station. Muffler shall be hospital-grade regarding noise suppression. Equipment shall meet air quality exhaust criteria of the San Joaquin Valley Air Basin as applicable.

C. The Contractor shall assess the work and develop a list of bypass equipment required for approval by the Contracting Officer. The Contractor shall assume that all pipes flow at capacity for the development of the equipment list. The Contractor shall also assume that sewer service shall not be interrupted and that continuous monitoring of all bypass operations and equipment is required. See plans for flow rates.

D. A sample list of minimum materials and equipment to be provided is listed below:

QUANTITY	MATERIALS
1 each	Pumps, trailer-mounted, with a built-in 30-gallon fuel tank.
1 each	Backup/Redundant Pumps, trailer-mounted, with a built-in fuel tank.
5 each	Four-inch cam-lock male x 4-inch cam lock female, 20-foot all-weather semi-flexible suction hoses, USA Blue Book, Product No. 44132, Edition 126.
12 each	Four-inch cam lock female x 4-inch cam-lock male, 50-foot very heavy-duty PVC red lay flat discharge hoses, USA Blue Book, Product No. 44224, Edition 126.
2 each	Four-inch female cam lock x 4-inch MIPT, USA Blue Book, Product No. 22254, Edition 126.
2 each	Four-inch male cam lock plug, USA Blue Book, Product No. 62316, Edition 111.
2 each	Four-inch male iron pipe thread, USA Blue Book, Product No. 22409, Edition 111.
2 each	Four-inch companion flange, USA Blue Book, Product No. 13003, Edition 111.
2 each	Portable Spill Guards, 12’ x 15’ x 0.5’ for trailer-mounted pumps to sit while in operation.
1 each	4” x 4” x 4” suction manifold and discharge manifold with gate valves with fittings, as required.
As required	Flow-through plugs for 6-inch to 15-inch pipe with 4-inch opening for use with a suction hose equipped with air line of sufficient length to reach outside of manhole and gauge to monitor plug air pressure.
500 ft	Hard tubing for use in running across roadways with blocking and sandbags to secure against traffic loads.

2.2 CAMERA EQUIPMENT

A. Main-line Camera: Main-line camera shall be a pan and tilt-type tractor-mounted color camera with a 360° scan of the circumference and tilt to allow viewing up to 115° back from the axis of the camera. The camera shall meet the following performance criteria:

1. The camera shall have built-in titling with date, time, footage count, manhole location, and comments.
2. The camera shall be able to focus from 1/2" to infinity and be equipped with remote focus, iris, and color balance. The camera shall have a 2.5-lux rating or better.
3. The camera shall be waterproof and sealed. The camera shall have o-ring sealed windows and a double-sealed body. Any camera fogging from internal moisture shall be removed and replaced with a watertight, fog-free camera.
4. The camera shall be equipped with sufficient cable to allow over 1,000' of video inspection in a single run.

2.3 CAMERA TRANSPORT DRIVE

A. The camera transport drive assembly shall be specifically manufactured for the pipe material and diameters being inspected. The Drive unit may be track or wheel driven and shall have the capability to pull over 1,000' of cable.

B. The drive unit shall have forward, reverse, and free-wheel drive capability.

C. The Drive unit shall provide a distance counter for measuring the traveled distance based on the revolutions of the drive. The distance shall be measured in both forward and reverse and shall be to the nearest 0.1 feet.

2.4 SOFTWARE REQUIREMENTS

A. Software Requirements: Database records shall be submitted in Microsoft Access 2000. The database shall document the beginning and ending manholes, line type, size, and slope, and all assessment information gathered (i.e., locations of roots, cracks, grease, pipe sags, etc.). The database shall be set up in such a way as to allow searches for all assessment categories separately, for example, lines with medium grease or lines with severe roots. The Contractor shall enter database information no later than 7 calendar days following the CCTV inspection to facilitate accurate data entry. The contractor shall schedule re-assessments for lines with inaccurate, missing, or contradictory information discovered during database entry.

B. CCTV reporting software shall allow still image capture, real documentation of all line conditions, pipe type and size, joint type, line length, report date, recording date, beginning, and ending manholes, comments regarding access requirements, etc., location of the line, and time of day.

C. The inspection report shall be in an electronic format that includes, at a minimum, the following:

1. Summary list of all pipeline segments inspected (i.e., manhole to manhole, sub, flusher branch, or drain inlet).
2. Inspection Reports (log sheets) of each segment.
3. Video of each segment.

D. The inspection report shall be indexed and coded for easy location of each line segment, video clips, and captured images. The video and captured images shall be clear and sharp. Voice recordings on the video shall be clear, complete, and distinct. A vocal description shall be recorded at the beginning of each inspection while the "Initial Screen Text" is displayed. A voice recording shall also be performed during each observation and after each inspection.

E. The following items shall be recorded, at a minimum, as screen text on the first 15± seconds of each section:

1. Upstream and downstream manhole numbers and direction of camera's travel
2. Location and/or project name
3. Date
4. Job Number
5. TV company name, operator's name, and evaluator's name

F. The following items shall be recorded, at a minimum, as audio information for each section:

1. Date of inspection
2. Verbal confirmation of upstream and downstream manhole numbers
3. Verbal descriptions of pipe size and type
4. Verbal description and location of the defect

G. During the CCTV inspection, the running screen shall show the following information on the screen away from the central focus of the main:

1. Running footage (distance traveled)
2. Date
3. Time of day
4. A gauging tool, e.g., a three-fourths inch (¾") cylinder (size of the cylinder shall be indicated on the label), shall proceed with the camera for gauging offsets.

H. Each DVD shall be new and shall be labeled with the Project name, DVD number, and reach numbers recorded. A log shall be included with each DVD listing the upstream and downstream manholes recorded therein.

PART 3 - EXECUTION

3.1 FLOW CONTROL

A. Divert sewage flows and stormwater around all sewer cleaning areas. Furnish, install, and operate pumps, plugs, conduits, and other equipment to divert the flow of sewage around the pipeline reach in which work is to be performed. Plugs shall be designed so that all or any portion of the sewage can be released. The plug shall be provided with a tag line. The pumping system shall be of sufficient capacity to manage existing flow, plus additional flow that may occur during a rainstorm. If pumping is required on a 24-hour basis and engine drives are required, engines shall be equipped in a manner to keep noise to a minimum. The contractor shall have personnel available 24 hours a day on an on-call basis to make repairs to bypass equipment if needed while the bypass is in service.

B. Standby pumps shall be provided. Pumping shall be done in such a manner as will not damage property or create a nuisance or health menace. After the work has been completed, flow shall be restored to normal.

C. The pipe used for bypassing shall be butt-fused HDPE.

D. See plans for flow rates.

3.2 BYPASS PUMPING

A. Bypass pumping may be required during cleaning to prevent surcharge and possible overflow of the sewer system. Bypass pumping may be required to allow immediate CCTV inspection before allowing waste to enter the pipeline. The contractor shall complete a prior assessment of the existing sewer flows and include an estimate of the required pumping in the weekly cleaning schedule submittals.

B. Bypass pumping is required during pipe replacement, pipe bursting, cured-in-place pipe (CIPP), and similar activities. The contractor shall complete a prior assessment of the existing sewer flows and include an estimate of the required pumping in the weekly cleaning schedule submittals.

3.3 CLEANING

A. Pre-cleaning setup shall be following the approved SPRP as amended for the specific site to be cleaned.

B. The sewer cleaning setup shall be configured to allow the retention and removal of all rocks, gravel, pipe fragments, root cuttings, and heavy debris for disposal at an approved landfill.

C. Sewer line cleaning shall be done by use of a high-pressure jetting head in combination with a vacuum truck for the removal of solids and debris. Multiple passes shall be used to thoroughly remove accumulated non-grease materials.

D. A root cutting head shall be used if at any time the cleaning head cannot pass through a pipe due to roots. The root cutter is not required if the jetting operation can pass the entire length of the pipeline. If a root cutter is necessary, it shall be passed through the pipeline a minimum of twice. The root cutter shall be capable of cleaning a 4" pipeline, and 6" and larger pipelines with offset joints. Multiple passes with high-pressure water and chain flail cutters may be required for pipelines with offset joints.

E. The post-cleaning condition of the pipe and manholes shall be free of settled solids in the invert, accumulated non-grease solids on the pipe walls, and service taps. Failure to sufficiently clean the pipeline before CCTV inspection will result in the re-cleaning and inspection of the affected pipeline at no additional cost to the Government.

F. Cleaning of the force main and force main bypass before removal shall consist of flushing the pipe with one pipe volume of water. The flush water shall be collected in trucks and discharged to the manholes noted on the plans. Flow rates for discharge of the flush water into the manhole are noted on the plans. Spill prevention measures as stipulated in the SPRP for this specific site shall be in place for this transfer.

3.4 SOLIDS REMOVAL

A. The Contractor shall collect and remove all solids produced during cleaning as follows:

1. Remove all rock, sand, gravel, grease, and other debris collected during cleaning.
2. Report all pipe segments, pieces, or other structural elements collected during cleaning to the Contracting Officer.
3. Clean and remove all material in the upstream and downstream manholes, including in the channel, on the bench, and the walls.
4. Dispose of all removed material off-site per all local, state, and federal regulations.

3.5 TRAFFIC CONTROL

A. The contractor shall provide all required traffic control needed per the requirements of the Manual for Uniform Traffic Control Devices (MUTCD). The contractor shall provide qualified personnel to install, maintain and remove the Contracting Officer approved traffic control systems.

3.6 SEWER SYSTEM CLEANING

A. The contractor shall clean, remove debris, and dispose of the debris for the sewer system segments shown on the project drawings.

3.7 CLOSED CIRCUIT TELEVISION INSPECTION (CCTV)

A. The contractor shall CCTV all sewer system line segments shown on the project drawings in preparation for rehabilitation work of the described improvements and final after installation inspection requirements.

END OF SECTION

SECTION 33 01 30.63

POLYUREA INTERIOR COATING
(MANHOLES, GREASE INTERCEPTOR, LIFT STATION WET WELL & OVERFLOW STORAGE)

PART 1 - GENERAL

1.1 SUMMARY

A. The work under this section consists of furnishing all necessary labor, equipment, materials and performing all operations in connection with the factory application of a 100% solids polyurea monolithic coating to the following precast concrete items as indicated in the Project Specifications and Plans:

1. Manholes (bottoms, barrels, cones, and riser rings) frame and cover excluded,
2. Grease interceptor (all interior surfaces),
3. Lift Station wet wells (all precast concrete surfaces),
4. Lift station emergency overflow storage tank (all interior surfaces).

B. Included in this specification are the required work, materials, equipment, and tools including specially developed application equipment as required for the installation of a factory-applied unique monolithic interior surfacing system. The use of specialized equipment combined with rigorous surface preparation requirements shall be used to apply the products. Product application requirements and procedures described herein include surface preparation, mixing application, material handling, and storage, qualification of the applicator, and application quality control.

C. The condition of the structures to receive the protective coating will be classified per the following criteria:

Condition	Description
New	New structures that have not been exposed to the sanitary sewer.

D. The minimum coating thickness shall be as described in the following table:

Type of Structure	Condition	Minimum Coating Thickness (mils)
Manhole (precast)	New	125
Grease Interceptor (precast)	New	125
Lift Station Wet Well (precast)	New	125
Wet Well Overflow Storage Tank (precast)	New	125

1.2 REFERENCES

A. The following standards are hereby incorporated into these specifications by reference:

1. ASTM C297 - Flatwise Tensile Strength of Sandwich Constructions.
2. ASTM D638 - Tensile Properties of Plastics
3. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
4. ASTM D543 - Resistance of Plastics to Chemical Reagents
5. ASTM D624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
6. ASTM D695 - Compressive Strength of Rigid Plastics
7. ASTM D790 - Flexural Properties of Un-reinforced and Reinforced Plastics
8. ASTM D1653 - Water Vapor Transmission of Organic Coating Films
9. ASTM D2584 - Volatile Matter Content
10. ASTM D2240 - Durometer Hardness, Type A and Type D
11. ASTM D4541 - Pull-off Strength of Coatings Using a Portable Adhesion Tester
12. ASTM G2010 - Standard Test Method for Chemical Resistance of Pipeline Coatings
13. ASTM - The published standards of the American Society for Testing and Materials, West Conshohocken, PA.
14. NACE - The published standards of the National Association of Corrosion Engineers (NACE International), Houston, TX.

1.3 SUBMITTALS

A. All submittals shall be submitted per the applicable portions of these specifications.

B. The Contractor shall submit the following information from the precast concrete supplier to the Contracting Officer for approval before placing orders for precast concrete components as described in the specifications and drawings.

1. Manufacturer’s data sheets for the coating materials.
2. Certification of factory applicator and factory quality assurance manager:
    a. The coating system shall be factory applied by an Applicator certified by the Coatings System manufacturer. The certification program shall include an annual renewal. The training outline for the certification program shall be submitted to the Contracting Officer for review and approval. The Contractor shall provide evidence that the manufacturer’s personnel performing the product factory application for each product has received the manufacturer's training for certification.
    b. The factory Applicator shall appoint a factory Quality Assurance Manager to take full responsibility for the quality of the work. The Quality Assurance Manager shall be fully certified and have a minimum of 2 years of application experience with the particular coating system.
3. Polyurea Coating Systems Factory Installed Application Plan as outlined in subsection 3.2. D.
4. Third-party test results verifying the physical properties of the coating materials meet or exceed the requirements of these specifications and are following ASTM G20-10, modified for use with concrete.

5. Factory Applicator's procedures for preparing the surface of the structure and installing the coating system.
6. Documentation that the factory Applicator of the coating has been trained and certified by the Manufacturer and meets the experience requirements of these specifications.

PART 2 – PRODUCTS

2.1 COATINGS

A. The coating system shall be a spray-applied 100% polyurea surfacing system for use in coating new precast concrete manholes, grease interceptors, lift station wet well and emergency overflow storage tank precast concrete structures. All products to be used on this project must be pre- approved by the Contracting Officer before the bid date. The following products have been pre-approved for use on this project.

1. Specialty Products Incorporated: POLYSHIELD HT™ 100F, or equal

B. The contractor shall supply the Government with 1 case of caulking tube patching material consisting of a one-part polyurethane for future operational and maintenance patching of joints and damaged surfaces from normal system operational use. The following product has been pre-approved.

1. Sika Corporation: Sikaflex®-1a+, or equal

2.2 REQUIREMENTS

A. To be considered an equal, a product must have the following minimum physical characteristics as measured by the applicable ASTM Standards referenced herein.

1. Minimum Tensile Strength (ASTM D638): 3,700 psi
2. Elongation (ASTM D638): +/- 300%
3. Hardness - Shore A (ASTM D2240-81): 97 +/- 5
4. Hardness - Shore D (ASTM D2240-81): 47 +/- 5
5. 100% Modulus (ASTM D412): 1,600psi +/- 100
6. 300% Modulus (ASTM D412): 3,500psi +/- 100
7. Tear Resistance (ASTM D624): 483 PLI +/-50
8. Service Temperature -60° F to +250° F
9. Minimum corrosion resistance is suitable for environments pH of 0.5 or higher.

B. Other manufacturers or products seeking pre-approval must submit the following documentation to the Contracting Officer a minimum of 2 weeks before the bid date. This time frame allows the Contracting Officer ample time to determine if the proposed product is an acceptable alternative.

1. Documentation that the proposed product meets the above minimum physical characteristics including results of testing performed by a bonded, third-party testing company.

2. An affidavit attesting to the successful use of the product as a protective coating for concrete structures for a minimum continuous period of 5 years in wastewater conditions recognized as corrosive or otherwise detrimental to concrete.
3. A verifiable list of references that document the successful manufacturer factory-applied lining and use of the product in a minimum of 250,000 sq ft of sanitary sewer precast concrete structures.
4. All additional products that are pre-approved by the Contracting Officer shall be identified in an addendum issued before the bid date.

PART 3 – EXECUTION

3.1 INSTALLER QUALIFICATIONS

A. All polyurea lining products must be factory applied in a controlled environment at the precast concrete manufacturer's applicator's facility by a factory Installer that has been trained and certified by the coating system's manufacturer.

B. The factory Installer must provide verifiable documentation of the above certification and the successful installation of 125,000 sq ft of the product in sanitary sewer precast concrete structures.

3.2 QUALITY ASSURANCE

A. Factory Applicator shall initiate and enforce quality control procedures consistent with applicable ASTM standards.

B. Factory Applicator shall use an adequate number of skilled workers who are thoroughly trained and experienced in the necessary crafts. These workers shall be completely familiar with the specified requirements and the methods needed for the proper performance of the work of this Section.

C. Factory Applicator shall use approved specialty equipment adequate in size, capacity, and number sufficient to accomplish the work of this Section promptly.

D. A Coating System Factory Applied Application Plan shall be prepared that includes a description of the following:

1. Quality Assurance Procedures
    a. Detailed duties of the factory Applicator's Quality Assurance Manager.
    b. Detailed duties of the Manufacturer's Representative.
    c. Training program to qualify personnel in the correct storage and handling of coating materials, and the necessary safety requirements.
    d. List of factory application and testing equipment to be used, including inspections confirming the satisfactory condition of the equipment.
    e. Detailed procedures and methods for surface preparation including repair and re-profiling if required, application of primer and the final coating, and testing.

2. Criteria for acceptance of the preparation of precast concrete structure surfaces.
3. Detailed plan of surface preparation, including repair and re-profiling.
4. Details of application of primer and finish coats, including required curing times.
5. Detailed environmental provisions such as shading from the sun.
6. Testing procedures for pinholes, coating thickness, and adhesion.
7. Wet film thickness testing.

3.3 SAFETY

A. The applicator shall perform his work in a manner to protects the health and safety of all workers.

B. All work shall be per standard industry safety practices.

C. All work, including entry into confined spaces, shall be performed in strict compliance with current OSHA regulations.

3.4 PRE-COAT INSPECTION

A. The factory applicator's vehicles and equipment must be able to access the structures to be coated under their power.

B. Installation of the protective coating shall not commence on any surfaces containing freshly cast precast concrete until the concrete substrate has properly cured, and in no case less than 28 days unless the concrete substrate can pass a specific moisture test as specified by the protective coating manufacturer's meeting the manufacturer's requirements and recommendations.

3.5 SURFACE PREPARATION

A. Factory Applicator shall inspect all surfaces specified to receive the monolithic surfacing system before surface preparation. Factory Applicator shall re-profile any noticeable disparity in the surfaces that may interfere with the proper preparation or application of the monolithic surfacing system.

B. All concrete that is not sound or has been damaged shall be restored to a sound concrete surface through proper re-profiling. All contaminants including all oils, grease, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants shall be removed.

C. Surfaces to receive protective coating shall be cleaned to produce a sound concrete surface with adequate profile and porosity to provide a strong bond between the monolithic surfacing system and the substrate. Surface preparation methods shall be based upon the conditions of the substrate and the requirements of the monolithic surfacing system to be applied, but as a minimum, shall be per the procedures listed below.

1. Clean all surfaces using either abrasive blasting and/or high-pressure water blast as recommended by the coating and/or repair product manufacturer to remove all loose or contaminated debris. Other equipment and methods may be required to remove all unsound material.
2. Where mechanical cleaning is accomplished by blast cleaning, the abrasive used shall be washed, graded, and free of contaminants, which might interfere with the adhesion of the coatings. The air used for blast cleaning shall be sufficiently free of oil and moisture to not cause detrimental contamination of the surfaces to be coated. All concrete or mortar that is not sound or has been damaged by chemical exposure shall be removed to a sound, neutralized surface.
3. The finished interior surface shall consist of sound concrete with adequate profile and porosity to provide a strong bond between the necessary repair materials and/or coating and the substrate.
4. When all loose, contaminated, and unsound debris has been removed, the surface shall be etched with a solution of 20% muriatic acid to clean and open the pores of the substrate.
5. The surface shall be washed again, and the wash water shall contain a dilute solution of chlorine to diminish microbiological bacteria growth and to kill any bacteria residing on the surface.
6. Test prepared surfaces after cleaning but before application of the polyurea coating system to determine pH and moisture content of the concrete, as required according to the manufacturer's recommendations surface shall be tested at various points throughout the structure to ensure that the pH is within the manufacturer's acceptable limits. If the surface does not meet the pH requirements, the above steps shall be repeated until the surface pH is within acceptable limits. All testing results will be retained for review by the Contracting Officer.

D. Defect repair of all surface defects including tie holds any honeycombing or otherwise defective concrete shall be repaired. All voids, holes, and rough or irregular surfaces shall be filled.

1. The factory Applicator shall use the repair and fill material recommended by the coating manufacturer to repair or fill all defects. Areas to be patched shall be cleaned. Minor honey- combed or otherwise defective areas shall be removed to solid concrete. The edges of the cut shall be perpendicular to the surface of the concrete. Patches on exposed surfaces shall be finished to match the adjoining surfaces after they have been set. Finishes shall be equal in workmanship, texture, and general appearance to that of the adjacent undamaged concrete. Concrete with honeycombing which exposes the reinforcing steel or with defects that affect the structural strength shall be repaired. The proposed repair method shall be approved by the precast concrete manufacturer.

3.6 APPLICATION

A. The interior surfacing system shall be applied to the following interior component surfaces:

1. Manholes (bottoms, barrels, cones, and riser rings) frame and cover excluded,
2. Grease interceptor (all interior surfaces),
3. Lift Station wet wells (all precast concrete surfaces),
4. Lift station emergency overflow storage tank (all interior surfaces).

B. All Coatings shall be applied in strict accordance with the manufacturer's requirements and recommendations. ALL EXPOSED SURFACE AREAS OF THE STRUCTURE INCLUDING THE WALLS, CEILING, FLOOR, INVERT, BENCH, BARREL SECTIONS, CONE, AND RISER RINGS SHALL BE COATED.

C. Confirm that the ambient temperature and humidity, the prepared surface temperature and moisture content, and the temperature of the coating material to be applied are within the manufacturer's recommended ranges. Coatings shall be applied at a time of day when the ambient temperature and humidity are expected to be steady or falling.

D. The prime and finish coast (as applicable) shall be a contrasting color. The color of the final coat shall be grey.

E. Ensure that pump, hoses, gun, tip, and pressure are properly matched for the coating to be applied. Ensure that the application equipment has been properly cleaned before the application of coating. Test spray pattern for uniformity of distribution.

F. Protect surfaces from rapid drying due to heavy wind or hot sun.

G. Cure coatings in strict accordance with the manufacturer's recommendations, before putting them into service. Drying time between coats shall be as recommended by the coating manufacturer.

H. The coating shall be applied to a minimum thickness of 125 mils in a single coat when possible. If the application of a single coat at the required thickness is not possible, multiple coats may be applied per the manufacturer’s instructions and within the time allowed for proper application.

I. The interior surfacing system shall be continuously bonded to all concrete, chemical sealant, grout, pipe, and other surfaces inside the manhole according to ASTM C882 testing and therefore shall be designed for hydrostatic loading.

J. When cured, the system shall form a continuous, tight-fitting, hard, impermeable surfacing that is suitable for sewer system service and chemically resistant to any chemicals, bacteria, or vapors normally found in domestic sewage.

K. The system shall effectively seal the interior surfaces of the precast structure and prevent any penetration or leakage of groundwater infiltration.

L. The system shall be compatible with the thermal conditions of the existing sewer system.

M. Application procedures shall conform to the recommendations of the interior surfacing system manufacturer, including material handling, mixing, and environmental controls during the application, safety, and equipment.

N. The factory Applicator’s equipment shall be specially designated to accurately ratio and apply the specified materials and shall be regularly maintained and in proper working order.

O. The specified materials must be applied by an approved factory applicator of the monolithic surfacing system.

P. Specially designed spray and/or spin-cast application equipment shall be used to apply each coat of the system.

Q. The factory Applicator shall follow the coating manufacturer's requirements for bonding the coating systems to the installed sewer liner, if applicable.

3.7 QUALITY ASSURANCE

A. The applicator shall initiate and enforce quality control procedures consistent with applicable ASTM standards.

B. The applicator shall use an adequate number of skilled workers who are thoroughly trained and experienced in the necessary crafts. These workers shall be completely familiar with the specified requirements and the methods needed for the proper performance of the work of this Section.

C. The applicator shall use approved specialty equipment adequate in size, capacity, and number sufficient to accomplish the work of this Section promptly.

3.8 TESTING AND INSPECTION

A. During application, a wet film thickness gage, such as those available through Paul N. Gardner Company, Inc. meeting ASTM D4414 – Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gages, shall be used to ensure a monolithic coating and uniform thickness during application.

B. The Contracting Officer and Applicator shall make a final visual inspection. Any deficiencies in the finished system shall be marked and repaired according to the procedures set forth herein by Applicator.

PART 4 – WARRANTY

4.1 TEN YEAR WARRANTY

A. All approved products must provide a 10-year performance limited warranty that the installed product will:

1. Stop deterioration of the lined surfaces by sewer gas-induced corrosion.
2. Prevent infiltration of groundwater into the collection system through the lined surfaces.
3. Stop root intrusion through the lined surfaces

END OF SECTION

SECTION 33 01 30.82

EPOXY INTERIOR COATING - FIELD APPLIED

PART 1 - GENERAL

1.1 SUMMARY

A. The work under this section consists of furnishing all necessary labor, equipment, and materials and performing all operations in connection with the install 100% solids epoxy monolithic coating to the walls, benches, and inverts of wet well to the specified surfaces of the sanitary sewer structures.

B. Included in this specification is the required work, materials, equipment, and tools including specially developed application equipment as required for installation of a field applied unique monolithic interior surfacing system. The use of specialized equipment combined with rigorous surface preparation requirements shall be used to apply the products without the use of solvents. The equipment adds high heat and pressure to the monolithic surfacing system resulting in a high build and quick set of the completed system. Product application requirements and procedures described herein include surface preparation, mixing application, material handling, and storage, qualification of the applicator, and application quality control.

C. The condition of the structures to receive the protective coating will be classified per the following criteria:

Condition	Description
Existing	Existing structures have been exposed to sanitary sewer. No evidence of infiltration.
A	Minimal damage. Minimal evidence of exposure to sanitary sewer gases. No evidence of infiltration.
B	Moderate damage such as missing mortar between bricks in brick manholes, and some exposed aggregates in concrete structures. Moderate evidence of exposure to sanitary sewer gases. Evidence of minimal infiltration.
C	Severe damage such as missing bricks in brick manholes severely exposed aggregates or exposed reinforcing steel in concrete structures. Severe evidence of exposure to sewer gases. Evidence of moderate infiltration.

D. The minimum coating thickness shall be as described in the following table:

Type of Structure	Condition	Minimum Coating Thickness (mils)
Wet well or Lift Station	A	200
Wet well or Lift Station	B	250
Wet well or Lift Station	C	350

1.2 REFERENCES

A. The following standards are hereby incorporated into these specifications by reference:

1. ASTM D638 - Tensile Properties of Plastics
2. ASTM D790 - Flexural Properties of Un-reinforced and Reinforced Plastics
3. ASTM D695 - Compressive Strength of Rigid Plastics
4. ASTM D4541 - Pull-off Strength of Coatings Using a Portable Adhesion Tester
5. ASTM D2584 - Volatile Matter Content
6. ASTM D2240 - Durometer Hardness, Type D
7. ASTM D1653 - Water Vapor Transmission of Organic Coating Films
8. ASTM D543 - Resistance of Plastics to Chemical Reagents
9. ASTM C297 - Flatwise Tensile Strength of Sandwich Constructions.
10. ASTM - The published standards of the American Society for Testing and Materials, West Conshohocken, PA.
11. NACE - The published standards of the National Association of Corrosion Engineers (NACE International), Houston, TX.

1.3 SUBMITTALS

A. All submittals shall be submitted per the applicable portions of these specifications.

B. The Contractor shall submit the following information to the Contracting Officer for approval before beginning the installation of the protective coating.

1. Manufactures datasheets for the coating materials
2. Third-party test results verifying the physical properties of the coating materials meet or exceed the requirements of these specifications.
3. Applicator’s procedures for preparing the surface of the structure and installing the coating system.
4. Documentation that the Applicator of the coating has been trained and certified by the Manufacturer and meets the experience requirements of these specifications.

PART 2 – PRODUCTS

2.1 COATING SYSTEM

A. The coating system shall be a spray-applied 100% solids epoxy monolithic surfacing system for use in coating existing manholes, lift station wet wells, treatment plants, and other structures. All products to be used on this project must be pre- approved by the Contracting Officer before the bid date. The following products have been pre-approved for use on this project.

1. S-301 by Warren Environmental, Inc
2. ARC S1HB by A. W. Chesterton Company

B. To be considered an equal, a product must have the following minimum physical characteristics as measured by the applicable ASTM Standards referenced herein.

Minimum Compressive Strength.....12,000 psi
Minimum Tensile Strength.....7,000 psi
Minimum Flexural Strength .....11,000 psi
Minimum Bond Strength.....500 psi
Minimum corrosion resistance is suitable for environments pH of 0.5 or higher.

C. Other manufacturers or products seeking pre-approval must submit the following documentation to the Engineer a minimum of two weeks before the bid date. This time frame allows the Engineer ample time to determine if the proposed product is an acceptable alternative.

1. Documentation that the proposed product meets the above minimum physical characteristics including results of testing performed by a bonded, third-party testing company.
2. An affidavit attesting to the successful use of the product as a protective coating for concrete or masonry structures for a minimum continuous period of 5 years in wastewater conditions recognized as corrosive or otherwise detrimental to concrete and masonry.
3. A verifiable list of references that document the successful installation and use of the product in a minimum of 750,000 square feet of sanitary sewer structures.

D. All additional products that are pre-approved by the Engineer shall be identified in an addendum issued before the bid date.

PART 3 – EXECUTION

3.1 INSTALLER QUALIFICATIONS

A. All products must be installed by an Installer that has been trained and certified by the manufacturer.

B. The Installer must provide verifiable documentation of the above certification and the successful installation of 250,000 square feet of the product in sanitary sewer structures.

3.2 QUALITY ASSURANCE

A. Applicator shall initiate and enforce quality control procedures consistent with applicable ASTM standards.

B. Applicator shall use an adequate number of skilled workers who are thoroughly trained and experienced in the necessary crafts. These workers shall be completely familiar with the specified requirements and the methods needed for the proper performance of the work of this Section.

C. Applicator shall use approved specialty equipment adequate in size, capacity, and number sufficient to accomplish the work of this Section promptly.

3.3 SAFETY

A. The applicator shall perform his work in a manner to protect the health and safety of all workers and the public.

B. All work shall be per standard industry safety practices.

C. All work, including entry into confined spaces, shall be performed in strict compliance with current OSHA regulations.

3.4 PRE-COAT INSPECTION

A. The applicator's vehicles and equipment must be able to access the structures to be coated under their power.

B. Active flows shall be dammed, plugged, or diverted as required to ensure that the liquid flow is maintained below the surfaces to be coated.

C. Installation of the protective coating shall not commence on any surfaces containing freshly poured concrete until the concrete substrate has properly cured and in no case less than 28 days.

3.5 SURFACE PREPARATION

A. The applicator shall inspect all surfaces specified to receive the monolithic surfacing system before surface preparation. The applicator shall promptly notify the Contracting Officer of any noticeable disparity in the surfaces that may interfere with the proper preparation or application of the monolithic surfacing system.

B. All concrete that is not sound or has been damaged by chemical exposure shall be restored to a sound concrete surface. All contaminants including all oils, grease, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants shall be removed.

C. Surfaces to receive protective coating shall be cleaned to produce a sound concrete or masonry surface with adequate profile and porosity to provide a strong bond between the monolithic surfacing system and the substrate. Surface preparation methods shall be based upon the conditions of the substrate and the requirements of the monolithic surfacing system to be applied, but as a minimum, shall be per the procedures listed below.

1. Clean all surfaces with high-pressure water to remove all loose or contaminated debris. Other equipment and methods may be required to remove all unsound material.
2. When all loose, contaminated, and unsound debris has been removed, the surface shall be etched with a solution of 20% muriatic acid to clean and open the pores of the substrate.
3. The surface shall be washed again, and the wash water shall contain a dilute solution of chlorine to diminish microbiological bacteria growth and to kill any bacteria residing on the surface.
4. The surface shall be tested with litmus paper at various points throughout the structure to ensure that the pH is within acceptable limits (not to exceed 8.5). If the surface does not meet the pH requirements, the above steps shall be repeated until the surface pH is within acceptable limits. All testing results will be retained for review by the Engineer.
5. Active water infiltration shall be stopped by using a cementitious water plug that is compatible and suitable for top coating with the specified monolithic surfacing system.
6. If pre-installation inspection reveals infiltration (defined as the visible and consistent movement of water) through the wall of the structure, a collapse in an area of the wall, a bench that needs to be rebuilt/repaired, a necessity for sandblasting (if necessary after surface preparation as described in the specification) or anything that will require more than typical preparation of the structure, the contractor will advise the COR. Such extra work will be approved in writing by the Contracting Officer before the commencement of the work and shall be considered as a separate pay item.

3.6 APPLICATION

A. The interior surfacing system shall be applied to the chimney, walls, bench, and invert of all manholes and to the specified surfaces of all other structures.

B. The interior surfacing system shall be continuously bonded to all brick, mortar, concrete, chemical sealant, grout, pipe, and other surfaces inside the manhole according to ASTM C882 testing and therefore shall be designed for hydrostatic loading.

C. The cured surfacing shall be monolithic with proper sealing connections to all un-surfaced areas and shall be placed and cured in conformance with the recommendations of the monolithic surfacing system manufacturer.

D. When cured, the system shall form a continuous, tight-fitting, hard, impermeable surfacing that is suitable for sewer system service and chemically resistant to any chemicals, bacteria, or vapors normally found in domestic sewage.

E. The system shall effectively seal the interior surfaces of the manhole and prevent any penetration or leakage of groundwater infiltration.

F. The system shall be compatible with the thermal conditions of the existing sewer manhole surfaces.

G. Heated, plural component, specially designed equipment for use in the spray or spin-cast application of the specified system approved for use by the monolithic surfacing system manufacturer.

H. Application procedures shall conform to the recommendations of the interior surfacing system manufacturer, including material handling, mixing, and environmental controls during the application, safety, and equipment.

I. The equipment shall be specially designated to accurately ratio and apply the specified materials and shall be regularly maintained and in proper working order.

J. The specified materials must be applied by an approved installer of the monolithic surfacing system.

K. The walls and bench and invert of the structure shall be lined with the monolithic surfacing system to provide a thickness as previously specified based on the condition of the existing structure. The cured surfacing shall be monolithic with proper sealing connections to all un-surfaced areas and shall be placed and cured per the recommendations of the monolithic surfacing system manufacturer.

L. Specially designed spray and/or spin-cast application equipment shall be used to apply each coat of the system.

3.7 QUALITY ASSURANCE

A. Applicator shall initiate and enforce quality control procedures consistent with applicable ASTM standards.

B. Applicator shall use an adequate number of skilled workers who are thoroughly trained and experienced in the necessary crafts. These workers shall be completely familiar with the specified requirements and the methods needed for the proper performance of the work of this Section.

C. Applicator shall use approved specialty equipment adequate in size, capacity, and number sufficient to accomplish the work of this Section promptly.

3.8 TESTING AND INSPECTION

A. During application, a wet film thickness gage, such as those available through Paul N. Gardner Company, Inc. meeting ASTM D4414 - Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gages, shall be used to ensure a monolithic coating and uniform thickness during application.

B. The Engineer and Applicator shall make a final visual inspection. Any deficiencies in the finished system shall be marked and repaired according to the procedures set forth herein by Applicator.

PART 4 – WARRANTY

4.1 TEN YEAR WARRANTY

A. All approved products must provide a ten-year performance limited warranty that the installed product will:

1. Stop deterioration of the lined surfaces by sewer gas-induced corrosion.
2. Prevent infiltration of groundwater into the collection system through the lined surfaces.
3. Stop root intrusion through the lined surfaces.

END OF SECTION

SECTION 33 05 00

COMMON WORK RESULTS FOR UTILITIES

PART 1 - GENERAL

1.1 SUMMARY

A. The work in this Section includes exterior utility systems five feet and beyond any buildings.

B. This section includes the work necessary for the installation of utility piping.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO)

1. M252, Standard Specification for Polyethylene Corrugated Drainage Tubing
2. M294, Corrugated Polyethylene Pipe, 12” - 24” diameter

B. American National Standards Institute (ANSI)

1. B16.3, Malleable Iron Threaded Fittings
2. B16.5, Pipe Flanges and Flanged Fittings
3. B16.9, Factory-Made Wrought Steel Butt-welding Fittings
4. B16.12, Cast Iron Threaded Drainage Fittings
5. B16.22, Wrought Copper, and Copper Alloy Solder Joint Pressure Fittings
6. B31.1, Power Piping
7. B31.3, Chemical Plant and Petroleum Refinery Piping
8. B31.9, Building Services Piping
9. B40.1, Gauges - Pressure Indicating Dial Type - Elastic Element

C. American Society for Testing and Materials (ASTM)

1. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded, and Seamless
2. A74, Standard Specification for Cast Iron Soil Pipe Fittings
3. A106, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
4. A197, Standard Specification for Cupola Malleable Iron
5. A234, Standard Specification for Pipe Fittings of Wrought Carbon Steel Alloy Steel for Moderate and Elevated Temperatures
6. A269, Standard Specification for Seamless and Welded Austenitic Stainless-Steel Tubing for General Service
7. A518, Corrosion - Resistant High - Silicon Iron Castings
8. A774, As-Welded Wrought Austenitic Stainless-Steel Fittings for General Corrosive Service at Low and Moderate Temperatures
9. A778, Welded, Unannealed Austenitic Stainless Steel Tubular Products
10. B86, Standard Specification for Zinc
11. B88, Standard Specification for Seamless Copper Water Tube

12. B306, Copper Drainage Tube CDWV
13. C76, Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
14. C361, Standard Specification for Reinforced Concrete Low Head Pressure Pipe
15. C443, Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
16. C564, Rubber Gaskets for Cast Iron Soil Pipe and Fittings
17. C924, Standard Practice for Testing Concrete Sewer Lines by Low Air Pressure Test Methods
18. C1103, Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
19. D1248, Polyethylene Plastics Molding and Extension Materials
20. D1785, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
21. D2241, Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
22. D2466, Socket Type PVC Plastic Pipe Fittings, Schedule 40
23. D2467, Standard Specification for Socket-Type Poly (Vinyl Chloride)
24. D2997, Standard Specification for Centrifugally Cast Thermosetting Plastic Pipe
25. D3034, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
26. D3350, Continuous Outdoor Use (UV)
27. D4101, Polypropylene Plastic Injection and Extrusion Materials
28. F1417, Installation Acceptance of Plastic Gravity Sewer Lines Using Low Pressure Air
29. F438, Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
30. F439, Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedule 80
31. F441, Standard Specification for Chlorinated Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40 and 80
32. F679, Standard Specifications for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
33. F794, Standard Specification for Poly (Vinyl Chloride) (PVC) Rubber Gravity Sewer Pipe and Fittings based on Controlled Inside Diameter
34. F1417, Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low Pressure Air
35. F2164, Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure.
36. F2206, Standard Specification for Fabricated Fittings of Butt-Fused Polyethylene (PE) Plastic Pipe, Fittings, Sheet Stock, Plate Stock, or Block Stock

D. American Water Works Association (AWWA)

1. C104, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
2. C110, Ductile Iron and Gray Iron Fittings, three (3) inch through forty-eight (48) inch for Water and Other Liquids
3. C111, Rubber Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fitting
4. C115, Flanged Ductile Iron Pipe with Threaded Flanges
5. C151, Ductile Iron Pipe, Centrifugally Cast, in Metal Molds or Sand-Lined Molds for Water or Other Liquids
6. C153/A21.53, American National Standard for Ductile-Iron Compact Fittings, three (3) inch through twenty-four (24) inch and fifty-four (54) inch through sixty-four (64) inch, for Water Service.

7. C200, Steel Water Pipe 6 inch and Larger
8. C203, Coal Tar Protective Coatings and Linings for Steel Water Lines - Enamel and Tape - Hot Applied
9. C205, Cement Mortar Lining and Coating for Steel Water Pipe four (4) inch and Larger, Shop Applied
10. C207, Steel Pipe Flanges for Waterworks Service - Sizes four (4) inch through one hundred forty-four (144) inch
11. C208, Dimensions for Fabricated Steel Water Pipe Fittings
12. C210, Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
13. C214, Tape Coating Systems for the Exterior of Steel Water Pipelines
14. C600-99, Installation of Ductile-Iron Water Mains and Their Appurtenances
15. C605-94, Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
16. C606, Grooved and Shouldered Joints
17. C651, Disinfection of Water Mains
18. C900, Polyvinyl Chloride (PVC) Pressure Pipe four (4) inch through twelve (12) inch for Water
19. C905, Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters fourteen (14) inch through thirty-six (36) inch
20. C906, Polyethelene (PE) Pressure Pipes and Fitting (Revised to Incorporate PE4710)
21. M11, Steel Pipe - A Guide for Design and Installation
22. Cast Iron Soil Pipe Institute (CISPI)
23. CISPI301, Hubless Cast Iron Sanitary System with No Hub Pipe and Fittings
24. CISPI310, Coupling for Use in Connection with Hubless Cast Iron and Fittings for Sanitary and Stormdrain, Waste, and Vent Piping Applications

E. Plastic Pipe Institute – Handbook of PE Pipe, 2nd Edition.

1. To include Technical Reports and Technical Notes (http://www.plasticpipe.org/publications/pe_handbook.html)
   a. Technical Notes #46, “Guidance for Field Hydrostatic Testing of High Density Polyethylene Pressure Pipelines: Owner’s Considerations, Planning, Procedures, and Checklists TN-46/2013”.

F. National Electric Manufacturer’s Association (NEMA)

1. ICS6, Enclosures for Industrial Controls and Systems

G. National Fire Protection Association (NFPA)

1. 54, National Fuel Gas Code

1.3 DELIVERY, STORAGE, AND HANDLING

A. The pipe should be stored, if possible, at the job site in unit packages provided by the manufacturer. Caution should be exercised to avoid compression damage or deformation to the bell ends of the pipe. The pipe should be stored in such a way as to prevent sagging or bending and protected from exposure to direct sunlight by covering it with an opaque material while

permitting adequate air circulation above and around the pipe. Gaskets should be stored in a cool, dark place out of the direct rays of the sun, preferably in original cartons.

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

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

D. Protect pipe coating during handling using methods recommended by the manufacturer. Use of bare cables, chains, hooks, metal bars, or narrow skids in contact with the coated pipe is not permitted.

E. Prevent damage to the pipe during transit. Repair abrasions, scars, and blemishes. If repair of satisfactory quality cannot be achieved, replace damaged material immediately. Accept valves on-site in shipping containers with labeling in place. Inspect for damage.

F. Provide temporary protective coating on cast iron and steel valves.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Furnish piping, fittings, and appurtenances per the Pipe Schedule as shown on the Drawings.

B. Non-HDPE Pipe sizes indicated are nominal inside diameter.

C. Use straight, round pipe.

D. For temporary piping not specifically addressed in Piping Schedule, utilize materials, joints, and fittings equal to those specified for similar applications of permanent construction.

2.1 BEDDING AND COVER MATERIALS

A. Bedding and Backfill: As specified in “Utility Excavation & Backfill” - Section 31 23 33.

PART 3 - EXECUTION

3.1 EXTERIOR PIPING ERECTION/INSTALLATION/APPLICATION

A. Lining-up Push-on Joint Piping

1. Lay piping on route lines shown on the Drawings.
2. Deflect from straight alignments or grades by vertical or horizontal curves.
3. The maximum offset between extended centerlines of any 2 adjacent pipe lengths is in strict accordance with the pipe manufacturers published literature on deflections and offsets.

4. Provide special bends when specified or where required alignment exceeds allowable deflections stipulated.
5. Provide shorter lengths of pipe in such length and number that angular deflection of any joint, as represented by specified maximum deflection, is not exceeded.

3.2 GENERAL PIPE TRENCHING

A. Excavate and backfill trench as specified in Section 31 23 00 - Excavation & Fill.

B. Install piping as shown, specified, and as recommended by the pipe and fittings manufacturer.

C. In event of a conflict between the manufacturer's recommendations and the Contract Documents, request an interpretation from the Contracting Officer before proceeding.

D. Lay pipe in only suitable weather with good trench conditions. Never lay pipe in water except approved by Contracting Officer.

E. Exercise care to avoid flotation when installing pipe in cast-in-place concrete, and in locations with high groundwater.

F. On steep slopes, take measures acceptable to the Contracting Officer to prevent movement of pipe during installation.

G. Hand trim excavation for accurate placement of pipe to elevations indicated.

H. The Contracting Officer will observe excavations and bedding before laying pipe by the Contractor. Notify the Contracting Officer in advance of excavating, bedding, pipe laying, and backfilling operations.

I. Backfill around sides and to top of the pipe with backfill material, tamp in place and compact, then complete backfilling.

J. Before installation, inspect and verify the condition of piping and appurtenances. Installation constitutes the installer's acceptance of product conditions for satisfactory installation.

K. The pipe shall be cleaned of all foreign matter, and water shall be kept out of trenches until joints have been completed. When WORK is not in progress, open ends of pipe and fittings shall be securely closed to keep foreign matter and animals from entering.

L. Correct defects or conditions which may interfere with or prevent a satisfactory installation.

M. The contractor shall inspect each pipe and fitting before installation to ensure that there are no damaged portions of the pipe. Pipe damage before completion of the project shall be repaired or replaced by the Contractor.

N. Do not place blocking under the pipe, unless specifically approved by the Contracting Officer for special conditions.

O. Where plugging is required for phasing of the Work or subsequent connection of piping, install watertight, permanent type plugs, caps, or bulkhead acceptable to the Contracting Officer.

P. Proper facilities shall be provided for lowering sections of pipe into trenches. Under no circumstances shall pipe, fittings, or any other material be dropped or dumped into trenches.

Q. Start laying pipe at the lowest point and proceed towards higher elevations, unless otherwise approved by the Contracting Officer.

R. Pipe, fittings, and accessories shall be carefully inspected after installation and those found defective shall be rejected. Pipe and fittings shall be free from fins and burrs. Pipe, fittings, and accessories shall be maintained in a clean condition.

S. Assure exposed piping is sufficiently supported to bear the weight of the valve when it is installed.

T. Before joining piping, thoroughly clean and wipe joint contact surfaces and then properly dress and make joint.

U. Unless otherwise shown on the Drawings, provide a minimum of 30 inches of earth cover over exterior buried piping systems and appurtenances conveying water, fluids, or solutions subject to freezing, or as indicated on the drawings and as directed by the Contracting Officer.

V. Install pipelines to alignment and grade indicated or established in the field.

3.3 CONNECTIONS WITH EXISTING PIPING

A. Verify that existing pipe and pipe fittings size, location, and invert are as indicated.

B. Where the connection between new work and existing work is made, use suitable and proper fittings to suit conditions encountered.

C. Perform connections with existing piping at the time and under conditions that will least interfere with service to those affected by such operation.

D. Utilize suitable equipment and facilities to dewater, drain, and dispose of liquid removed without damage to the surrounding area.

E. Where connections to existing systems necessitate the employment of past installation methods not currently part of trade practice, utilize necessary special piping components.

END OF SECTION

SECTION 33 05 61

CONCRETE MANHOLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Manholes and appurtenances.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM A48, Gray Iron Castings (Class 35 Minimum)
2. ASTM C1244, Concrete Sewer Manhole Negative Air Pressures (Vacuum) Test
3. ASTM C150, Portland Cement
4. ASTM C478, Precast Reinforced Concrete Manhole Sections

1.3 SUBMITTALS

A. See Section 01 33 23.

B. Include detailed diagrams of manholes showing typical components and dimensions.

C. Itemize, on a separate schedule, a sectional breakdown of each manhole structure with all components and refer to drawing identification number or notation.

D. Indicate knockout elevations for all piping entering each manhole.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Manhole steps, rings, covers, and frames:
   a. Neenah Foundry
   b. Deeter Foundry
   c. J Mark Corporation
   d. Municipal Castings
   e. Castings, Inc.
   f. Or equal.

2. Pre-molded Joint Compound
    a. Ram Nec
    b. Kent Seal
    c. Or equal.

2.2 SANITARY SEWER MANHOLE STRUCTURE COMPONENTS

A. Manhole sections. Provide manhole sections reinforced in compliance with ASTM C478. Provide a minimum section wall thickness of 5". Adjust the final minimum 6" to maximum 18" distance to grade by using precast adjuster rings. Provide the following components for the manhole structures to be installed or replaced:

1. Precast manhole bases or cast-in-place manhole bases.
2. Precast Bottom Section
3. Precast Barrel Section(s)
4. Precast Transition Section (Concentric or Eccentric)
5. Precast Adjuster Ring(s)

B. Cast-In-Place Manhole Bases

1. 28-day Compressive Strength: 3,000 psi
2. Type II, per ASTM C150, Modified Sulfate Resistant Concrete, tricalcium aluminate content limited to 4% or less.

C. Frames and Cover

1. Provide cast or ductile iron frame and covers made of material meeting ASTM A48, Class 35 (minimum).
2. Use only cast or ductile iron of the best quality, free from imperfections and blowholes.
3. Furnish frame and cover of heavy-duty construction, a minimum total weight of 400 lb.
4. Machine all horizontal surfaces.
5. Furnish unit with solid non-ventilated lid with concealed pick holes. The letter covers "SEWER" for all collection system manholes.
6. Coat underside of manhole cover and interior of the frame with 8-mil coal-tar epoxy.
7. Ensure minimum clear opening as shown on the Drawings.

D. Manhole Storm Water Insert

E. Manhole Steps

1. Provide each manhole with extruded aluminum manhole steps with a safety tread. Furnish spacing and dimensions of steps complying with OSHA requirements for fixed ladders. Copolymer polypropylene-coated steel steps (MA Industries Model PS-2-PF) are also acceptable.
2. Ensure maximum distance from surface to the first rung is not greater than 16" and that maximum spacing on remaining steps is 12" on center. Locate step such that the center of the rung is nominal 6" clear of the wall.

3. Minimum step width of 14” and minimum cross-section of 0.875 inches of solid material.
4. Embed a minimum of 3” and anchor integrally into manhole or structure walls.

F. Flexible Pipe-to-Manhole Connector

1. A flexible pipe-to-manhole connector shall be used in the connection of the sewer pipe to precast manholes.
2. The flexible pipe connector shall be Quik-LOK as manufactured by A-LOK Products, or equal.
3. Internal expander assembly and external pipe clamp shall be Type 316 stainless steel.

G. Coating

1. Coat the exterior of all manholes with a Conceal 55 coating or approved equal.
2. All vault seams shall be sealed with flexible butyl resin sealant for concrete structures, ConSeal CS-101, or approved equal.
3. Coat the interior of all manholes with a factory-applied polyurea liner coating as specified.

PART 3 - EXECUTION

3.1 MANHOLE CONSTRUCTION

A. General

1. Make inverts with a semicircular bottom conforming to the inside contour of the adjacent sewer sections.
2. Shape inverts accurately and gives them a steel trowel finish. For changes in direction of the sewer and entering branches into the manhole, make a circular curve in the manhole invert.
3. Provide a minimum of 0.1-footfall across all manholes with changes in direction of flow.

B. Build at such elevation that pipe sections built into the wall of the manhole will be true extensions of the line of pipe.

C. Set and adjust the frame, and cover to match the finished pavement grade elevation. In unimproved areas, the top of the frame shall be elevated 6” above finished grade.

D. Manhole sections shall be set with pre-molded joint compound.

3.2 MANHOLE TESTING

A. Manholes shall be tested for leakage separately from the pipe as specified in the design documents. The sewer pipe in the manhole shall be plugged. All manholes shall be vacuum tested. The test shall comply with ASTM C1244-93 “Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure Test”.

B. No manhole will be accepted that has any visible infiltration when empty.

C. Any manhole whose test is unsatisfactory shall be repaired and retested until satisfactory results are obtained.

3.3 PLACEMENT OF CONCRETE COLLARS

A. Place concrete collars per detail shown on the plans on all manholes encountered on the project. Concrete to be class 3000 psi.

B. Finish the surface of the concrete collar with a smooth uniform lightly broomed surface inch 1/8” - 1/4” below the adjacent pavement surface in paved areas.

C. Install frame and cover even with the concrete surface.

D. Allow Contracting Officer to inspect concrete reinforcement on each collar before placing concrete.

END OF SECTION

SECTION 33 05 63

CONCRETE VAULTS & CHAMBERS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Furnish, deliver, install, and connect precast concrete grease interceptor tank and appurtenances to the separated effluent system piping for grease removal from the sanitary sewer system.

B. Furnish, deliver, install, and connect precast concrete overflow storage tank and appurtenances to the wastewater grinder pump lift station system for sewer bypass, overflow, and return capability.

1.2 REFERENCES

A. ASTM C1613 Standard Specifications for Precast Grease Interceptor Tanks

B. ASTM C 890 Standard for Wastewater Structures

C. ASTM C 318 Standard for Reinforced Concrete

1.3 QUALITY ASSURANCE

A. All precast concrete tanks are to be designed by Professional Civil & Structural Engineers licensed in the State of California.

B. Grease interceptor tanks are to be designed and manufactured per ASTM C1613 - Standard Specification for Precast Concrete Grease Interceptor Tanks.

C. All tanks are designed and constructed to be 100% watertight. Manufacturing processes shall provide detailed and comprehensive quality control procedures consistent with the National Precast Concrete Associations Plant Certification Program. Inlet and outlet pipe connections have gaskets to prevent leakage.

D. All building connections from buildings shall be made per the Uniform Plumbing Code.

1.4 SUBMITTALS

A. Submit detailed dimensional drawings to the Contracting Officer 10 days before installation prepared and stamped by a California licensed professional engineer showing the dual compartment constructed grease interceptor tank and its appurtenances along with anti-buoyancy measures that assume a groundwater level equal to ground surface level. Also provide copies of the manufacturer’s literature, materials of construction, and any other information necessary to determine grease interceptor compliance with the plumbing code, specifications, and project requirements.

B. Submit experience history of grease interceptor installer who must have at least 5 years recent experience in grease interceptor installation.

C. Submit detailed dimensional drawings to the Contracting Officer 10 days before installation prepared and stamped by a California licensed professional engineer showing the constructed overflow storage tank and its appurtenances along with anti-buoyancy measures that assume groundwater level equal to ground surface level. Also provide copies of the manufacturer's literature, materials for construction of the overflow storage tank, and any other information necessary to determine overflow compliance with the specifications and project requirements.

1.5 WARRANTY

A. The overflow tank and grease interceptor manufacturer shall provide a minimum 2-year warranty for overflow tank and grease interceptor tank defects, cracks, or failure to maintain watertight conditions. Overflow tanks and grease interceptor tanks and their appurtenances found defective within 2 years shall be replaced by the manufacturer at no additional cost to the government.

PART 2 - PRODUCTS

2.1 PRECAST CONCRETE TANKS

A. Grease Interceptor Tanks

1. The Grease Interceptor system requires a 750-gallon tank and an inspection tank vault utilized in series for the greywater grease interceptor treatment system that does not accept sanitary sewer or toilet wastes.
2. The grease interceptor tank and inspection vaults shall be constructed of reinforced concrete, meeting ASTM C1613. Reinforced Pre-cast concrete construction shall use concrete meeting 4,000 psi at 28 days. Tanks shall not be moved from the manufacturing site to the project site until the tank has cured for at least 14 days or has reached 2/3 of the design strength. Reinforcement steel shall be ASTM A615 Grade 60 fy = 60,000 psi.
3. The pre-cast grease interceptor tank and inspection vault shall be connected to a gravity sewer per Uniform Plumbing Code requirements.
4. All tanks shall be structurally sound and watertight and shall be guaranteed in writing by the tank manufacturer for 2 years from the date of final acceptance. The tank guarantee/warranty shall be furnished at the time of submittal. Tank warranty shall not be a limited liability to the replacement cost of the tanks. The grease interceptor tank shall be capable of withstanding long-term hydrostatic loading, in addition to the soil loading, due to a water table maintained at the ground surface. The grease interceptor tank(s) and inspection vault shall be designed to accommodate AASHTO H20 loadings.
5. The grease interceptor tank(s) shall be dual compartment tanks with the first compartment approximately twice the capacity of the second compartment, separated by a baffle. The inspection vault shall be a single compartment tank.
6. Tanks shall be manufactured and furnished with access openings 24" in diameter. Modification of completed tanks will not be permitted.

7. Inlet plumbing shall include an inlet tee that penetrates 18” into the liquid from the inlet flow line. (The depth may vary depending on the tank’s height; in all cases, though, the inlet should extend to a level below the bottom of the maximum grease depth.) The inlet plumbing shall allow for natural ventilation back through the building sewer and vent stack.
8. All tanks shall be installed in strict accordance with the manufacturer's recommended installation instructions.

2.2 OVERFLOW STORAGE TANK

A. The overflow storage tank system requires a 9,000-gallon tank at the lift station for sewer overflow and return capability to the lift station.

B. The overflow tank shall be constructed of reinforced concrete, meeting ASTM C1613. Reinforced Pre-cast concrete construction shall use concrete meeting 4,000 psi at 28 days. The tank shall not be moved from the manufacturing site to the project site until the tank has cured for at least 14 days or has reached 2/3 of the design strength. Reinforcement steel shall be ASTM A615 Grade 60 fy = 60,000 psi.

C. The pre-cast tank shall be connected to a pump vault per contract drawings and Uniform Plumbing Code requirements.

D. All tanks shall be structurally sound and watertight and shall be guaranteed in writing by the tank manufacturer for 2 years from the date of final acceptance. The tank guarantee/warranty shall be furnished at the time of submittal. Tank warranty shall not be a limited liability to the replacement cost of the tanks. The pre-cast tank shall be capable of withstanding long-term hydrostatic loading, in addition to the soil loading, due to a water table maintained at the ground surface.

E. The pre-cast storage tank shall be designed to accommodate AASHTO H20 loadings.

F. The pre-cast storage tank shall be a single compartment tank. The tank shall have two manways, (access openings) for entry, inspection, pumping, and flushing operations.

G. The tank shall be manufactured and furnished with access openings 24” in diameter. Modification of the completed tank will not be permitted.

H. Bypass inlet, overflow inlet, and outlet return piping penetrations shall be provided and located as shown on the contract drawings. The overflow inlet plumbing shall allow for natural ventilation back through the lift station and vent system.

I. All tanks shall be installed in strict accordance with the manufacturer's recommended installation instructions.

2.3 RISERS

A. Risers with lids shall be provided for the overflow tank for access and cleaning for access to internal vaults and access to the grease interceptor tank for grease removal pumping. All risers and lids shall be watertight and shall be attached to the tanks such that a watertight seal is maintained. The riser-to-tank connection shall be watertight and structurally sound. The riser-to-tank connection shall be capable of withstanding a vertical uplift of 5,000 pounds to prevent riser separation due to tank settlement, frost heave, or vehicle traffic over the tank. The material may be PVC as per ASTM D-1784 and tested per AASHTO M304M-89. The risers and lids shall be constructed of non-corrosive material and designed to be buried in soil, capable of withstanding a truck wheel load of 2,500 pounds for 60 minutes with a maximum vertical deflection of 1/2". Risers shall extend to 3" above the ground surface to allow for settlement and grass growth. In paved areas, risers shall be set flush with the finished surface. Lids shall form a watertight seal with the riser, not pose a tripping hazard for foot traffic, and be secured with tamper-resistant fasteners having recessed drives, such as hex, Torx, or square.

PART 3 – EXECUTION

3.1 INSTALLATION AND QUALITY CONTROL

A. A pre-construction conference is required to establish the responsibilities and duties among the parties associated with the acquisition and installation of the overflow tank and grease interceptor tank and their appurtenances. Conference attendees should include appropriate representatives from the National Park Service, the construction contractor, and the overflow tank and grease interceptor tank manufacturer and/or installer.

B. The overflow tank and grease interceptor tank and inspection vault shall be installed level on a solid bed, minimum of 6" thick compacted granular bedding overlying a firm uniform base. Backfill must be performed on all sides simultaneously tamped in place and compacted to a minimum of 90% of maximum dry density as tested per ASTM D 698 or the manufacturer's specifications. Ensure that select backfill is used within 12" of the tank and vault.

C. An experienced overflow tank and grease interceptor tank and inspection vault installer with at least 5 years of overflow tank and grease interceptor tank installation experience shall be used to install the overflow tank and grease interceptor tank and appurtenances.

D. The overflow tank, grease interceptor tank, and vault manufacturer and its installer shall certify the tanks are sound, free of defects, and demonstrate the tanks are watertight.

E. All piping and appurtenances inside of the tank shall be appropriately installed per manufacturer recommendations. Work shall be performed to code and as required by Section 22 00 00 - Plumbing General Requirements.

END OF SECTION

SECTION 33 05 71

SANITARY SEWER CLEANOUTS & VALVES

PART 1 - GENERAL

1.1 SCOPE

A. Standard Clean-outs and Appurtenances

B. Eccentric Plug Valve and Appurtenances

1.2 RELATED SECTIONS

A. Section 31 23 00 - Excavation & Fill

B. Section 31 23 33 - Utility Excavation & Backfill

C. Section 31 23 33.20 - Restoration of Surfaces

1.3 REFERENCES

A. ASTM A 48: Gray Iron Castings

B. ASTM A 126, Class B: Cast Iron (semi-steel)

1.4 SUBMITTALS

A. Submit shop drawings for materials to be installed or furnished under this section.

B. Submit manufacturer’s certification that pipe, and fittings meet or exceed specified requirements.

C. Submit manufacturer’s installation instructions and maintain a copy at the Jobsite.

1.5 PROJECT RECORD DOCUMENTS

A. Accurately record actual locations of constructed clean-outs and other encountered utilities concerning existing permanent benchmarks.

B. Provide a copy of record documents to the Contracting Officer before issuance of substantial completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Handle and store clean-out pipe and appurtenances in a manner that prevents shock, damage, or excessive exposure to sunlight and weather.

B. Protect gasket material from sunlight and contamination until ready for installation in the pipe.

PART 2 - MATERIALS

2.1 PIPE SIZE, TYPE, AND STRENGTH

A. Clean-out materials to match the material used for gravity sewer per Section 33 31 13 – Site Sanitary Sewerage Gravity Piping or Section 32 84 24 - Irrigation Sprinkler Systems. Comply with pipe size, type, and strength classifications indicated in the Contract Documents.

B. Submit connection shop drawings for Contracting Officer's approval if using clean-out material that does not match the type and strength of the gravity sewer material.

C. Notify the Contracting Officer if installation conditions such as trench width, depth, soils, and bedding conditions do not match conditions contemplated by the Contract Documents.

2.2 GENERAL CLEAN-OUT FRAMES AND COVERS

A. Provide size and shape as detailed on the drawings.

B. Provide tough, close-grained, gray iron, castings free from blowholes conforming to ASTM A 48 Class 20 ksi or better.

C. Place or grind castings, if necessary, to ensure perfectly flat, smooth, even, and true surfaces.

D. Concrete Collar: Concrete to be Class 3000 psi Cast-in-Place Concrete

2.3 DRAINFIELD CLEAN-OUT BOXES

A. Provide plastic boxes as shown at drainfield lateral piping clean-outs where the clean-outs are accessed above grade. Acceptable manufacturer: Tuff-Tite or equal.

2.4 DRAINFIELD KNIFE GATE

A. Isolation valves for individual drainfield zones as located at the drainfield splitter outlets shall be knife gate valves installed in plastic valve boxes of sufficient size for valve and union fittings. The knife gates are quick to open/close full-port valves with solvent welded or flanged end connections. The knife gate paddle material shall be PVC, the stem shall be 304 or 316 stainless steel, the seals shall be TPV (EPDM thermoplastic vulcanizate), and the closed valve working pressure shall be a minimum of 15 psig for the intended 4-inch gates. Identical valves are required on every distribution zone pipe. Provide true-union fittings at both the inlet and outlet piping for ease of maintenance. Acceptable manufacturer: Valterra or equal.

2.5 ECCENTRIC PLUG (Ball) VALVE

A. Plug Valves shall be of the tight closing, resilient faced non-lubricating variety and shall be of an eccentric design such that the valve's pressure member (plug) rises off the body seat contact area immediately upon shaft re-adaptation during the opening movement.

1. Valves shall be drop-tight at the rated pressure (175 psi through 12-inch, 150 psi 14 inches and above) and shall be satisfactory for applications involving throttling service as well as frequent or infrequent on-off service.
2. The valve closing member should rotate approximately 90 degrees from the full-open to full-closed position and vice-versa
3. The valve body shall be constructed of cast iron (semi-steel) conforming to ASTM A 126, Class B.
4. Valve shall have flanges in conformance with ANSI B16.1 for Class 125 iron flanges.
5. Eccentric Plug Valves shall have a rectangular-shaped port. Port areas for 3-inch - 20-inch valves shall be a minimum 80% full pipe area.
6. The valve seat surface shall be a welded-in overlay, cylindrically shaped of not less than 90% pure nickel. The seat area shall be raised, with raised area completely covered with weld to insure proper seat contact. The machined seat area shall be a minimum of .125" thick and .500" wide.
7. The valve plug shall be constructed of cast iron (semi-steel) conforming to ASTM A126, Class B. The plug shall have a cylindrical seating surface that is offset from the center of the plug shafts. The plug shafts shall be integral. The entire plug shall be 100% encapsulated with Buna-N rubber in all valve sizes. The rubber compound shall be approximately 70 (Shore A) durometer hardness. The rubber to metal bond must withstand 75 lbs, pull under test procedure ASTM D- 429-73 Method B.
8. Shaft bearings, upper and lower, shall be sleeve-type metal bearings, sintered, oil impregnated, and permanently lubricated Type 316 stainless steel.
9. Thrust bearings shall be Nylatron.
10. Plug valve shaft seals shall be on the multiple V-ring (Chevron) and shall be adjustable.
11. All packing shall be replaceable without removing the bonnet or actuator while the valve is in service. Shaft seals shall be made of Buna-N.
12. Each valve shall be given a test against the seat at the full rated working pressure and a hydrostatic shell test at twice the rated working pressure. Certified copies of individual tests shall be submitted when requested.
13. All eccentric plug valves shall be Clow F5412 (Flanged) or approved equal.

2.6 GENERAL ACCESSORIES

A. Valve Boxes

1. Provide service boxes of cast-iron construction and cover marked “SEWER” or “S.” The specific style of box and cover shall be as shown. The service box shall be long enough to reach from the pipe to at least 1” above the final ground surface elevation.
2. Extend service boxes to the required length using “Buffalo” screw adjustment.
3. Provide boxes with housings of sufficient size to completely cover the top of the valve and complete with identifying covers.

4. Design valve boxes so that traffic load on top of the box is not transmitted to the valve.
5. Provide wheel-operated stands with hand-wheels of the same diameter as those specified for the valve being operated.

B. Valve Stands

1. Provide cast-iron frames, with a 5¼" shaft, and extension stem adjustable for elevation. The specific style of the stem shall be as shown.
2. Fit stands with roller or ball bearings designed to take thrust.
3. Assure adequate provision for lubrication and protect operating parts from the weather.
4. Furnish operating nuts constructed of Grade C bronze finished all over, suitably splined to connect with hand-wheel or gear and with threads which will engage smoothly with those of lifting shaft

PART 3 – WORKMANSHIP

3.1 EXAMINATIONS

A. Verify that excavations are to required alignment and grade.

B. Verify that trench conditions and shoring, sheeting, and bracing protect workers and meet the requirements of OSHA.

C. Verify utility locations, existing piping locations, and required separation from water line before beginning work. Notify the Contracting Officer if field conditions are different from the Contract Documents. Allow 4 hours for Contracting Officer to modify the design, if necessary, unless otherwise specified.

3.2 GENERAL PLACEMENT OF BEDDING AND BACKFILL

A. Excavate per Section 31 23 33 - Utility Excavation & Backfill. Place pipe bedding material from the trench bottom or 6" below the pipe, whichever is greater, to 6" above the top of the main and to the bottom of the vertical riser.

B. Compact the bedding material to fill and compact under the pipe haunches and fill voids of the clean-out. Place bedding material against undisturbed earth.

3.3 JOINING PIPE AND FITTINGS

A. Join pipe materials per manufacturer's recommendations for the type of the main pipe unless otherwise approved by the Contracting Officer.

3.4 GENERAL INSTALLATION OF RING AND COVER

A. Adjust ring to grade by the use of a 12" diameter, minimum 1' long section of PVC, ductile, or cast-iron riser pipe.

B. Fill the void between the pipe and the clean-out structure with fiber joint packing, Ram-Nek, or approved substitution.

C. Place concrete collar around the frame and cover.

3.5 TESTING

A. Test clean-out per Section 33 08 30 - Commissioning of Sanitary Sewerage Utilities.

END OF SECTION

SECTION 33 05 97.16

MARKERS FOR UTILITY IDENTIFICATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work of this Section consists of furnishing and installing utility line marking, surface markers, locator wire, boxes, and tape in the utility trench.

1.2 SUBMITTALS

A. As specified in Submittals - Section 01 33 23.

B. Samples: 24” strips of tape and 2 markers.

C. Sample sealed connector box for tracer wire.

D. Certification that the materials used in the tape fabrication meet the requirements of this Section.

PART 2 - PRODUCTS

2.1 MARKING TAPE

A. Capable of being inductively detected electronically.

B. Construction: 2 layers of impervious plastic film not less than 4” wide. The total thickness of tape shall not be less than 0.005 inches (5 millimeters) plus or minus 10% manufacturing tolerances.

1. Film: Inert plastic. Each film layer shall be not less than 0.0005 inches thick (0.5 millimeters).
2. Adhesive: Compatible with foil and film.

C. Imprint: 1” or larger in bold black letters.

D. Legend: Identify buried utility line tape with imprints such as "CAUTION: WATER LINE BELOW". Repeat identification at approximately 24” intervals.

E. Background Color: APWA color code and as specified below:

Color	Utility
Safety Red	Electric
High Visibility Safety Yellow	Gas, Oil, Steam, Dangerous Materials
Safety Alert Orange	Telephone, Communications, Cable Television
Safety Precaution Blue	Water System
Safety Green	Sanitary Sewer, Storm Sewer
Safety Purple	Reclaimed Water, Irrigation, Slurry Lines

F. Manufacturer: Lineguard, Inc., Wheaton, Illinois; Reef Industries, Inc., Houston, Texas; Thor Enterprises, Inc., Sun Prairie, Wisconsin; or approved equal.

2.2 COPPER WIRE

A. Insulated solid strand copper wire, Single Conductor Sewer Pipe Tracer Wire AWG 8/1 Gauge Gage Size 8, One Conductor Solid Copper. Underground. Direct Burial. Temperature range: -20C to 60C, 600 Volts RMS. Applications: For use in Utility Sewer Pipe tracer applications. Green Jacket.

2.3 CARSONITE MARKERS

A. 4-inch green Carsonite posts.

PART 3 - EXECUTION

3.1 MARKING TAPE

A. Install tape in backfill directly over each buried utility line as shown. Place tape by plowing or during final backfilling. Bury tape approximately 10” below finish grade.

B. Where utilities are buried in a common trench, identify each line by a separate warning tape. Bury tapes side by side directly over the applicable line.

3.2 COPPER TRACER WIRE

A. Place tracer wire on top of pipe and tape at 5-foot intervals.

B. Extend wire 2 feet above the ground and terminate in a small standard connector box (Christie G5 or approved equal).

3.3 CARSONITE MARKERS

A. Place adjacent to connector box and/or valves located within landscaped areas.

END OF SECTION

SECTION 33 08 00

COMMISSIONING OF SITE UTILITY SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION

A. The requirements of this Section apply to all sections of Division 31.

B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned and the commissioning process is specified in Section 01 91 14 TOTAL BUILDING COMMISSIONING. A Commissioning Agent (CxA) will be appointed to manage the commissioning process.

1.2 RELATED WORK

A. Section 01 91 14 TOTAL BUILDING COMMISSIONING.

B. Section 01 33 23 SUBMITTAL PROCEDURES.

1.3 SUMMARY

A. This Section includes requirements for commissioning the Facility site utility systems, related subsystems, and related equipment. This Section supplements the general requirements specified in Section 01 91 14.

B. Refer to Section 01 91 14 for more details regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

1.4 DEFINITIONS

A. Refer to Section 01 91 14 for definitions.

1.5 COMMISSIONED SYSTEMS

A. Commissioning of a system or systems specified in Division 31 is part of the construction process. Documentation and testing of these systems, as well as training of the CA's Operation and Maintenance personnel per the requirements of Section 01 91 14 and Division 31, is required in cooperation with the state and the Commissioning Agent.

B. The Facility site utility systems commissioning will include the systems listed in Section 01 91 14.

1.6 SUBMITTALS

A. The commissioning process requires the review of selected Submittals that pertain to the systems to be commissioned. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the state before forwarding it to the Contractor. Refer to Section 01 33 23 for further details.

B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 14.

PART 2 - PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 CONSTRUCTION INSPECTIONS

A. Commissioning of Site Utility systems will require inspection of individual elements of the site utility systems construction throughout the construction period.

B. The Contractor shall coordinate with the Commissioning Agent per Section 01 91 14 and the Commissioning plan to schedule site utility systems inspections as required to support the Commissioning Process.

3.2 3.2 PRE-FUNCTIONAL CHECKLISTS

A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation.

B. The Contractor shall complete the checklists. Completed checklists shall be submitted to the NPS and the Commissioning Agent for review. The Commissioning Agent may spot-check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission.

C. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission.

D. Refer to Section 01 91 14 for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

3.3 CONTRACTORS TESTS

A. Contractor tests as required by other sections of Division 31 shall be scheduled and documented per Section 01 40 00 Quality Requirements. All testing shall be incorporated into the project schedule. The contractor shall provide no less than 7 calendar days' notice of testing.

B. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed before scheduling Systems Functional Performance Testing.

3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING

A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady-state conditions, test system reaction to changes in operating conditions, and system performance under emergency conditions.

B. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Resident Engineer. The Contractor shall review and comment on the tests before approval.

C. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests.

D. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 14, for additional details.

3.5 3.5 TRAINING OF NPS PERSONNEL

A. Training of the operation and maintenance personnel is required in cooperation with the Resident Engineer and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.

B. The contractor shall submit training agendas and trainer resumes per the requirements of Section 01 91 14. The instruction shall be scheduled in coordination with the Engineer after submission and approval of formal training plans. Refer to Section 01 91 14 and Division 31 Sections for additional Contractor training requirements.

END OF SECTION

SECTION 33 09 30

INSTRUMENTATION & CONTROL FOR SANITARY SEWERAGE UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work under this Section specifies flow measurement devices for process instrumentation, auxiliary equipment, and supplies directly related to the installation of and operation of these flow measurement devices, to perform the required functions in conjunction with information and equipment specified in other sections of Division 33 and other sections of Division 26.

1.2 SUBMITTALS

A. Submit per Section 01 33 23 “Submittal Procedures.”

B. Manufacturer's Literature and Data:

1. Flow measurement Water Meter (Sparling TigermagEP™ FM656 Flanged Electromagnetic Flowmeter or Approved Equal).
2. Product certificate for each type of meter
3. Pressure Gauge with Snubber.

C. Operations and Maintenance manual shall include:

1. System Description
2. Major assembly block diagrams
3. Troubleshooting and preventive maintenance guidelines
4. Spare parts information.

D. Shop Drawings shall include the following:

1. One line, wiring, and terminal diagrams including terminals identified, protocol or communication modules, and Ethernet connection shop drawings to be submitted in this Section shall be made in one package under the Product Review Category of Section 01 33 23: Submittal Procedures.

E. Shop Drawings:

1. Instrumentation and Controls, General Requirements, shop drawings shall include for each type of instrument: supply voltage and frequency, electrical load, accuracy, description of operation, operating instructions, and calibration procedure.
2. Furnish Shop Drawings for each item of mechanical equipment present sufficient data to determine compliance with these Specifications. Submit completed ISA S20 forms for each device and physical dimensions. Also submit the manufacturer's recommended upstream and downstream straight piping lengths, recommended location of any pressure taps, and estimates of pressure losses through the device.

F. Installation Method: The proposed method of mounting sensors and instruments shall accompany all shop drawings.

G. Parts List: Submit a Parts List with current net prices and a list of recommended spares.

H. Factory Testing and Calibration:

1. All meters shall be factory tested. Perform a factory test and/or provide certification of calibration from an independent test laboratory.

I Manuals: Furnish manufacturer's installation, lubrication, operation and maintenance manuals, bulletins, and spare parts lists.

J. Affidavits: Furnish affidavits from the manufacturers stating that the meters have been properly installed and tested and each is ready for full-time operation.

1.3 QUALITY ASSURANCE

A. Manufacturer: Flow measurement devices furnished shall be manufactured by firms regularly and currently engaged in the design and manufacture of similar equipment. All equipment furnished shall be new and of the current design.

B. Maintainability: All equipment shall be designed for ease of maintenance and repair, and access to critical parts shall not require a major disassembly. Internal field adjustments permitted or required herein shall be easily accessible upon removal of a panel or cover.

C. Materials and Installation: Materials and installation shall comply with the requirements of the current editions of referenced electrical codes and standards, and the codes and standards referred to shall be used for establishing the minimum quality of the materials and equipment supplied and installed. All equipment of the same type shall be products of the same manufacturer. Capacities of all equipment shall not be less than that indicated on the Drawings or as specified.

1.4 SEISMIC PROTECTION

A. Seismic restraint for metering devices that are integral with piping shall be as specified for the piping system in which they are installed. Seismic design certification and anchorage descriptions may be required by code and if applicable shall satisfy ASME B31.3 Standard for Process Piping.

1.5 INDICATING UNITS

A. Provide flow indication in GPM, CFS, MGD, etc. Do not use indicators, which read 0 to 100 percent, 4-20 mA, etc.

1.6 SERVICE CONDITIONS

A. Provide process fluid description that includes the type of liquid, viscosity, or suspended solids concentration to support flow device materials.

PART 2 - PRODUCTS

2.1 MAGNETIC FLOWMETER - INDUCTION TYPE

A. General: Magnetic meters shall utilize the principle of electromagnetic induction to produce an output proportional to the rate of fluid flow. The magnetic flowmeter shall utilize DC bipolar pulsed coil excitation, operating at frequencies up to 100 Hz and automatically re-zeroing after every cycle.

1. The meters shall be housed in a NEMA 4 enclosure. The metering liner shall be lined with Ceramic (aluminum oxide 99.5%).
2. Protect coils from contact with the fluid. The flowmeter electrodes on ceramic liners shall be fused with platinum.
3. The magnetic flowmeter shall be microprocessor-based flanged. It shall indicate, totalize, and transmit flow in full pipes.
4. The meter shall incorporate Hi-Z circuitry. The preamplifier input impedance shall not be less than 1012 ohms. External ultrasonic electrode cleaners shall not be acceptable.
5. The flowmeter shall have a switching power supply having an operating range from 77-265 Vac, 50/60 Hz (12-60 Vdc). Power consumption shall not exceed 20 Watts.
6. The meters shall be designed to operate from a 120-volt ac, 60-cycles, single-phase power supply. A 10% variation in power line voltage or frequency shall not affect the meter output accuracy of more than 0.5 percent of full scale.
7. Provide magnetic flowmeters suitable for fluids with conductivities as low as 5.0 micromhos/cm.
8. Each magnetic flow meter system shall have an accuracy of at least 0.5 percent of the actual flow rate over a 33:1 turn-down at all flow rates above 1 foot per second. Accuracy shall be verified by calibration in a flow laboratory traceable to the U.S. National Institute of Standards and Technology.
9. Meters shall have repeatability within +/- 0.1 percent of full scale.
10. All printed circuit boards shall be contained in a plug-in module and be interchangeable for any size without requiring test equipment.
11. The flowmeter manufacturer shall have meters of the DC pulse type in similar flowing media for a minimum of 5 years.
12. The flowmeter shall be warranted against defective workmanship or materials for two years from the date of shipment.
13. Totalized flow and programmed configuration shall be maintained in memory for the meter’s lifetime.
14. The flowmeter shall be a 4-inch Ultra Mag Flow Meter manufactured by McCrometer, or equal.

15. Each magnetic flow meter shall be equipped with the following outputs:
    a. Isolated analog 4-20mA DC into 800 ohms (std)
    b. 0-1000 Hz freq., for 0-100% of flow rate, 15 V DC
    c. Two flow alarms
    d. Fault, with open collector
    e. RS232 communication flow direction with open collector
    f. Positive Zero Return (PZR) for external relay contacts. Output b. can be an open collector if required.

B. Manufacturer: Meters and signal converters shall be Sparling; Water Specialties; Khrone; Foxboro; Fischer & Porter; or equal.

2.2 MISCELLANEOUS PRODUCTS

A. Pressure Gauges: Pressure and compound gauges shall be glycerin filled with a built-in pressure snubber and have a 4-1/2 inches minimum diameter face and be turret style, the black phenolic case with a clear glass face. The movement shall be rotary of 400 Series stainless steel with Teflon coated pinion gear and segment. The gauge shall be bottom connected into a 1/4 inch NPT female thread. All gauges shall be mounted with isolating valves to facilitate gauge removal. The following ranges shall be provided:

Gauge Type	Range
Distribution Pressure	0 / 100 psi
Reservoir Pressure	0 / 15 psi

Gauges shall be Ashcroft Model 1279 or Contracting Officer approved equal.

PART 3 - EXECUTION

3.1 INSPECTION

A. Provide installation, testing, calibration, verification, and startup instructions per Section 33 11 00.10: Testing of HDPE Water Lines & Sewer Force Main Lines, Section 33 32 13.13: Wastewater Lift Station Pump for installation in the Lift Station, and Section 33 31 23 Sanitary Sewerage Force Main Piping.

3.2 FIELD TESTING

A. All flow devices are to be field-tested against a secondary standard at the normal (or expected) process flow rates.

END OF SECTION

SECTION 33 11 00.10

TESTING HDPE WATER LINES & SEWER FORCE MAIN LINES

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work of this Section consists of leak testing sewer force main lines and related valves and fittings. Rejected work shall be retested or replaced.

1.2 REFERENCES

A. AWWA M55; PE Pipe - Design and Installation

B. Handbook of PE Pipe, 2nd ed. Plastic Pipe Institute.

C. Plastic Pipe Institute Technical Notes and Reports:

1. TN-46 2013a - Hydrostatic Universal Field Test Procedure

1.3 QUALITY ASSURANCE

A. Flow meters shall record the actual volume plus or minus 2 percent.

B. Water test gauges shall be ANSI B40.1.80, Grade 2A (plus or minus 0.5 percent of full-scale accuracy), dial range approximately twice the required test pressure.

1.4 SUBMITTALS

A. As specified in “Submittals” - Section 01 33 23.

B. Accuracy certification: Contracting Officer’s approval of test gauges required. Approval shall be granted no more than 14 days before actual system testing.

C. Before testing, provide the following information:

1. All Tests: Describe precautions that will be taken to protect system equipment that might be damaged under test pressures and the proposed method for bypass pumping where the system must remain in service.
2. High-Pressure Water Test: Describe the proposed method for the disposal of water used inline testing.

1.5 PROJECT CONDITIONS

A. Testing shall not be performed until each system has been flushed or thoroughly cleaned.

B. Water for Flushing and Testing: See “Temporary Facilities & Controls” – Section 01 50 00.

PART 2 - PRODUCTS - NONE.

PART 3 - EXECUTION

3.1 GENERAL

A. Perform testing in the Contracting Officer's presence after backfilling and proper compaction of trenches. Where lines are installed under roadways and parking areas, perform tests after completion of final subgrade preparation and before application of surface courses. Notify Contracting Officer at least 5 days before testing.

B. Prepare each section for testing, using adequate bracing; protect system equipment susceptible to damage by test pressures; make provision for installation of Government pressure gauge in parallel with Contractor's gauge, if so requested; and maintenance services where required.

3.2 TESTING OF HDPE SEWER FORCE MAIN LINES

A. Isolate components that may be damaged by the specified pressure test conditions.

B. Pressure testing of all HDPE pressure piping shall be performed following guidelines established under AWWA M55, PE Pipe - Design and Installation guidelines.

C. Do not use paints, asphalts, tars, or other types of pipe compounds to eliminate leaks.

D. Replace leaking fittings, nipples, or lengths of pipe at the Contractor’s expense.

E. Testing methods and criteria

1. HDPE Pressure Pipe Systems. Test pressure is temperature-dependent. Test fluid and test section temperatures shall be less than 80º F (27ºC). At temperatures above 80º F (27ºC), a reduced test pressure is required. Testing at temperatures above 80º F shall only be permitted with the Contracting Officer’s written approval. Contact the pipe manufacturer for technical assistance with elevated temperature pressure reduction. Sunlight heating of exposed PE pipe especially black PE pipe can result in high pipe temperature. Before applying test pressure, allow time for the test fluid and the test section to temperature equalize. Hydrostatic leak tests typically use cooler liquids so the liquid-filled test section will tend to equalize to a lower temperature near the test liquid temperature. Compressed gases used in pneumatic leak tests do not have similar temperature lowering effects, so it is more likely that test pressures will have to be reduced due to elevated temperature effects when conducting pneumatic leak tests. Bursting can result if test pressure is not reduced for elevated test section temperature.

2. Leak Test Pressure and Duration - The maximum allowable leak test pressure and leak test time including initial expansion, and time at leak test pressure shall be following the following equation and Tables 1 and 2.

$$P(T) = \frac{2(HDS)(Ft)(HT)}{(DR - 1)}$$

Where:

P(T) = Leak Test Pressure, psi (MPa), for Leak Test Time, T
T = Leak Test Time, hours
HDS = PE material hydrostatic design stress for water at seventy-three degrees (73º) F (23ºC), psi (MPa)
Ft = PE material temperature reduction factor
HT = Leak test duration factor for leak test time, T
DR = Pipe dimension ratio

TABLE 1 - Leak Test Duration Factor, "HT"

Leak Test Pressure, $P_{(T)}$, psi (MPa)	Leak Test Time, T, hours	Leak Test Duration Factor, H_T
P (8)	≤ 8	1.5
P (48)	≤ 48	1.25
P (120)	≤ 120	1.0

TABLE 2 - PE Material Hydrostatic Design Stress

PE Material Designation	HDS for Water at 73ºF (23ºC), psi (MPa)
PE4710	1000 (6.9)

3. The contractor shall consult with the PE pipe manufacturer for applicable PE4710 elevated temperature performance temperature reduction factors, "Ft".

F. Types of pressure testing and inspection to be employed include hydrostatic pressure testing.

1. For buried piping: Perform testing after backfilling and proper compaction of trenches. Where lines are installed under roadways and parking areas and perform tests after completion of final grade preparation and before application of surface courses. Notify Contracting Officer at least 48 hours before testing. Provide temporary restraints for expansion joints for additional pressure load under test. Isolate equipment in the piping system with rated pressure lower than pipe test pressure by valves or blind flanges.
2. For exposed piping: Prepare each section for testing, using adequate bracing and protect system equipment susceptible to damage by test pressures. Do not paint or insulate exposed piping until the successful performance of pressure test.

END OF SECTION

SECTION 33 12 00

VALVES: GENERAL STATEMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work covered in this Section includes all valves, operators, and valve appurtenances.

1.2 RELATED SECTIONS

A. Water Utility Distribution Valves - Section 33 12 16

B. Sanitary Sewer Cleanouts & Valves - Section 33 05 71

1.3 REFERENCES

A. American National Standards Institute (ANSI)

1. B1.20.1, Pipe Threads, General Purpose
2. B16.1, Cast Iron Pipe Flanges and Flanged Fittings
3. B16.5, Pipe Flanges and Flanged Fittings
4. B16.18, Cast Copper Alloy Solder Joint Pressure Fittings Class 25, 125, 250 and 800

B. American Water Works Association (AWWA)

1. C111, Rubber-Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings
2. C207, Steel Pipe Flanges for Waterworks Service - Sizes 4 through 144 inches.

C. National Electrical Manufacturers Association (NEMA)

1. MG1, Motors and Generators

1.4 SUBMITTALS

A. Certifications and testing consistent with Contractor Quality Control – Section 01 40 00

B. Certification that products being used meet the requirements of standards referenced.

C. Shop Drawings consistent with Submittals - Section 01 33 23 and including:

1. Product technical data including:
2. Valve pressure/temperature rating
   a. End connection type and rating
   b. Valve material for construction

c. Special linings
d. Valve dimensions and weight
e. Valve flow coefficient conversion
f. Manufacturer's installation instructions for the actuator

D. Operation and Maintenance Manuals are consistent with affected Sections.

PART 2 - PRODUCTS

2.1 VALVES

A. End Connections

1. Provide end connections for valves as defined in the Piping Specification Schedules presented in “Valves General Statement” - Section 33 12 00.
2. Assure end connections meet the following standards
   a. Screwed: ANSI B1.20.1
   b. Flanged: ANSI B16.1 or B16.5 or AWWA C207
   c. Bell and faucet or mechanical (gland) type: AWWA C111
   d. Soldered: ANSI B16.18

2.2 ACCESSORIES

A. Valve Boxes

1. Provide service boxes of cast-iron construction and cover marked “WATER” or “W.” The specific style of the box and cover shall be as shown. The service box shall be long enough to reach from the pipe to at least 1” above the final ground surface elevation.
2. Extend service boxes to the required length using the “Buffalo” screw adjustment.
3. Provide boxes with housings of sufficient size to completely cover the top of the valve and complete with identifying covers.
4. Design valve boxes so that the traffic load on top of the box is not transmitted to the valve.

B. Valve Stands

1. Provide cast-iron frames, with a 5¼” shaft, extension stem adjustable for elevation. The specific style of the stem shall be as shown.
2. Fit stands with roller or ball bearings designed to take thrust.
3. Assure adequate provision for lubrication and protect operating parts from the weather.
4. Furnish operating nuts constructed of Grade C bronze finished all over, suitably splined to connect with hand-wheel or gear and with threads that will engage smoothly with those of lifting shaft.
5. Provide wheel-operated stands with hand-wheels of the same diameter as those specified for the valve being operated.
6. Provide valve stands of non-rising stem or rising stem depending on the valve that the stands will operate.
7. For O.S.&Y. valves, provide a valve with a special yoke attachment and furnish indicating NRS floor-stand.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before installation, inspect interconnecting piping and end connections to assure compatibility.

B. Before installation, inspect and verify the condition of the valve and appurtenances. Installation constitutes the installer's acceptance of product conditions for satisfactory installation.

C. Assure exposed piping is sufficiently supported to bear the weight of the valve when it is installed.

3.2 PREPARATION

A. Correct defects or conditions which may interfere with or prevent a satisfactory installation.

3.3 ERECTION / INSTALLATION / APPLICATION

A. Provide following the manufacturer's instructions.

B. Protect all bolts with corrosion-resistant paint and polyethylene wrapping.

C. Setting Outside Valves

1. Locate valves installed in trenches indicated on the Drawing.
2. Set valves plumb.
3. Place valve boxes directly over valves with the top of the box being brought to the surface of the finished grade.
4. After installation, carefully backfill each side of the box.

D. Support exposed valves to minimize bending of the valve end connections because of pipe loading.

3.4 FIELD QUALITY CONTROL

A. Repair or remove and replace defective material.

3.5 ADJUSTING

A. Make all adjustments to valves, operators, and appurtenant equipment before Project acceptance by Contracting Officer.

END OF SECTION

SECTION 33 12 16

WATER UTILITY DISTRIBUTION VALVES (ASH MOUNTAIN ONLY)

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work described in this Section includes all gate valves.

1.2 RELATED SECTIONS

A. Water Utility Distribution Equipment - Section 33 12 00

1.3 REFERENCES

A. American Water Works Association (AWWA)

1. C500, Gate Valves for Water and Sewerage Systems
2. C509, Resilient Seated Gate Valves, 2 through 12 NPS, for Water and Sewer Systems

B. Manufacturer's Standardization Society of the Valve and Fittings Industry, Inc. (MSS)

1. SP-80, Bronze Gate, Globe, Angle, and Check Valves

1.4 SUBMITTALS

A. Certifications and testing consistent with Contractor Quality Control - Section 01 40 00 and including:

1. See Valves General Statement - Section 33 12 00
2. Test results for all tests are required in Article 2.3 of this Section

B. Shop Drawings consistent with Submittals - Section 01 33 23 and including:

1. See Valves General Statement - Section 33 12 00

C. Operation and Maintenance Data consistent with Submittals - Section 01 33 23

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Gate Valves

1. Products as manufactured by Clow, Crane, M&H, Powell, Watts, or approved equal.

2.2 MANUFACTURED UNITS

A. General

1. Provide valves with clear waterways the full diameter of the valve.
2. Provide end connections per Piping Specification Schedules in Pipe & Pipe Fittings - Section 33 00 00.

B. Water Valves

1. Gate Valves 2”-12”: Option No. 1
   a. Iron body
   b. Meeting MSS SP-70 and AWWA C500
   c. Rated for 200 psi working pressure and 400 psi test pressure
   d. Solid wedge construction
   e. Non-rising stem (NRS)
2. Gate Valves 2”-12”: Option No. 2
   a. Resilient seated
   b. Rated 200 psi WWP
   c. Meeting AWWA C509
   d. Non-rising stem (NRS)

2.3 SOURCE QUALITY CONTROL

A. Perform the following tests, following AWWA C500, on valves constructed following AWWA C500.

1. Operation test
2. Hydrostatic test

B. Perform the following tests, following AWWA C509, on valves constructed following AWWA C509

1. Operation test
2. Shell test
3. Seal test
4. Hydrostatic test
5. Torque test
6. Leakage test
7. Pressure test

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before installation, inspect interconnecting piping and end connections to assure compatibility.

B. Before installation, inspect and verify the condition of the valve and appurtenances. Installation constitutes the installer's acceptance of product conditions for satisfactory installation.

C. Assure exposed piping is sufficiently supported to bear the weight of the valve when it is installed.

3.2 PREPARATION

A. Correct defects or conditions which may interfere with or prevent a satisfactory installation.

3.3 ERECTION / INSTALLATION / APPLICATION

A. See Valves General Statement - Section 33 12 00

B. Install buried valves in the closed position. Support valve in the trench to prevent settling and excessive strain on the connection to the pipe.

C. Do not install gate valves inverted or with the stems sloped more than 45 degrees from the upright unless the valve was ordered and manufactured specifically for this orientation.

3.4 FIELD QUALITY CONTROL

A. Repair or remove and replace defective valves.

END OF SECTION

SECTION 33 14 00

WATER FITTINGS & APPURTENANCES

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work of this section consists of furnishing and installing water system piping, and fittings.

1.2 DEFINITION

A. Bedding and backfill material types are defined in Section 31 23 00.

1.3 RELATED SECTIONS

A. Testing of Water Lines - Section 33 14 00.30

B. Trenching & Backfill - Section 31 23 33

C. Utility Line Marking - Section 33 05 97.16

1.4 SUBMITTALS

A. As specified in Section 01 33 23.

B. Manufacturer's literature and certificates of compliance with the reference standards for pipe, fittings, and couplings.

C. Manufacturer's installation instructions or guide.

D. Written procedure for cleaning water lines and disposing of fluidized materials removed.

1.5 PRODUCT HANDLING

A. Delivery: Handle pipe carefully to ensure delivery at the project site in sound, undamaged condition. Contracting Officer will reject the damaged pipe on site. The contractor shall replace the damaged pipe at no additional expense to the Government.

B. Storage: Do not store materials directly on the ground. Adequately support piping to prevent warpage. Use protective covers where the pipe may be damaged by direct sunlight.

1.6 CLOSEOUT SUBMITTALS

A. As specified in Section 01 77 00.

B. A minimum of one of each type of tool needed to open the valve box lid for each style and size of box and lid.

C. Operation and maintenance data for review and approval.

PART 2 - PRODUCTS

2.1 PLASTIC PIPE, JOINTS, AND BACKFILL MATERIAL

A. Pipe: Materials shall be approved by NSF or the state for use in potable water systems.

1. AWWA C900-97 for pipe 4 to 12 inches diameter. Class 150 and 200.
2. C900, Class 150, and Class 200 shall be CertainTeed (1-800-527-2243) or approved equal.

B. Elastomeric Gasket Joint: ASTM D3139-89. Use with AWWA C900 and ASTM D2241 pipe. Manufacturer's standard. Integrally formed bell, push-fit, rubber gasketed joint system.

C. Elastomeric Gasket Lubricant: Manufacturer's standard non-toxic lubricant, approved for potable water systems.

D. Plain Ends: For joining with standard manufactured couplings.

E. Mechanical Fittings: Compression fitting (gasket type). Use with AWWA C901 pipe and tubing only. 110 Series as manufactured by Mueller Brass Company, Port Huron, Michigan; Haystite as manufactured by Fluid Controls Division, Romac Industries, Inc., Lowell, North Carolina; Packjoint as manufactured by Ford Meter Box Company, Inc., Wabash, Indiana; or approved equal. Provide stainless steel insert stiffener at each joint.

F. Bedding, Utility Trenching, and Backfill - Section 31 23 00.

2.2 HIGH-DENSITY POLYETHYLENE (HDPE) AND JOINTS

A. Pipe: 6-inch HDPE SDR 11

1. Approved by NSF or the state for use in potable water systems.
2. HDPE SDR 11 shall meet AWWA C906, ASTM D-3350, and ASTM F-714. HDPE pipe shall have a standard PE code designation of PE 3408 and have a cell classification of 345464C as described in ASTM D-3350.
3. HDPE pipe shall be Driscoplex 4100 series IPS or approved equal.
4. The pipe shall contain no recycled compound except that generated in the manufacturer’s plant from the resin of the same specification from the same raw material.

5. HDPE pipe shall be BLACK.
6. The pipe shall be homogeneous throughout and free of visible cracks, bubbles, holes, foreign inclusions, or other injurious defects. It shall be uniform in color, opacity, density, and other physical properties and produced to the dimensions and tolerances specified in ASTM F-714. The inside and outside surfaces shall be semi-matte or glossy in appearance. Any pipe not meeting these criteria shall be rejected.

B. Fittings: HDPE fittings shall meet AWWA C906 (or C901), ASTM D-3350, and ASTM F-714. All fittings shall be fully pressure rated and provide a working pressure equal to that of the pipe with an included 2:1 safety factor. HDPE fittings shall be joined to HDPE pipe via heat fusion.

C. Joining: All HDPE pipe and HDPE fittings shall be joined via heat fusion unless otherwise shown on plans. Heat fusion shall follow the manufacturer's recommendations and shall meet ASTM D-3261. Fusion operators shall be certified by the pipe manufacturer. Extrusion welding or hot gas welding shall not be allowed.

2.3 FITTINGS

A. Size, grade, joint type, and lining to match pipe, and as recommended by the pipe manufacturer.

2.4 FITTINGS FOR PLASTIC PIPE

A. For plastic pipe use cast or ductile iron fittings. For cast iron O.D. pipe, use standard cast fittings. For IPS O.D. pipe use IPS cast fittings or standard cast fittings with transition gaskets.

B. Fittings for PVC C900 CL150 shall be PVC C900 CL150 (slip-on).

C. Fittings for PVC C900 CL200 shall be ductile iron (mechanical joint). The interior of the ductile iron fittings shall consist of a cement-mortar lining that meets ANSI/AWWA C104. The exterior of the ductile iron fittings shall consist of a protective fusion-bonded epoxy that meets AWWA/ANSI C166.

2.5 COUPLINGS FOR PLAIN ENDS AND DISSIMILAR PIPES

A. Sleeve and transition type couplings shall be factory manufactured to ensure a tight fit and smooth flow transition at the joint. The fittings (ductile iron) interior shall consist of a cement-mortar lining that meets ANSI/AWWA C104. The fittings (ductile iron) exterior shall consist of a protective fusion-bonded epoxy that meets AWWA/ANSI C166.

2.6 VALVES

A. Valves: The manufacturer's name and pressure rating are marked on the valve body.

B. Gate Valves Up To 3 Inches:

1. Brass or Bronze body, non-rising stem, inside screw, single wedge, or disc, IPS ends, and handwheel.
2. Product: Powell U.S. Bronze Gate Valves or approved equal.

C. Gate Valves 3 Inches and Over:

1. AWWA C509-01, iron body, bronze trim, non-rising stem with square nut, single wedge, resilient seat, mechanical joint, or flanged ends as indicated, and cast-iron valve box.
2. Product: Mueller Gate Valve or Resilient Seat Gate Valve, with appropriate type Tyler 564 A Cast Iron Valve Box or approved equal.

D. Corporation Stops: shall be a type for connecting to copper or polyethylene pipe; Mueller No. H-15000, or approved equal, for up to a 2-inch service line.

2.7 ACCESSORIES

A. Service Clamps: shall be bronze, double-strap type; Mueller No. H-16134, or approved equal, for up to 2-inch service lines.

B. Concrete for Thrust Restraints: Concrete type specified in Normal Weight Structural Concrete - Section 03 31 00.

1. Restraint Devices for PVC Pipe shall incorporate a series of serrations on the inside diameter to provide positive restraint, exact fit, 360-degree contact, and support of the pipe wall.
2. Restraint Devices shall be manufactured of high strength ductile iron, ASTM A536, Grade 65-45-12, or ASTM A36 structural steel.
3. Bolts and connecting hardware shall be of high strength low alloy material following ANSI/AWWA C111/A21.11
4. Restraint Devices for PVC Pipe shall have a water working pressure rating equivalent to the full rated pressure of the HDPE Pipe on which they are installed, with a minimum 2:1 safety factor in any nominal pipe size.
5. Notarized certification from the manufacturer of the restraint device shall be provided with submittals.
6. Restrain Devices for mechanical Joint or Push-On fittings shall be Uni-Flange 1300 (series) or approved equal.

2.8 CONCRETE

A. Following State of California, Department of Transportation (CalTrans), Standard Specifications for Construction.

PART 3 - EXECUTION

3.1 GENERAL

A. Construct the water system to the lines and grades shown or established in the field.

3.2 TRENCHING

A. Section 31 23 33 – Utility Excavation & Backfill

3.3 BEDDING

A. Section 31 23 33 – Utility Excavation & Backfill

3.4 INSTALLATION OF SLIP LINE PIPE - NOT USED

3.5 INSTALLATION OF DIRECT BURIAL PIPE

A. Inspection: Inspect pipe for defects before lowering it into the trench. Defective, damaged, or unsound pipe will be rejected.

B. Laying: After the trench bottom has been prepared for pipe installation following Section 31 23 33, lay pipe with bells facing in the direction of laying unless otherwise approved. On slopes exceeding 20 percent, bells shall face upgrade and laying shall proceed upgrade. Where connections are made with other lines, bells may face as needed.

C. Cleaning: As work progresses, clear the pipe interior of dirt and other debris by keeping swabs in the pipe and pulling them forward past each completed joint.

D. Pipe Cutting: Cutting for closure or other reasons shall be done neatly by methods recommended by the manufacturer.

E. Jointing: Clean gaskets, seats, and threads of foreign materials before joint assembly. Apply lubricant or sealing tape as recommended by the manufacturer.

1. Push-On Joint: Carefully insert the faucet end into the bell to prevent the entry of dirt and incorrect entry angle. With a fork tool or crowbar, or by hand, make the joint to the insertion depth recommended by the manufacturer. When the selected pipe uses joints not designed for full depth insertion, prevent further closure of previously completed joints by the restraining movement of the installed line while making succeeding joints.
2. Mechanical Joint: Carefully center the faucet in the bell and position the gasket evenly in the seat. Tighten bolts alternately to an even torque, causing the follower gland to expand the gasket uniformly for a tight seal.
3. Plain End Jointing: Install factory-made couplers per manufacturer's directions. Center the coupling collar over the joint and tighten bolts evenly.

4. Threaded Joint: Cut threads accurately with sharp dies. Assemble screwed joints after applying Teflon tape to male threads. Once the joint has been tightened, backing off will not be permitted unless the new tape is applied to the threads.
5. Flanged End Jointing: Install correct gasket for flange faces used and tighten bolts evenly.
6. Flared End Jointing: Check that the tube end is round. Ream all tube ends to remove burrs before flaring. Use a sharp deburring tool as manufactured by T-Drill, Norcross, Georgia, or approved equal.

3.6 DEFLECTION AT PLASTIC JOINTS

A. Follow deflection guidelines of the pipe manufacturer.

3.7 PIPE ENDS

A. Valve, plug, or cap future connection stubs, fittings, and taps as shown.

3.8 CONCRETE THRUST BLOCKS

A. Construct at all bends, tees, crosses, reducers, valves, and dead ends as shown and as recommended by the pipe manufacturer.

3.9 BACKFILLING

A. Section 31 23 33 – Utility Excavation & Backfill

B. All buried water lines, metallic and nonmetallic, shall be marked with detectable identifying tape.

3.10 WATER LINE MARKING

A. Section 33 05 97.16 – Markers for Utility Identification

3.11 FINAL PIPE CLEANING

A. Before testing, clean all lines to be tested by high-pressure water jet or mechanical means. Remove and dispose of fluidized materials as approved.

3.12 TESTING

A. Section 33 14 00.30 – Testing of Water Lines

3.13 SURFACE FINISH WORK

A. Section 31 23 33.20 – Restoration of Surfaces

3.14 DISINFECTION

A. After completion of testing and before placing in service, disinfect the potable water system as specified in Section 33 14 00.30 – Testing of Water Lines.

END OF SECTION

SECTION 33 14 00.30

TESTING OF WATER LINES

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work of this Section consists of leak testing water lines and related valves and fittings. Rejected work shall be retested or replaced.

1.2 QUALITY ASSURANCE

A. Flow meters shall record the actual volume plus or minus 2 percent.

B. Water test gauges shall be ANSI B40.1.80, Grade 2A (plus or minus one half (0.5) percent of full-scale accuracy), dial range approximately twice the required test pressure.

1.3 SUBMITTALS

A. As specified in “Submittals” - Section 01 33 23.

1. Accuracy certification by approved independent testing laboratories for flow meters and test gauges. Certifications shall be dated no more than 30 days before actual system testing.
2. Before testing, provide the following information:
   a. All Tests: Describe precautions that will be taken to protect system equipment that might be damaged under test pressures and the proposed method for bypass pumping where the system must remain in service.
   b. High-Pressure Water Test: Describe the proposed method for the disposal of water used inline testing.

1.4 PROJECT CONDITIONS

A. Testing shall not be performed until each system has been flushed or thoroughly cleaned.

B. Not Used.

C. Water for Flushing and Testing: See “Temporary Facilities & Controls” - Section 01 50 00.

PART 2 - PRODUCTS - NONE

PART 3 - EXECUTION

3.1 GENERAL

A. Perform testing in the Contracting Officer's presence after backfilling and proper compaction of trenches. Where lines are installed under roadways and parking areas, perform tests after completion of final subgrade preparation and before application of surface courses. Notify Contracting Officer at least 5 days before testing.

B. Prepare each section for testing, using adequate bracing; protect system equipment susceptible to damage by test pressures; make provision for installation of Government pressure gauge in parallel with Contractor's gauge, if so requested; and maintain services where required.

3.2 TESTING OF WATER LINES

A. Isolate components that may be damaged by the specified pressure test conditions.

B. Perform pressure tests using calibrated pressure gauges and calibrated volumetric measuring equipment to determine leakage rates. Select each gauge so that the specified test pressure falls within the upper half of the gauge’s range. Notify Contracting Officer 24 hours before each test.

3.3 HDPE WATER LINES

A. Test all HDPE waterlines per Section 33 11 00.10 - Testing of HDPE Water Lines & Sewer Force Main Lines

B. Pressure testing of all HDPE pressure piping shall be performed following guidelines established under AWWA M55, PE Pipe - Design and Installation guidelines.

C. HDPE piping shall be tested separately from all other non-HDPE piping.

3.4 ALL OTHER NON-HDPE WATER LINES

A. Fill line with water; eliminate all air. Allow a minimum standing time of 2 hours for materials to absorb water.

B. Raise the internal pressure by pumping in water to 50 psig above the maximum anticipated service pressure (ignore water hammer) at the point of test gauge attachment.

C. Maintain the test pressure within 5 psig for 2 hours by pumping in metered quantities of makeup water.

D. The line section will have passed the test if the metered makeup water does not exceed that determined by the following formula: Leakage in gallons equals 0.00002 times the nominal diameter of the pipe in inches times the length of the test section in feet times the square root of the test pressure in psig.

E. Do not use paints, asphalts, tars, or other types of pipe compounds to eliminate leaks.

F. Replace leaking fittings, nipples, or lengths of pipe at the Contractor's expense.

G. Testing methods and criteria

1. Liquid systems
   a. The following liquid piping systems shall have zero allowable leakage at the specified test pressure throughout the specified duration: exposed piping, buried insulated piping, and buried or exposed piping carrying liquid chemicals.
   b. The allowable leakage of buried liquid piping systems that are not carrying liquid chemicals shall be determined as follows:
      1) Polyvinyl chloride (PVC) pressure pipe systems: Test PVC pressure pipe following the latest version of AWWA C605. Per AWWA C605, the allowable leakage in gallons per hour from buried PVC pressure pipe systems shall be less than the number of joints in the length of pipeline tested, times the nominal diameter of the pipe in inches, time the square root of the average test pressure during the leakage test in pounds per square inch (gauge), divided by 7,400. The duration of each leakage test shall be 2 hours. The equation for computing the allowable leakage is:

$$L = \frac{ND\sqrt{P}}{7{,}400}$$

Where:

L = allowable leakage, in gallons per hour
N = number of joints in the length of the pipeline tested
D = nominal diameter of the pipe, in inches
P = average test pressure during the leakage test, in psi

2. Unless otherwise specified, the allowable leakage in gallons per hour from other buried liquid piping systems shall be less than the length of the pipeline tested in feet, time the nominal diameter of the pipe in inches, times the square root of the average test pressure during the leakage test in pounds per square inch (gauge), divided by 133,200. The duration of each leakage test shall be 2 hours. The equation for computing the allowable leakage is:

$$L = \frac{SD\sqrt{P}}{133{,}200}$$

Where:

L = allowable leakage, in gallons per hour
S = length of the pipe tested, in feet
D = nominal diameter of the pipe, in inches
P = average test pressure during the leakage test, in psi

3. Types of pressure testing and inspection to be employed include hydrostatic pressure testing, cylinder water pumped compressed air or cylinder nitrogen testing, low-pressure air testing, and hydrostatic ex-filtration/infiltration testing.
   a. Hydrostatic pressure testing
      1) For buried piping: Perform testing after backfilling and proper compaction of trenches. Where lines are installed under roadways and parking areas and perform tests after completion of final grade preparation and before application of surface courses. Notify the Engineer at least 48 hours before testing. Provide temporary restraints for expansion joints for additional pressure load under test. Isolate equipment in the piping system with rated pressure lower than pipe test pressure by valves or blind flanges.
      2) For exposed piping: Prepare each section for testing, using adequate bracing and protect system equipment susceptible to damage by test pressures. Do not paint or insulate exposed piping until the successful performance of the pressure test.

3.5 PIPE TEST RESULT FORMS

HYDROSTATIC PIPELINE LEAKAGE TEST FOR PVC
(Based on AWWA C-605)

Project Title: _____

Project Number: _____

Date of Test: _____

Pipeline Service: _____

Pipeline Description: _____

Test Point: _____

Test Duration: _____ hour(s)

Test Pressure (P): _____ psi

Pipe Diameter (D): _____ inches

Number of Joints (N): _____ feet

Allowable Leakage (L): _____ gal/hr

$$L = \frac{(N)(D)\sqrt{P}}{7{,}400}$$

Test Data

Time	Pressure (psi)	Meter Reading (gal)	Water Added (gal)	Comments

Actual Loss: _____ gals/hr or _____ ounces/hr

Test Status: £ **Passed** £ **Failed**

Was this Test in accordance with AWWA C-605 testing procedures? £ Yes £ No

We hereby certify that the testing completed on the above-referenced pipeline(s) is in accordance with the requirements of the Contract Documents.

Test Performed By: _____

_____(Company)

_____

Witnessed By: _____(Company)

3.6 FLUSHING AND DISINFECTION PLAN REQUIREMENTS

A. The elements listed below must be addressed in the submitted plan before approval to proceed will be granted by the Facilities Branch. While the items below address critical requirements for flushing and disinfecting waterlines they may not address all situations or conditions in the field. It is the contractor's responsibility to meet all state and federal requirements. It is also the contractor's responsibility to comply with all codes and standards that may apply to the specific project or situation. The Facilities Branch office is available for consultation before plan development or approval after these critical elements are assembled in a draft plan. Allow 15 working days for approval after draft submission.

B. Requesting party

Complete	N/A	Incomplete	
£	£	£	Project name, include distinct name if more than one plan is anticipated during the course of the project
£	£	£	Name and address of contractor performing
£	£	£	Contractor representative, including 24 hour/ 7 day per week phone number
£	£	£	NPS PM or representative, 24 hour/ 7 day per week phone number

C. Description of work to be completed

Complete	N/A	Incomplete	
£	£	£	Purpose of this project
£	£	£	Description of what will this work fix, modify or repair
£	£	£	Pipe size and length(s)_____
£	£	£	Total constructed length_____
£	£	£	Pipe construction material(s)_____
£	£	£	Accurate and legible maps and drawings
£	£	£	Copy of plans to Design and Engineering

D. Site visit

Complete	N/A	Incomplete	
£	£	£	Site visit completed by Facilities Management representative (name)_____ (date)_____
£	£	£	Facility Operator to verify and operate valves before the plan
£	£	£	Approval of Traffic control requirements for Facility Operator

E. Primacy

Complete	N/A	Incomplete	
£	£	£	Utility locates complete for NPS power, water, sewer, and USA Locate notification
£	£	£	Date requested for work to begin _____
£	£	£	Date requested for final hookup _____
£	£	£	NPS will maintain primacy of all valves connected to the utility
£	£	£	Utility system valve sequencing plan (switch order)
£	£	£	Add test plates or other defined means of separation
£	£	£	Water outage notification procedure, residential, NPS Fire, Dispatch and Daily Report
£	£	£	Fire hydrant outage requires NPS Fire notification and hydrant "out of order" posting
£	£	£	Emergency notification procedure

F. Public Health

Complete	N/A	Incomplete	
£	£	£	Backflow devices affected by planned outage require testing within the last 11 months
£	£	£	Plan meets authority of CDPH/ AWWA C651
£	£	£	NSF 60 approved additives, disinfectant (12.5% sodium hypochlorite)
£	£	£	NSF 61 approved materials and adhesives
£	£	£	Approved backflow device for flushing
£	£	£	Flush at 2.5 ft per second equaling _____ gallons per minute
£	£	£	List approved method for verifying chlorine measurements
£	£	£	Disinfect line with 25 ppm of free chlorine for 24 hours
£	£	£	Free chlorine residual after 24 hours must be > 10 ppm
£	£	£	Flush water to achieve normal background chlorine residual of 0.2-1.0 ppm
£	£	£	Collect two (2) coliform samples 24 hours apart and list location of samples
£	£	£	Samples determined negative for total coliform by laboratory personnel
£	£	£	Approved method of disposal for chlorinated water
£	£	£	Approved method of disposal for chlorinated water
£	£	£	Samples determined negative for total coliform by laboratory personnel
£	£	£	Failure of any standard requires retesting.

G. Public Health

Complete	N/A	Incomplete	
£	£	£	Final construction plans as built with survey control points for NPS Engineering
£	£	£	Hydrostatic leak testing completed
£	£	£	Remove all trench water and disinfect the work area with chlorine
£	£	£	Remove test plates
£	£	£	Verify protection of pipe/ sealed ends
£	£	£	Plan exceptions and final hook up shall only be approved by the Facility Manager in writing through the Project Manager/ COR.
£	£	£	Remove test plates

For Facility Management approval. Do not write below this line

Plan name_____ Submitted by _____ Date received_____

Plan approval for work to begin

£ Approved £ Denied by _____ Date _____

Final connection authorized by Facilities Branch Chief

£ Approved £ Denied by _____ Date _____

Notes:

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END OF SECTION

SECTION 33 30 00

SANITARY SEWERAGE

PART 1 GENERAL

1.1 DESCRIPTION

A. The work in this Section consists of furnishing and installing the pipe and related components for the sewer system including excavation, backfill, and compaction.

B. Related Sections:

1. Section 03 40 00 - Precast Concrete Items
2. Section 31 23 33 - Utility Trench Excavation & Backfill

1.2 REFERENCES

A. American Society for Testing and Materials

1. ASTM A 74-98, 'Standard Specification for Cast Iron Soil Pipe and Fittings'
2. ASTM C 564-97, 'Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings'
3. ASTM D 2235-96a, 'Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings'
4. ASTM D 2321-00, 'Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications'
5. ASTM D 2564-96a, 'Standard Specification for Solvent Cements for Poly Vinyl Chloride (PVC) Plastic Piping Systems'
6. ASTM D 2661-97a, 'Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings'
7. ASTM D 2665-00, 'Standard Specification for Poly Vinyl Chloride (PVC) Plastic Drain, Waste, and Vent Pipe Fittings'
8. ASTM D 3034-00, 'Standard Specification for Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings'
9. ASTM F 656-96a, 'Standard Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings'
10. ASTM F 789-95a, 'Standard Specification for Type PSM Poly Vinyl Chloride (PVC) Plastic Gravity Flow Sewer Pipe and Fittings'

1.3 QUALITY ASSURANCE

A. Regulatory Requirements - Install cleanouts and piping per local governing authority and State codes.

1.4 SUBMITTALS

A. Submit product data for materials to be installed or furnished under this section.

B. Submit manufacturer's certification that material meets or exceeds specified requirements including all test results and material identifications.

C. Submit manufacturer's installation instructions.

PART 2 PRODUCTS

2.1 COMPONENTS

A. Cast Iron Soil Pipe and Fittings

1. Meet requirements of ASTM A 74, Service Grade.
   a. Cast iron for bell and faucet fittings
   b. Cast iron for no-hub joints.
2. Approved Joint Material and Manufacturers
   a. For Bell and Faucet Pipe - Rubber gaskets meet the requirements of ASTM C 564 and are compatible with the pipe used.
   b. For No-Hub Pipe -
      1) Approved Products -
         a) Neoprene gaskets with type 304 stainless steel clamp and 24 ga type 304 stainless steel housing by Clamp-All Corp, Haverhill, MA (800) 762-7255 or (978) 372-9010 www.clampall.com
         b) SuperGrip 304 by AB&I - American Brass & Iron, Oakland, CA (800) 468-4766 or (510) 632-3467 www.abifoundry,com
         c) Husky SD 4000 coupling by ANACO, Anaheim, CA (707) 259-0602
         d) MG Coupling by MG Piping Products Co, Stanton, CA (800) 761-8055 or (714) 761-8055 www.mgcoupling.com

B. ABS Schedule 40 solid wall plastic pipe and fittings meeting requirements of ASTM D 2661 joined with pipe cement meeting requirements of ASTM 2235.

C. PVC Schedule 40 solid wall plastic pipe and fittings meeting requirements of ASTM D 2665 joined using cement primer meeting requirements of ASTM F 656 and pipe cement meeting requirements of ASTM D 2564.

D. Solid wall PVC plastic pipe and fittings meeting requirements of ASTM D 3034 with a min. SDR 35 wall thickness. Joints shall be elastomeric gasket joints with ASTM F477-02 elastomeric gaskets.

E. Clean-out Frame and Covers shall be close-grained, gray iron, castings free from blowholes conforming to ASTM A48 Class 20 or better.

F. Septic Tank

1. General: Pre-cast Concrete Septic Tanks: ASTM C 1227, precast reinforced concrete of depth indicated with provision for rubber gasket joints.
   a. Grade Rings - Provide 2 or 3 reinforced concrete rings of 6 to 9 inches total thickness and match 24 inches diameter frame and cover.
   b. Gaskets - ASTM C 443, rubber.
   c. Steps - Cast into the base, riser, and top sections sidewall at 12 inches intervals.
   d. Pipe connectors - ASTM C 923, resilient, of the size required for each pipe connecting to the base section.
2. Frames & Covers
   a. ASTM A 536, Grade 60-40-18, heavy-duty, ductile iron, 24 inches inside diameter by 7 to 9 inches riser with 4 inches minimum width flange and 26 inches diameter cover indented top design, with lettering "SANITARY SEWER" cast into the cover.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before installation, inspect the pipe for defects and cracks. Do not use defective, damaged, or unsound pipes.

3.2 PREPARATION

A. Trench and backfill as specified in Section 31 23 00 with the following additional requirements:

1. Runs shall be as close as possible to those shown on the Drawings.
2. Excavate to required depth and grade to obtain fall required.
3. Bottom of trenches shall be hard. Tamp as required.
4. Remove debris from trench before laying of pipe.
5. Do not cut trenches near footings without consulting Contracting Officer.
6. Excavate trenches so the outside pipe will be 12 inches minimum below the frost line, 18 inches minimum below finish grade, or as indicated on the drawings, whichever is deeper.

3.3 INSTALLATION

A. General
1. When work is not in progress, close open ends of pipes and fittings so no trench water, soil, or other substances will enter pipes or fittings.
2. Keep trenches free from water until pipe jointing material has been set. Do not lay pipe when the condition of the trench or weather is unsuitable for such work.
3. Trench width at top of pipe - Outside diameter of pipe plus 2 feet.

B. Placing and Laying of Underground Pipe

1. Deflections from a straight line or grade, as required by vertical curves, horizontal curves, or offsets, shall not exceed 6/D inches per linear foot of pipe where D represents the nominal diameter of pipe expressed in inches
2. Deflections to be determined between center lines extended of 2 connecting pipes.
3. If alignment requires deflection more than these limitations, provide special bends or enough shorter lengths of pipe to provide angular deflections within limits approved by the contracting officer.
4. Laying
    a. Pipe laying shall proceed up-grade with faucet ends of bell-and-faucet pipe pointing in direction of flow.
    b. Lay each pipe true to line and grade and in such manner as to form a close concentric joint with adjoining pipe and to prevent sudden offsets of the flow line.
    c. As work progresses, the clear interior of pipe of dirt and superfluous materials. Where cleaning after laying is difficult because of the small pipe, keep a suitable swab or drag in the pipe and pull forward past each joint immediately after jointing has been completed.
5. Make joints between cast iron pipe and other types of pipes with standard manufactured cast-iron adapters and fittings.
6. Valve, plug, or cap, as directed by the contracting officer, where pipe ends are left for future connections.

C. Cast Iron Pipe and Fittings

1. Shape trench bottom to give uniform circumferential support to the lower third of each pipe. Provide depression under the bell of each joint to maintain even bearing of sewer pipe.
2. Connect to street main as required by local authorities.
3. Use jacks to make-up gasketed joints.

D. Thermoplastic Pipe and Fittings

1. Install per Manufacturer's recommendations and ASTM D 2321.
2 Stabilize unstable trench bottoms.
3. Bed pipe true to line and grade with continuous support from a firm base.
    a. Bedding depth - 4 to 6 inches.
    b. Material and compaction to meet ASTM standard noted above.
4. Excavate bell holes into bedding material so the pipe is uniformly supported along its entire length. Blocking to grade pipe is forbidden.
5. Piping and joints shall be clean and installed according to the Manufacturer's recommendations. Break down contaminated joints, clean seats, and gaskets, and reinstall.
6. Do not use a backhoe or power equipment to assemble pipe.
7. Initial backfill shall be 1 inch above the top of the pipe with the material specified in referenced ASTM standard.
8. Minimum cover over the top of the pipe
    a. 36 inches before allowing vehicular traffic over the pipe
    b. 48 inches before use of compaction equipment other than hand or impact tampers.

E. Septic Tank - General

1. Install septic tank complete with accessories as indicated. Elsewhere, set tops 3 inches above finish surface unless otherwise indicated.
2. Provide a rubber joint gasket complying with ASTM C 443 at joints of sections.
3. Apply bituminous mastic coating at joints of sections.

F. Clean-outs - General

1. Install per the Manufacturer's recommendations.
2. Place or grind castings, if necessary, to ensure flat, smooth, even, and true surfaces.

3.4 FIELD QUALITY CONTROL

A. Failure to install joints properly shall be cause for rejection and replacement of the piping system.

B. Testing

1. Perform testing in the presence of the Contracting Officer.
2. Gravity sewer piping shall be tested using the following methods:
   a. Visual Inspection - Visually inspect the pipeline between manholes with mirrors or lights after the trench has been backfilled to check alignment and grade, and to check for pipe distortions, leaks, infiltration, and other defects. Verify that the full diameter of the pipe is visible from one manhole to the next. Uncover and repair leaks and defects in the pipeline. Do not reinstall the damaged pipe.
3. Air Pressure Testing
   a. Low-pressure air test lines that are 24 inches and smaller in diameter.
   b. Provide equipment including gauges and instrumentation and calibrate the equipment at the request of the Contract Officer.
   c. Preliminary and Final Testing:
      1) Preliminary Testing: At the discretion of the Contractor, preliminary testing may be done at any time before the installation of other utilities.
      2) Final Testing: Perform final testing after backfilling and compaction and following the installation of other utilities, but before surface restoration.
   d. Test procedure:
      1) Securely brace plugs to prevent unintentional release of the plug. Prohibit workers from entering a manhole where a plugged pipe is under pressure.
      2) Locate pressure gauges, valves, and instrumentation required for the test and operation of the equipment at the ground surface.
      3) Equip the testing apparatus with a pressure release device such as a rupture disk or pressure relief valve to relieve pressure in the pipe being tested at 6.0 psi.
      4) Pressurize the pipe to 5.0 psi and disconnect the air supply.
      5) Test pressure shall maintain for 6 minutes and show no pressure drop.

C. Pipe Cleaning

1. Before deflection testing and CCTV inspection, clean the completed pipeline with a hydro- cleaner, or other Contracting Officer-approved cleaning equipment, and provide a pipeline free of dirt, mud, rocks, or other material. Leave downstream plugs in place during cleaning and do not introduce foreign material into existing sewer lines. Closed Circuit Television (CCTV) Inspection.

D. Deflection Tests for Flexible Pipe

1. Deflection tests all flexible pipelines no sooner than 30 days after trench backfill and compaction are completed. Unless otherwise provided in the contract, the Contractor is to bear costs associated with completing surface repair or other work before all required testing. The maximum allowable deflection is to be 5.0%of the nominal pipe diameter.
2. Provide test mandrels with a diameter of at least 95 percent of the actual inside diameter (ID) of the pipe. For pipes with controlled outside diameter, calculate the actual ID of the pipe by taking the average outside diameter (OD) as set by the ASTM standard minus 2 times the minimum wall thickness as set by the ASTM standard. For pipes with controlled inside diameter, use the ID set by the ASTM standard.
3. The mandrel shall be constructed of a metal or a rigid plastic material that can withstand 200 psi without being deformed. The mandrel shall have nine or more “runners” as long as the total number of legs is odd. The length of the mandrel barrel section shall be a minimum of 75 percent of the inside pipe diameter. A proving ring shall be provided and used for each mandrel size in use.
4. Pull the appropriate mandrel through the pipe using one of the following methods:
   a. Pull the mandrel through the pipe by hand. If the pipe will not allow the mandrel to pass, repeat the test from the opposite direction to determine the limits of failure.
   b. As a part of the CCTV inspection, pull the mandrel through the pipe by connecting it in front of the CCTV camera lens at a distance equal to the camera’s focal length. Notify Contracting Officer of time and date of test at least 24 hours before testing to allow for Contracting Officer, at Contracting Officer’s discretion, to witness the test. Provide tag line to reverse mandrel and camera should mandrel fail to pass through-line. Perform the test as a separate step from the CCTV inspection thus a separate VHS tape-record must be made of the mandrel test. Mark tape identifying project name, mandrel test, and the pipe will not allow the mandrel to pass, repeat the test from the opposite direction to determine the limits of failure.
5. Uncover and, if required by the Contracting Officer, remove, and reinstall new pipe sections for reaches with excessive deflection or recompact bedding if, in the opinion of the Contracting Officer, the existing pipe is not damaged. Retest pipe after any repair work is completed. Do not reinstall the damaged pipe.
6. Use a “Go-Nogo” pin gauge instead of a mandrel if “Insta-Tap” tee fittings are used for service connections. Use test diameter per E.2 above.
7. The Owner may conduct additional deflection testing before the expiration of the warranty period. Uncover and reinstall sections of the pipe found to have excessive deflection. Do not reinstall the damaged pipe.

END OF SECTION

SECTION 33 31 13

SITE SANITARY SEWERAGE GRAVITY PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. The WORK under this Section includes providing all labor, materials, tools, and equipment necessary for furnishing and installing sanitary sewer pipes, per these Specifications and in reasonably close conformity with the lines and grades shown on the Drawings or established by the Contracting Officer.

B. This WORK includes furnishings and installing connecting bands, branch connections, elbows or other fittings, and all appurtenances required to complete the sanitary sewer.

1.2 RELATED WORK

A. Section 33 01 30.40 - Sewer & Manhole Testing.

1.3 SUBMITTALS

A. Sanitary Sewer Pipe: Material certifications stating conformance with the requirements of this Section.

PART 2 - PRODUCTS

2.1 DUCTILE IRON PIPE (GRAVITY AND PRESSURE SEWER)

A. Ductile Iron Pipe shall conform to ANSI A21.51. Pipe and fittings shall be cement mortar lined in conformance with ANSI A21.4 and shall have an exterior bituminous coating conforming to the requirements of ANSI A21.10. Pipe joints shall conform to ANSI A2.11 and shall be push-on type as manufactured by United States Pipe and Foundry Company for Tyton pipe, or equal.

B. Before the use of any pipe, the CONTRACTOR shall furnish a certification from the pipe manufacturer that all required tests have been made and that the pipe fully complies with the requirements of ANSI A21.51.

C. The nominal pipe diameter is shown on the Drawings. No change in pipe diameter shall be made unless approved by the CONTRACTING OFFICER. The minimum pipe strength shall be thickness Class 52. The pipe size and thickness class shall be clearly marked on each pipe.

D. Where special fittings are required, they shall be fabricated from steel pipe manufactured following AWWA Standard C200. The steel fitting shall be fabricated with faucet ends suitable for connection to the ductile iron pipe, with cast iron transition couplings as manufactured by Smith-Blair, Inc., or equal. Steel fittings shall be lined and coated with a fusion epoxy system as supplied by Water Works Supply Company, Union City, California, or with hot-applied coal tar following AWWA C203.

E. Connections between the ductile iron pipe and PVC pipe shall be made with 'ROMAC" Stainless Steel Sleeve or approved equal.

2.2 PVC SEWER PIPE

A. PVC Sewer Pipe, 4” through 15” in diameter, inclusive, shall have a standard dimension ratio (DR) of 25, and conform to AWWA C900-07 with gaskets meeting ASTM F477 and joints in compliance with ASTM D3139. Before any PVC pipe is used on this Project, the CONTRACTOR shall supply certifications, signed by an authorized agent of the seller or manufacturer, stating that the material has been sampled, tested, and inspected following ASTM D 1599.

B. PVC Sewer Pipe greater than 15 inches in diameter shall conform to ASTM F 679. Before any PVC pipe is used, the CONTRACTOR shall supply certifications, signed by an authorized agent of the seller or manufacturer, stating that the material has been sampled, tested, and inspected following ASTM F 679. The pipe shall have integral wall bell and spigot joints conforming to ASTM D 3212. The bell shall consist of an integral wall section with a solid cross-section elastomeric ring, factory assembled, securely locked in place to prevent displacement.

C. Flexible water-tight connections, approved by the CONTRACTING OFFICER, shall be used at PVC pipe connections to manholes and other rigid structures.

2.3 PVC PIPE ENCASED IN CONCRETE

A. PVC pipe encased in concrete shall conform to the applicable requirements of ANSI/AWWA C900-07 with gaskets meeting ASTM F477 and joints in compliance with ASTM D3139 and subject to additional requirements specified herein.

B. The pipe shall be DR25 and shall be furnished complete with rubber gaskets.

2.4 PVC PIPE ABOVE GROUND - INSULATED

A. PVC above ground - insulated pipe system shall be INSUL-SEAL, Insulated PVC system or pre-approved equal and shall consist of 10-foot units insulated with urethane foam which is protected with a polyethylene sleeve. The outer jacket shall be C900 PVC and conform to ASTM D 1599.

B. PVC above ground - insulated pipe (inner pipe) shall be C900 PVC and conform to ASTM D 1599 and subject to additional requirements specified herein.

C. R-value of foam shall have a rating of at least 14.

D. Installation

1. All pipes and accessories shall be per the manufacturers' recommendations.
2. Immediately after installation, for any portions to be buried in the ditch, a partial backfill shall be made in the middle of each unit leaving joints exposed for inspection.
3. After placement, a hydrostatic test of 5 psi shall be required for 6 minutes and show no pressure drop.
4. After the hydrostatic test, a final backfill of selected earth shall be hand placed and hand tamped in 4" layers to 12" minimum over the top of the jacket. The remainder of the backfill shall be free of large boulders, rocks over 6 inches in diameter, frozen earth, or foreign matter. The backfill operation can now be completed by any convenient means. Do not use tracked or wheeled vehicles for tamping.

E. Pre-approved Manufacturer

1. INSUL-SEAL, Insulated PVC
   217 Harrison Street North
   Box 68
   Racine, Minnesota 55967
   Tel: 507.378.4131
   Email: info@insulseal.com
   Website: http://www.insulseal.com/index.html

2.5 HDPE PIPE

A. High-Density Polyethylene (HDPE) pipe shall conform to ASTM F714 designation PE 4710. Pipe for pressure sewer mains shall have a minimum pressure rating of 200 psi and a Dimension Ratio (DR) of 9. Pipes for 18" gravity sewer trunk main shall have a pressure rating of 80 psi and a Dimension Ratio (DR) of 21. Pipes for 6" and 8" gravity sewer laterals and mains shall have a pressure rating of 100 psi and a Dimension Ratio (DR) of 17. Sewer force main HDPE piping shall have a standard iron pipe size (IPS) outside diameter. Gravity sewer main HDPE piping shall have a standard ductile iron pipe size (DIPS) outside diameter.

B. The pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, or other injurious defects. It shall be uniform in color, opacity, density, and other physical properties.

C. The pipe shall be marked at 5' intervals with a coded number that identifies the manufacturer, DR size, PPI rating, manufacturing standard reference, and production code from which data and place of manufacturer can be determined.

D. When HDPE pipe is connected to ductile iron pipe, a flange adapter shall be used. A flange-coupling adapter shall be used on the ductile iron pipe. HDPE flange adapters shall be manufactured by the same manufacturer as the pipe using the same resin as the pipe. Each flange adapter shall be furnished with a ductile iron convoluted backup ring drilled to match the standard ANSI bolt pattern for the nominal diameter of the pipe used.

E. Connection of the pipe and fittings shall be performed by the thermal butt fusion system. HDPE pipe lengths, fittings, and flange adapter connections to be fused shall be of the same type, grade, and class of polyethylene compound and supplied by the same raw material supplier.

PART 3- EXECUTION

3.1 CONSTRUCTION

A. Bedding and backfill shall conform to the requirements of Utility Excavation and Backfill.

B. Sheeting and bracing required for trenches shall be removed to the elevation of the conduit, but no sheeting will be allowed to be pulled, removed, or disturbed below the conduit. Sheeting and bracing shall meet OSHA requirements.

C. Before lowering into the trench, the pipe shall be inspected for defects. All cracked, chipped, or broken pipes shall be discarded. The ends and interior of the pipe shall be clean. Belled ends shall be laid upgrade. Handling of the pipe shall be accomplished in a manner that will not damage the pipe. The joint shall be made in the manner recommended by the manufacturer. Care shall be taken not to buckle or disturb previously laid pipe.

D. The pipe shall be laid accurately to the staked line and grade. All service connections shall be installed as indicated on the Drawings. Where existing service sewers are to be connected, the contractor shall provide suitable fittings and adapters.

E. The pipe shall be cleaned of all foreign matter, and water shall be kept out of trenches until joints have been completed. When WORK is not in progress, open ends of pipe and fittings shall be securely closed to keep foreign matter and animals from entering.

F. Each joint shall be inspected to ensure that it is properly made before backfilling is done. Care shall be taken to prevent any dirt or foreign matter from entering the open end of the pipe. Where it is necessary to cut pipe, such cuts shall be neatly made in an approved manner. The laid pipe shall be true to line and grade and, when completed, the sewer shall have a smooth and uniform invert. No section of gravity sewer, including service connections, shall have an adverse grade which would be pond water in the invert of the sewer.

G. Connections to existing sewer mains, service connections, and manholes shall be made in such a manner as to not damage the existing facility. Such connections shall be made so that no projections or rough surfaces occur within the pipe.

H. Lateral connections to existing sewer mains shall not obstruct flow and shall be with a Romac CB saddle or equivalent. No “insert-tees” are allowed.

I. Lateral connections to new sewer mains shall be made with a manufactured sanitary wye of the same material as the mainline pipe.

J. Where gravity flow sanitary sewers cross above or less than 18” below waterlines, or approximately parallel water lines within 10’ horizontally, the sewer pipe shall meet the requirements of ductile iron pipe or PVC pressure pipe, as described in Part 2 of this Section. All sewer mains shall be installed to the criteria for the separation of water mains and sanitary sewers outlined in the California Water Works Standards contained in the California Administrative Code. Any deviations from such requirements must be approved by the National Park Service.

K. HDPE to HDPE connections shall be made by thermal butt fusion, following ASTM D2657. Fusion jointing shall utilize a pipe manufacturer-approved fusion machine operated by experienced and qualified personnel. The CONTRACTOR shall provide three copies of a "Heat Fusion Qualification Guide," published by the HDPE manufacturer that provides criteria for inspection of thermal fusion joints. The guide shall include criteria for operator training requirements and experience; visual inspection criteria (including photographs) for both intact thermal fusion joints and sample strips cut for thermal fusion joints. The thermal fusion machine operator shall perform a minimum of three test joints in the presence of the CONTRACTING OFFICER. The test joints will be examined from both exterior appearances and the appearance of the joint cross-section once the samples have been cut into strips.

L. Bolted HDPE to HDPE connections shall include a polyethylene flange adapter (stub end) butt fused to the pipe, a backup flange ring, bolts, nuts, and a gasket. Flange rings shall be Standard Steel ring Flanges, Class D, following AWWA C207. High-strength bolts, nuts, washers, and gaskets shall be in conformance with AWWA C207, Appendix A. Flange rings, bolts, nuts, and Washers shall be hot-dip galvanized after fabrication per ASTM A153 and A386. Gasket dimensions and bolt lengths shall be per the pipe manufacturer's recommendations.

3.2 FIELD QUALITY CONTROL

A. Failure to install joints properly shall be cause for rejection and replacement of the piping system.

B. Gravity Lines Testing

1. Perform testing in the presence of the Contracting Officer.
2. Above ground PVC insulated pipe. See section 2.4.D.
3. Testing shall be per specification section 33 01 30.13 - Sewer & Manhole Testing.

C. HDPE Force Main Testing

1. Perform testing in the presence of the Contracting Officer.
2. Testing shall be per specification section 33 11 00 10 “Testing HDPE Pipe.”

END OF SECTION

SECTION 33 31 23

SANITARY SEWERAGE FORCE MAIN PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work covered in this Section includes furnishing, installing force main piping systems, and fittings for project sewer lines between pump stations and gravity sewer mains including miscellaneous products, accessories, and appurtenant items.

1.2 RELATED SECTIONS

A. Section 22 11 00 - “Facility Water Distribution.”

B. Section 33 32 13.13 - “Wastewater Lift Station Pump.”

C. Section 31 23 33 - “Utility Excavation & Backfill.”

D. Section 33 14 00.30 - “Testing of Water Lines.”

1.3 REFERENCES

A. Handbook of PE Pipe, 2nd ed. - Plastic Pipe Institute.

B. Plastic Pipe Institute - Technical Notes and Reports:

1. TN-42 2013 - Recommended Minimum Training Guidelines for PE Pipe Butt Fusion Joining Operators for Municipal and Industrial Projects.
2. TR-33 2012 - Generic Butt Fusion Joining Procedure for Field Joining of Polyethylene Pipe.

1.4 SUBMITTALS

A. See “Submittals” - Section 01 33 23 for submittal procedures.

B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories.

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

D. Certifications of personnel involved in Butt Fusion Welding.

E. Project Record Documents: Record actual locations of pipelines, valves, connections, thrust restraints, and invert elevations. Identify and describe unexpected variations to subsoil conditions or the discovery of uncharted utilities. Contractor records and drawings shall be submitted with as-built submittals. Contractor to maintain as-built throughout the project duration during construction on-site.

1.5 DELIVERY, STORAGE, PROTECTION, AND HANDLING

A. Deliver and store valves in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

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

D. Deliver and store piping covered to protect piping from ultraviolet UV exposure.

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

PART 2 - PRODUCTS

2.1 SEWER PIPE

A. High-Density Polyethylene (HDPE) PE 4710 DR 9 Class 250 minimum:

1. Resin: Resin shall be PE4710 or better with a minimum 2% carbon black content.
2. Fittings: AWWA C906 revised to incorporate PE4710.
3. Joints: HDPE pipe to HDPE pipe shall be thermal butt fusion type. HDPE pipe to HDPE bolted flanged fitting joints shall be thermal butt fusion type. HDPE pipe to other pipe types (PVC or Ductile Iron) or ductile iron fittings/flanges (e.g., valves, extenders, flex connectors) shall be by bolted flange connections.
4. HDPE Piping - Shall be delivered in 500 Ft. Coils minimum length.

B. Ductile Iron Pipe: AWWA C151/A21.51-02

1. Pipe: Ductile or gray iron, standard thickness.
2. Flanged AWWA 115
3. Mechanical AWWA C151
4. Joints: Flanged AWWA 115
5. Mechanical AWWA C151

2.2 FITTINGS, JOINTS, AND GASKETS

A. Fittings

1. Flanged: AWWA C110
2. Mechanical: AWWA C153

B. Gaskets

1. Flanged: AWWA C111
2. Mechanical: AWWA

C. Bolts: ASTM A307 / AWWA C115/ C110

2.3 VALVES

A. Valves: The manufacturer's name and pressure rating are marked on the valve body.

B. Plug Valves

1. See Specification Section 33 39 23 - Sanitary Sewer Cleanouts & Valves

C. Gate Valves

1. Not Used

D. Corporation Stops: shall be typed for connecting to copper or polyethylene pipe; Mueller No. H- 15000, or approved equal, for up to a 2-inch service line.

2.4 COMBINATION AIR RELEASE/VACUUM VALVE

A. The combination air release/vacuum valve shall comply with AWWA C512.

B. Manufacturers shall have a quality management system that is certified to ISO 9001 by an accredited, certifying body.

C. Valves shall have a full-size NPT 2-inch inlet and 1-inch outlet. The body inlet connections shall be hexagonal for a wrench connection. The body shall have a 2-inch NPT cleanout and 1-inch NPT drain connection on the side of the casing.

D. The valve shall have three additional NPT connections for the addition of backwash accessories.

E. Valves shall provide an extended body with a through-flow area equal to the nominal size. Floats shall be unconditionally guaranteed against failure including pressure surges. The seat shall provide drop tight shut off to the full valve pressure rating.

F. Valves shall have a full port orifice, a double guided plug, and an adjustable threaded orifice button. The 1-inch body shall be globe style to increase float clearance and reduce clogging. The plug shall be protected against direct water impact by an internal baffle and an extended float system. The plug shall have a precision orifice drilled through the center stem. The float shall include a sensitivity skirt to minimize spillage.

G. The valve body and cover shall be constructed of ASTM A126 Class B cast iron.

H. The float, plug, guide shafts, and bushings shall be constructed of Type 316 stainless steel. Non-metallic guides and bushings are not acceptable. Resilient seats shall be Buna-N.

I. The exterior of the valve shall be coated with a universal alkyd primer.

J. Wastewater Combination Air Valves shall be automatic float operated valves designed to exhaust air during filling of the piping system and close upon liquid entry. The valve shall open during draining or if a negative pressure occurs. The valve shall also release accumulated air from a piping system while the system is in operation and under pressure. The valve shall perform the functions of both Wastewater Air Release and Wastewater Air/Vacuum Valves.

K. Valve shall be a single body type, 1-inch wastewater combination air valve, VM-801A as manufactured by Val-Matic Valve and Manufacturing Corporation, or equivalent.

2.5 BEDDING AND COVER MATERIALS

A. Bedding and Backfill: As specified in “Utility Trench Excavation & Backfill” - Section 31 23 33.

2.6 ACCESSORIES

A. Concrete for Thrust Restraints: Concrete type specified in “Normal Weight Structural Concrete” - Section 03 31 00.

PART 3 - EXECUTION

3.1 QUALITY CONTROL

A. All equipment and procedures used shall be in strict compliance with the manufacturer’s recommendations. Fusing shall be accomplished by personnel certified as fusion technicians by a manufacturer of polyethylene pipe and/or fusing equipment.

3.2 EXAMINATION

A. Verify that sewer force main and mainline tee size, location, and invert are as indicated.

B. The contractor shall inspect each pipe and fitting before installation to ensure that there are no damaged portions of the pipe. Pipe damage before completion of the project shall be repaired or replaced by the Contractor.

C. Handling: Pipe, fittings, and accessories shall be carefully inspected before and after installation and those found defective shall be rejected. Pipe and fittings shall be free from fins and burrs. Before being placed in position, pipe, fittings, and accessories shall be cleaned and shall be maintained in a clean condition. Proper facilities shall be provided for lowering sections of pipe into trenches. Under no circumstances shall pipe, fittings, or any other material be dropped or dumped into trenches.

D. Storage: The pipe should be stored, if possible, at the job site in unit packages provided by the manufacturer. Caution should be exercised to avoid compression damage or deformation to the pipe. The pipe should be stored in such a way as to prevent material damage and protected from exposure to direct sunlight by covering it with an opaque material while permitting adequate air circulation above and around the pipe. Gaskets should be stored in a cool, dark place out of the direct rays of the sun, preferably in original cartons.

E. Assure exposed piping is sufficiently supported to bear the weight of the valve when it is installed.

3.3 PREPARATION

A. The pipe shall be joined by the butt fusion procedure outlined in ASTM F 2620 or PPI TR - 33. All fusion joints shall be made in compliance with the pipe or fitting manufacturer's recommendations. Fusion joints shall be made by qualified fusion technicians per PPI TN - 42.

B. Remove moisture, dirt, and foreign materials on the inside and outside of piping to be fused or joined before facing, fusing, and assembling joints.

C. Prepare pipe connections to equipment or structures with flanged connections only. No mechanical joints shall be used.

3.4 TRENCHING

A. See "Utility Trench Excavation & Backfill" - Section 31 23 33 for additional requirements.

B. Hand trim excavation for accurate placement of pipe to elevations indicated.

C. Backfill around sides and to top of the pipe with backfill material, tamp in place and compact, then complete backfilling.

3.5 INSTALLATION - PIPE

A. Maintain separation of non-potable water main from potable water sources per State code.

B. Establish elevations of buried piping to ensure not less than 3 feet of cover over the pipe, or encase in concrete as indicated on the drawings and as directed by the Contracting Officer.

C. Install pipe to indicated elevation to within a tolerance of 1 inch.

D. Install HDPE pipe and fittings to AWWA C906, ASTM F2206, and PPI Handbook of PE Pipe 2nd edition including Technical Reports and Notes.

E. Install PVC pressure piping and fittings to ASTM D2774-04.

F. Install pipelines to line and grade indicated.

G. Install pipe to allow for expansion and contraction without stressing pipe or joints.

H. Install trace wire above the top of the HDPE pipe.

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

3.6 TESTING

A. For Testing of Water Lines refer to Section 33 14 00.30

3.7 CLEANING

A. Clean the interior of piping systems thoroughly before installing.

B. Maintain pipe in clean condition during installation.

C. Before jointing piping, thoroughly clean and wipe joint contact surfaces and then properly face and fuse and or dress and make joint.

D. Immediately before pressure testing, clean and remove grease, metal cuttings, dirt, or other foreign materials which may have entered the system.

E. After work completion but before final acceptance, thoroughly clean work installed under these specifications. Clean fixtures, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated by operation of the system, from testing, or other causes.

3.8 FIELD QUALITY CONTROL

A. Perform field inspection and testing following Section 33 11 00.10.

B. If tests indicate Work does not meet specified requirements, remove work, replace, and retest at no cost to the Government.

END OF SECTION

SECTION 33 32 13.13

WASTEWATER LIFT STATION PUMP - ASH MOUNTAIN

PART 1 - GENERAL

1.1 SCOPE

A. Pumps and associated systems shall be fully operational and complete with all necessary motors, drives, piping, valves, fittings, gauges, controls, accessories, and appurtenances including spare parts, to form a complete operating system in compliance with these specifications and as shown on Drawings.

B. All components of pumps, including accessories, shall be provided by a single manufacturer unless otherwise specified herein to be provided by others. The contractor shall have sole responsibility for proper coordination to ensure adequate performance and compatibility of system components that are specified to be within the manufacturer's scope of supply. System components within a single manufacturer's scope of supply provided by other equipment manufacturers shall be rejected. Sole responsibility includes all components supplied by the manufacturer within their scope of supply, even if described in greater detail in another specification section or on Contract Drawings.

C. To assure proper interfacing and reliable operation of all system components, the Contractor shall coordinate and be responsible for the quantity and proper functioning of all components within the manufacturer's scope of supply, including those not of his manufacture.

D. The contractor shall perform equipment installation following the manufacturer's recommendations to ensure the system is fully operational and capable of functioning as intended.

E. The manufacturer shall provide the Contractor and Contracting Officer with arrangement drawings, process, and instrumentation diagrams (P&IDs), and any other information necessary for the Contractor to adequately price materials and labor required for a fully functional system including system startup and testing requirements. Electrical and instrumentation wiring, cabling, and conduit requirements, as well as plumbing and process piping, ancillary equipment, and temporary equipment required for startup and testing, shall be determined by the Contractor in coordination with the manufacturer and be provided by the Contractor if not provided by the manufacturer.

F. Pumps to be supplied as specified herein and shall be of end suction design of 50 HP, 3 phase motor at 460 volts for use in wastewater applications. The pump shall be sized to match the electrical consumption of the motor running at full load and dimensioned according to current NEMA standards. The discharge of the pump shall be 4 NPT inch discharge connection and the pump shall be capable of delivering 308 US GPM at 393 feet TDH to be supplied under this specification and shall be suitable for use in FM-certified explosion-proof applications having a heavy-duty, high-efficiency design.

1.2 QUALITY ASSURANCE

A. The equipment covered under this specification shall be a standard product of proven reliability. All units specified in this specification shall be supplied by a single pump manufacturer.

B. The pumps shall be tested per the standards of the Hydraulic Institute, ANSI/HI 11.6:2017, 3B. All testing is to be performed at the pump manufacturer’s facility. A performance curve shall be completed after the test and is included in the final data package.

1.3 SUBMITTALS

A. With the proposal, the pump manufacturer shall submit a typical pump outline drawing, typical cross-sectional drawing, and typical price book curve for the required conditions to demonstrate compliance with the referenced specifications.

B. A specific Installation and Operating Instructions shall be included in the shipment.

1.4 SHIPPING, DELIVERY, STORAGE, AND HANDLING

A. Submersible grinder pumps shall ship fully assembled.

B. The skidded pump and related equipment shall be unloaded, stored, and installed in strict accordance with the manufacturer's Installation and Operating Instructions and reviewed in detail to implement items relating to mounting, lubrication, power requirements, and pump rotation as contained in the manufacturer’s Installation and Operating Instructions to insure proper warranty. If storage is planned to be longer than 3 months or in a harsh environment, the manufacturer’s long-term storage instructions must be followed.

1.5 START-UP FIELD SERVICE

A. The pump manufacturer's representative shall include in the bid a minimum one-day start-up field service to supervise pump start-up and instruction on proper pump operation and maintenance.

B. Field/functional testing will be performed to ensure proper mechanical operation at the Jobsite. All testing to be used for evaluation shall be performed at the pump manufacturer's facility.

1.6 WARRANTY

A. Pumps shall be warranted for 2 years from defects in material and/or workmanship per the manufactures normal warranty statement.

PART 2 - PRODUCT

2.1 OPERATING CONDITIONS

A. The pump shall have a continuously rising head capacity curve from run-out flow through shutoff.

B. The pump shall be designed to operate continuously for extended periods at any point in the allowable operating range (AOR) of the curve without cavitation, overheating, or excessive vibration. The motor nameplate horsepower rating shall not be greater than specified herein.

C. TABLE 1 - PERFORMANCE DATA

Pump Part Number	CRN 64-4-1 H-G44-A-E-HQQE
Number of Units Required	2
Rated Duty Point Condition	
Capacity (Flow)	308 GPM
Total Dynamic Head (TDH)	393 Feet
Pump Efficiency	78.11%
Nameplate motor rating	50 hp
Rated power (based on duty point)	42.16 hp
Flange rating inlet	300 lb
Electrical Characteristics Required	
Voltage	460 Volt
Phase	3 PH
Hertz	60 Hz
Rated Amps	90/45 Amps
IE Efficiency class	NEMA Premium / IE3 60Hz
Insulation class (IEC 85)	F
Speed, rated	3550 rpm

D. TABLE 2 - Operating point of the pump (CRN 64-4-2 H-G44-A-E-HQQE)

Flow (GPM)	Head (ft)
0	518.4
308	423.6
449.1	297.2

2.2 GUIDE DESIGN

A. Two vertical multistage centrifugal pumps shall be provided and installed as per drawings and specifications.

B. Vertical multistage centrifugal pumps typically are mounted on a base plate. The in-line design enables installation in a horizontal one-pipe system where the inlet and outlet ports are in the same horizontal plane and have the same pipe dimensions. This design allows vertically lifting the motor and pump shaft out of the sleeve for service. Pumps can be selected that meet ASME B73.1 dimensional standards for suction and discharge piping as well as many of the baseplate dimensional standards. CR-H pumps do not fully comply with the ASME B73.1 specification.

C. Grundfos recommends installing the pump on a concrete foundation that is heavy enough to provide permanent and rigid support to the entire pump. The foundation must be capable of absorbing any vibration, normal strain, or shock. As a rule of thumb, the weight of the concrete foundation should be 1.5 times the weight of the pump and base plate. The concrete foundation must have an absolutely level and even surface. The foundation should be at least 3 to 6 inches longer and wider than the base plate.

2.3 PUMP CONSTRUCTION

A. Major pump components including casing and motor frame shall be of a minimum Class 30B cast iron with smooth surfaces devoid of blowholes or other irregularities. The base and impeller are stainless steel.

B. All exposed nuts or bolts shall be stainless steel. All metal surfaces meeting the pumped media, other than stainless steel, shall be protected by a factory-applied impact-resistance powder coating finish on the exterior of the pump.

C. The impeller design shall be a semi-open centrifugal flow design, with a patented smart trim system for adjusting impeller clearance back to factory settings shaft shall be stainless steel. Pumps without an adjustable impeller clearance to restore to factory settings by use of no special tools shall not be acceptable.

D. The pump housing and motor housing shall be fastened together by a stainless-steel clamp instead of bolts for ease of maintenance and serviceability. Stainless steel brackets on the clamp are fitted with a one bolt connection design for safe locking. No special tools are needed for disassembly or inspection of the hydraulic end.

2.4 CABLE AND CABLE ENTRY SEAL

A. The power cable shall be sized following NEC and ICEA standards and shall be 33 feet and available in longer optional sizes. The outer jacket of the cable shall be oil-resistant chloroprene rubber according to UL Standard 62, ASTM B3, and ASTM B8. The conductor shall be a stranded plain copper conductor according to UL Standard 62, ASTM B3, and ASTM B8.

B. The pump shall be equipped with a leak-proof stainless steel cable plug where the unscreened conductors of the cable are cast into the plug utilizing a two-component sealant to prevent moisture from entering the motor via the cable core.

C. The pump cable end (plug) is fastened with a union nut and O-ring to provide sealing against liquid penetration and shall incorporate in its design the ability to quickly disconnect the power cable from the pump without the need to enter the pump.

2.5 PUMP MOTOR

A. Motors shall meet scheduled horsepower, speed, voltage, and enclosure design. The pump and motors shall be factory aligned.

B. The pump motor shall be a watertight, totally encapsulated motor according to IEC class IP 68 and NEMA MG1, part 31 with Class F insulation materials rated for 311°F.

C. The motor shall be explosion-proof and inverter duty rated Factory Mutual approved for use in Class 1, Division 1, Group C & D T4, T3C hazardous areas. The stator windings and stator leads shall be insulated with moisture-resistant Class F insulation rated for 311°F. UL-approved motors shall not be acceptable.

D. The stator shall be heat shrunk fitted into the cast iron stator housing. The use of bolts, pins, or other fastening devices requiring penetration of the stator housing is not acceptable. The motor shall be designed for continuous duty handling pumped media of -22 to 248 °F.

E. The motor shall have a voltage tolerance of plus 6% or minus 10%. The motor shall be designed for operation up to 356°F ambient temperature, with a temperature rise of class F.

F. The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out. The service factor shall be a minimum of 1.15 and indicated on the pump performance data sheet and the nameplate.

2.6 BEARINGS

A. Motor bearings shall be grease lubricated for the life of the bearing. Motors with grease fittings should only be lubricated with approved types of grease (see table below). Do not over-grease the bearings. Over greasing will cause increased bearing heat and may result in bearing/motor failure. Do not mix petroleum grease and silicon grease in motor bearings. Pump bearings and shaft seals are maintenance-free. Do not start the pump until it has been filled with liquid and vented. If the pump runs dry, the pump bearings and the shaft seal may be damaged.

2.7 MECHANICAL SEALS

A. The CRN pump uses a unique mechanical shaft seal of the cartridge type design with a spacer coupling. The operating range of the shaft seal depends on operating pressure, pump type, type of shaft seal, and liquid temperature. The pressure against the closed valve must always be lower than the maximum permissible operating pressure. If the maximum permissible operating pressure is exceeded, the bearing in the motor may be damaged and the life of the shaft seal reduced.

2.8 PUMP SHAFT

A. The pump shaft must have a short overhang and be dynamically balanced to eliminate shaft deflection. The pump shaft shall be 316 stainless steel for better corrosion resistance and tensile strength.

2.9 IMPELLER / CUTTER

A. The CR-H, CRN-H pump is a vertical multistage centrifugal pump with enclosed impellers. The heavy-duty impeller and intermediate chambers shall be 316 stainless steel with a built-in adjusting stainless steel nut for resetting impeller clearance.

B. The chamber stack and the outer sleeve are secured between the pump head and the volute utilizing staybolts. Impellers should be free from physical markings except for the guide vane welds.

C. The impeller shall be of the enclosed Francis vane type, single-suction design, both hydraulically and dynamically balanced and keyed to the shaft. The impeller shall be trimmed to meet the specific hydraulic requirements.

2.10 VOLUTE

A. Volute shall have integrally cast suction and discharge connections, gauge ports at nozzles, and vent and drain ports. Pumps with a specific speed greater than 1600 shall have a double volute casing.

2.11 PUMP PROTECTION

A. Pumps that are not being used during periods of frost should be drained to avoid damage. Drain the pump by loosening the vent screw in the pump head and by removing the drain plug from the base.

2.12 AUTO COUPLING SYSTEM

A. If the pump is supplied as a complete unit (motor attached to pump end), the position of the coupling that connects the pump shaft to the motor shaft is set at factory specifications. No adjustment is required.

B. If the unit is supplied as a pump end only, follow the manufacturer's adjustment procedures to assemble the motor and pump end. Pumps shall be equipped with a complete auto coupling system to include factory upper guide rail brackets, base elbow, and guide claw. Fabricated non-factory components will not be accepted.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that site conditions are ready to receive the work of this section.

B. Examine all materials delivered to the site for defects or damage and that it meets the requirements of the contract documents.

C. Verify that electrical power is available and of the correct characteristics.

3.2 INSTALLATION

A. Field Testing and Start-Up:

1. Install new lift station pumps, and new pressure sewer main connections from the treatment plant and to the disposal sprayfield pipes per Contract Documents.
2. Perform start-up of lift station in accordance to pump and controls manufacturer's requirements.

B. Start-Up:

1. The pump manufacturer shall provide the services of a factory-trained and qualified representative to insure the pump station is installed properly and without defects, test the system and instruct Government personnel in proper operation and maintenance of the pump system. The Contractor will provide the necessary means to successfully start and operate the pumps, including a minimum of 1,000 gallons of water, and a minimum of one construction worker to facilitate and coordinate the start-up for each pump.
    a. The contractor will coordinate with Contracting Officer, system supplier, and manufacturer to establish a date and time for the start-up. The contractor will be responsible for the satisfactory installation and operation of the lift station connections and system.
2. Proper start-up by pump manufacturer representative shall consist of the following procedure:
    a. A thorough inspection of installation and wiring to make sure there are no installation errors.
    b. Fill the tank with water with the H/O/A switch on the off position. When the audible alarm sounds the switch should be turned to automatic and the pump will evacuate the station and the alarm will turn off.
    c. When the pump turns off the representative should briefly turn the pump into Hand to operate the pumps manually.
    d. Complete a Manufacturer's start-up report for the Contracting Officer. The start-up report should be done digitally and contain pump serial #, voltage, running current, photographs confirming proper installation and operation at the time of start-up, and any other pertinent information.
        1) The Contracting Officer will receive a copy of the MSR via email from the pump representative.

END OF SECTION

SECTION 33 32 13.13

WASTEWATER LIFT STATION PUMP – BUCKEYE HOUSING

PART 1: GENERAL

1.1 SCOPE

A. Pumps to be supplied as specified herein and shall be of submersible grinder design of A nominal 4 HP, 3 phase motor at 460 volts for use in wastewater applications.

B. The pump shall be sized to match the electrical consumption of the motor running at full load and dimensioned according to current NEMA standards.

C. The discharge of the pump shall be a 2-inch discharge connection and the pump shall be capable of delivering 65 US GPM at 76 feet TDH to be supplied under this specification and shall be suitable for use in FM-certified explosion-proof applications having heavy-duty, high-efficiency design.

1.2 QUALITY ASSURANCE

A. The equipment covered under this specification shall be a standard product of proven reliability. All units specified in this specification shall be supplied by a single pump manufacturer.

B. The pumps shall be tested per the standards of the Hydraulic Institute, ANSI/HI 11.6:2017, 3B. All testing is to be performed at the pump manufacturer’s facility. A performance curve shall be completed after the test and is included in the final data package.

1.3 SUBMITTALS

A. With the proposal - the pump manufacturer shall submit a typical pump outline drawing, typical cross-sectional drawing, and typical price book curve for the required conditions to demonstrate compliance with the referenced specifications.

B. A specific Installation and Operating Instructions shall be included in the shipment.

1.4 SHIPPING, DELIVERY, STORAGE, AND HANDLING

A. Submersible grinder pumps shall ship fully assembled.

B. The skidded pump and related equipment shall be unloaded, stored, and installed in strict accordance with the manufacturer's Installation and Operating Instructions and reviewed in detail to implement items relating to mounting, lubrication, power requirements, and pump rotation as contained in the manufacturer’s Installation and Operating Instructions to insure proper warranty. If storage is planned to be longer than 3 months or in a harsh environment, the manufacturer’s long-term storage instructions must be followed.

1.5 START-UP FIELD SERVICE

A. The pump manufacturer's representative shall include in the bid a minimum one-day start-up field service to supervise pump start-up and instruction on proper pump operation and maintenance.

B. Field/functional testing will be performed to ensure proper mechanical operation at the Jobsite. All testing to be used for evaluation shall be performed at the pump manufacturer's facility.

1.6 WARRANTY

A. Pumps shall be warranted for a period of 2 years from defects in material and/or workmanship per the manufactures normal warranty statement.

PART 2: PRODUCT

2.1 OPERATING CONDITIONS

A. The pump shall have a continuously rising head capacity curve from run-out flow through shutoff.

B. The pump shall be designed to operate continuously for extended periods at any point in the allowable operating range (AOR) of the curve without cavitation, overheating, or excessive vibration. The motor nameplate horsepower rating shall not be greater than specified herein.

C. TABLE 1 - PERFORMANCE DATA

Pump Part Number	SEG.A20.40.EX.2.60H
Number of Units Required	2
Rated Duty Point Condition	
Capacity (Flow)	65 GPM
Total Dynamic Head (TDH)	76 Feet
Minimum Pump Efficiency	47.44%
Nameplate motor rating	4 hp
Rated power (based on duty point)	2.72 hp
Max power (non-overloading)	3.79 hp
Electrical Characteristics Required	
Voltage	460 Volt
Phase	3 PH
Hertz	60 Hz
Rated Amps	6 Amps
Service Factor	1.15
IE Efficiency class	NEMA Premium / IE3 60Hz
Insulation class (IEC 85)	F
Speed, rated	3490 rpm

D. TABLE 2 - Operating point of the pump (SEG.A20.40.EX.2.60H)

Flow (GPM)	Head (ft)
0	87
65	79
145	45

2.2 GUIDE DESIGN

A. Each pump shall have a flanged guide claw attached to the pump discharge flange by an ANSI flange connection. A replaceable Nitrile Butadiene Rubber (NBR) profile seal shall be provided as an integral part of the guide claw to form a leak-proof seal with the base discharge elbow.

B. The guide claw shall direct the pump down by two vertical guide rails to the discharge connection in a simple linear movement without tilting the pump sidewards. There shall be no need for any person to enter the wet well to remove the pumps. No portion of the pump shall be supported directly on the bottom of the wet well, guide rails, or lifting chain. A cast iron or fabricated steel base elbow with integral guide rail holders shall be provided. The base shall be designed with an integral 90° elbow or adapted to a commercially available elbow.

2.3 PUMP CONSTRUCTION

A. Major pump components including casing, impellers, and motor frame shall be of a minimum Class 30B cast iron with smooth surfaces devoid of blowholes or other irregularities.

B. All exposed nuts or bolts shall be stainless steel. All metal surfaces coming into contact with the pumped media, other than stainless steel, shall be protected by a factory-applied impact-resistance powder coating finish on the exterior of the pump.

C. The grinder system shall have two primary cutter blades in front of the inlet to the pump and two secondary cutter blades inside the pump housing for sufficient grinding of destructible items. Pump-free passage of impurities shall not be less than 0.2 inches spherical.

D. The impeller design shall be a semi-open centrifugal flow design, with a patented smart trim system for adjusting impeller clearance back to factory settings shaft shall be stainless steel. Pumps without an adjustable impeller clearance to restore to factory settings by use of no special tools shall not be acceptable.

E. The pump housing and motor housing shall be fastened together by a stainless steel clamp instead of bolts for ease of maintenance and serviceability. Stainless steel brackets on the clamp are fitted with a one bolt connection design for safe locking. No special tools are needed for disassembly or inspection of the hydraulic end.

2.4 CABLE AND CABLE ENTRY SEAL

A. The power cable shall be sized per NEC and ICEA standards and shall be 33 feet and available in longer optional sizes. The outer jacket of the cable shall be oil-resistant chloroprene rubber according to UL Standard 62, ASTM B3, and ASTM B8. The conductor shall be a stranded plain copper conductor according to UL Standard 62, ASTM B3, and ASTM B8.

B. The pump shall be equipped with a leak-proof stainless steel cable plug where the unscreened conductors of the cable are cast into the plug utilizing a two-component sealant to prevent moisture from entering the motor via the cable core.

C. The pump cable end (plug) is fastened with a union nut and O-ring to provide sealing against liquid penetration and shall incorporate in its design the ability to quickly disconnect the power cable from the pump without the need to enter the pump.

D. The power cable shall include all sensor leads and must be designed for use with submersible grinder pumps and shall be capable of continuous submergence without loss of waterproof integrity to a depth of 65 feet.

2.5 PUMP MOTOR

A. The pump motor shall be a watertight, totally encapsulated motor according to IEC class IP 68 and NEMA MG1, part 31 with Class F insulation materials rated for 311°F (155°C).

B. The motor shall be explosion-proof and inverter duty rated Factory Mutual approved for use in Class 1, Division 1, Group C & D T4, T3C hazardous areas. The stator windings and stator leads shall be insulated with moisture-resistant Class F insulation rated for 311°F (155°C). UL-approved motors shall not be acceptable.

C. The stator shall be heat shrunk fitted into the cast iron stator housing. The use of bolts, pins, or other fastening devices requiring penetration of the stator housing is not acceptable. The motor shall be designed for continuous duty handling pumped media of 104°F (40°C) and capable of up to 30 spaced starts per hour.

D. The motor shall have a voltage tolerance of plus 6% or minus 10%. The motor shall be designed for operation up to 221°F (105°C) ambient temperature, with a temperature rise of class F.

E. The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out. The service factor shall be a minimum of 1.15 and indicated on the pump performance data sheet and the nameplate.

2.6 BEARINGS

A. The pump shaft shall rotate on two bearings. Motor bearings shall be grease lubricated for the life of the bearing. The upper motor bearing and the lower bearings shall compensate for axial thrust and radial forces.

B. The main bearing and secondary bearing shall be deep groove single-row ball bearings.

2.7 MECHANICAL SEALS

A. The double mechanical seal of the 2HP grinder, with primary and secondary seal built into one unit, shall be a cartridge-style encased in an EN -JL-1030 housing. Separate upper and lower seals not built together in one unit shall not be acceptable. Primary seal faces shall be silicon carbide/silicon carbide and secondary seal faces shall be lip seal – NBR. Shaft seals in contact with the pumped liquid shall not be accepted

B. The double mechanical seal of the 3-5.5HP grinder, with primary and secondary seal built into one unit, shall be a cartridge-style encased in a stainless steel EN 1.4408 housing. Separate upper and lower seals not built together in one unit shall not be acceptable. Primary seal faces shall be silicon carbide/silicon carbide and secondary seal faces shall be carbon/aluminum oxide. Shaft seals in contact with the pumped liquid shall not be accepted

2.8 PUMP SHAFT

A. The pump shaft must have a short overhang and be dynamically balanced to eliminate shaft deflection. The pump shaft shall be 304 stainless steel EN 1.0533 for better corrosion resistance and tensile strength.

2.9 IMPELLER/CUTTER

A. The heavy-duty semi-open multi-channel style impeller shall be of heavy-duty cast iron ASTM A48 class 30B with a built-in adjusting stainless steel nut for resetting impeller clearance.

B. The hardened stainless steel grinder system shall have a stationary ring and rotating cutting head. The stationary ring shall be fitted to the pump housing in front of the inlet and the rotating cutting head shall be fitted to the shaft.

C. The grinder system shall be easily replaceable and consist of a stationary ring and a rotating head made of hardened stainless steel AISI 630. The stationary ring shall be easily replaceable with only one screw and it shall have two guiding channels and two primary cutter blades on the inlet side. On the back side, the stationary ring shall have two guiding channels and two secondary cutter blades. The rotating head shall have two long spiral cutting edges to make the two primary and the two secondary cuts in each rotation. The rotation head shall keep the impeller in the exact trimmed position and fastened with only one screw.

2.10 VOLUTE

A. The pump volute shall be a single piece cast iron, ASTM A48, Class 30B, with a non-concentric design with smooth passage to all passage of solids through the grinder system. The inlet and discharge shall be sized according to requirements.

2.11 LIFTING BAIL

A. The lifting bail shall be solid cast stainless steel bolted to the top of the pump.

2.12 PUMP PROTECTION

A. Each pump shall incorporate thermal switches embedded in the stator windings to monitor the temperature of the motor. The switches shall open at 275°F to stop the motor.

B. Pumps shall have one normally closed moisture switch. The moisture switches shall be incorporated into the pump to sense moisture in the bottom of the stator housing. The switch shall be wired in series so that if a switch opens the motor is de-energized and the pump is stopped.

2.13 SURFACE FINISH

A. The pump is coated with a smooth and easy to clean surface to enable the wash off of sedimentation and impurities. The primer to all cast iron surfaces has Cathodic electro-deposition protection. The surface coating is a two-part component powder coating NCS 9000N, gloss 30, with a thickness of 100 µm.

2.14 AUTO COUPLING SYSTEM

A. Pumps shall be equipped with a complete auto coupling system to include factory upper guide rail brackets, base elbow, and guide claw. Fabricated non-factory components will not be accepted.

B. The upper guide rail bracket shall be stainless steel and the base elbow shall be gray cast iron, ASTM A-48, Class 35B, and have a smooth interior to allow for specific solids passage with smooth surfaces devoid of blowholes or other irregularities. Base elbows shall have a factory-applied spray coating.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that site conditions are ready to receive the work of this section.

B. Examine all materials delivered to the site for defects or damage and that it meets the requirements of the contract documents.

C. Verify that electrical power is available and of the correct characteristics.

3.2 INSTALLATION

A. Field Testing and Start-Up:

1. Install new lift station pumps and rails, new pressure sewer main, and the new gravity sewer pipe connections per Contract Documents.

2. Perform hydrostatic testing on lift station wet well. Any visual leakage will be a cause for rejection. The hydrostatic test shall be completed before backfilling the structure.
    a. Plug all inlets and outlets of the structure.
    b. Fill the structure with water (wastewater is not allowed) 24 hours before the time of the test to permit normal absorption into the walls to occur.
    c. Fill structure to within 1 foot of the finish elevation.
    d. Measure water level after a 2 hour duration. An allowance of 0.025 gallons/hour for each 1 foot of structure depth.
    e. If the test fails, repair and retest.
3. Perform start-up of lift station in accordance to pump and controls manufacturer's requirements.

B. Start-Up:

1. The pump manufacturer shall provide the services of a factory-trained and qualified representative to insure the pump station is installed properly and without defects, test the system and instruct Government personnel in proper operation and maintenance of the pump system.
    a. The Contractor will provide the necessary means to successfully start and operate the grinder pumps, including a minimum of one thousand (1,000) gallons of water, and a minimum of one construction worker to facilitate and coordinate the start-up for each grinder pump station.
    b. The contractor will coordinate with Contracting Officer, system supplier, and manufacturer to establish a date and time for the start-up.
    c. The contractor will be responsible for the satisfactory installation and operation of the pressure sewer system.
2. Proper start-up by pump manufacturer representative shall consist of the following procedure:
    a. A thorough inspection of installation and wiring to make sure there are no installation errors.
    b. Fill the tank with water with the H/O/A switch on the off position. When the audible alarm sounds the switch should be turned to automatic and the pump will evacuate the station and the alarm will turn off.
    c. When the pump turns off the representative should briefly turn the pump into a Hand to operate the pumps manually.
    d. Complete a Manufacturer's start-up report for the Contracting Officer. The start-up report should be done digitally and contain pump serial #, voltage, running current, photographs confirming proper installation and operation at the time of start-up, and any other pertinent information. The Contracting Officer will receive a copy of the MSR via email from the pump representative.

END OF SECTION

SEQUOIA & KINGS CANYON NATIONAL PARKS

Contract No. 140P8519D0001

TITLE II
SPILL PREVENTION PLAN

SEKI PMIS 317446 (formerly 184085, 246176 & 181622)

Task Order No. 140P8521F0073

Rehabilitate Ash Mountain and Buckeye Wastewater Treatment Plants

Prepared for:

Sequoia & Kings Canyon National Parks
Tulare County, California

REGISTERED PROFESSIONAL ENGINEER
DAVID BARTON BROOKE
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CIVIL
STATE OF CALIFORNIA

100% DRAFT CD SUBMITTAL

April 2022

HECO Project No. NPS 19-0330 T2

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1.0 PROJECT DESCRIPTION

1.1 Regulatory Body Governing Spill Prevention and Response Plan

The Spill Prevention and Response Plan shall be implemented to protect public health and the environment as required by the California State Water Resources Control Board (SWRCB) Order No. 2006-0003, Statewide General Discharge Requirements for Sanitary Sewer Systems. The SWRCB Order No. 2006-0003 requires that a spill prevention and response plan be in place that satisfies the requirements of the Sewer System Management Plan (SSMP).

1.2 Spill Prevention and Response Plan

The Utilities Supervisor is responsible for ensuring that the Park's sewer services are provided per SWRCB requirements regarding spill prevention and response. A Spill Prevention and Response Plan (SPRP) shall be prepared by the contractor for this project for submission to the California State Regional Water Quality Control Board (RWQCB)for their approval. The RWQCB review period is approximately two weeks.

The purpose of this outline is to guide the contractor in developing an SPRP that will provide the following:

1) Prevent sewage spills from occurring through proper planning and protection of the project area.
2) Respond to any sewage spill that occurs during construction operations including NPS notification.

The spilled sewage has the potential of reaching the adjacent Kaweah River.

The SPRP is structured in two parts:

1) Spill Prevention Plan
2) Spill Response Plan.

The Spill Prevention Plan (SPP) includes evaluation of specific conditions, set-up of containment for bypass pumping, and other site-specific work.

The Spill Response Plan (SRP) includes the initial response to stop and contain any spills, notification of NPS staff, clean-up, and follow-up documentation.

The complete SPRP will be comprised of both the SPP and SRP.

1.3 Contractor Responsibilities

Upon discovery of any sewage spill, release, leak, or potential for a spill, release, or a leak, all site personnel are to act immediately by notifying their supervisor and correcting the problem causing the potential spill or containing the spill if it has occurred.

The Contractor shall provide sufficient staffing and a written plan such that the following duties and protocol can be effectively implemented and carried out:

- Provide adequate provisions for immediate action to contain spills within the smallest area and to notify NPS immediately of any spill or release.
- Provide for cleanup and removal of contaminated material from the site to an approved disposal site. Develop and implement a program for inspecting and monitoring compliance with environmental requirements.
- Review changes in RWQCB regulations and determine if procedural changes and/or retraining are required.
- Inspect facilities and sites for compliance with environmental regulations.
- Provide additional standby support if spill cleanup exceeds the capacity of the on-site personnel and equipment.
- Collect and submit documentation to NPS that meets response requirements of RWQCB, Office of Emergency Services (OES), and other State and Federal Agencies. Documentation for reports shall be prepared and submitted within 24 hours after containment measures have been completed.
- Provide staff for the undertaking of responsibilities when Project Superintendent and Project Quality Control Manager are absent.
- Provide staff to ensure that there are adequate provisions for immediate action to contain spills within the smallest area and to notify the NPS within (2) two hours of the spill or release.
- Upon discovery of any sewage spill, release, leak, or potential for a spill, release, or a leak, all site personnel are to notify their delegated supervisor; Notify the NPS Utilities Supervisor immediately and take action to correct the problem causing the potential spill or contain the spill if it has occurred.

2.0 SPILL PREVENTION PLAN

Before commencing construction work on any sewer pipeline or lift station, replacement, or bypass, the Contractor shall prepare a Spill Prevention Plan (SPP) for that segment. Spill Response Plans (SRP) are general, and the same SRP can be applied to the segment-specific SRP to form a complete SPRP.

The primary purpose of the Spill Prevention Plan is to:

- Identify the risk of a sewage spill for a specific component of work for each line segment.
- Identify where sewage could enter the adjacent Kaweah River through the preparation of Spill Prevention Analysis forms (with updates as necessary) and site drawings that have been marked up to show potential problem locations including locations of storm drains and drainages that lead to the Kaweah River.
- Identify where sewage could endanger public health and safety.
- Establish containment procedures for potential problem areas within the segment through the preparation of Spill Containment Plans and implementation of these plans as described below and
- Specify the response equipment (pipe repair truck and vacuum truck) available in case of a spill as described below.

The SPP will contain:

1) Spill Prevention Analysis forms that have a map that describes the Spill Containment System as described in Section 2.1 below.
2) Assessment of spill risk associated during all operations with particular emphasis on pipeline and lift station construction, replacement, or bypass operations.

2.1 Spill Prevention Importance

Emphasis cannot be placed heavily enough on the importance of spill prevention along the Kaweah River corridor for the protection of vital natural resources, including public health and safety. With proper planning and training, all spills are preventable.

2.2 Spill Prevention Analysis

Before performing work in any location, a Spill Prevention Analysis will be performed. The Spill Prevention Analysis includes:

- Description of type of operation (i.e., construction, pipeline replacement, bypass, etc.).
- Step by Step Plan to implement the operation.
- Identification and mitigation of potential spill hazards.
- Precautionary measures to prevent spills.
- Assessment of need for Spill Containment Systems.

Sample Spill Prevention Analysis forms are found in Appendix A. The Spill Prevention Analysis will also include a location map showing sanitary sewer manholes and storm drains and surface ditches that lead to the Kaweah River or any drainage features.

2.3 Spill Containment System

Based on the results of the Spill Prevention Analysis, Spill Containment System will be in place at all locations identified as requiring spill containment. The Spill Containment System is intended to prevent sewage from entering the Kaweah River or storm drains and surface ditches that lead to the Kaweah River in case of a spill. It is also intended to prevent spills from endangering public health and safety. The system will be placed around manholes that have been identified to have a spill potential because of new construction, bypass pumps, at strategic locations along with any bypass operation, crossings of existing sewer services, and work areas around sewage lift stations to ensure that in case of a spill, all the sewage will be contained without entering the Kaweah River, other drainage features or any storm drains and surface ditches that lead to the Kaweah River.

The specific placement of the spill containment system components will be made by the Contractor, with the approval of the NPS Contracting Officer (CO) or Contracting Officer's Representative (COR) for each setup.

The Spill Containment System components will consist of:

1) A temporary containment area consisting of sandbags and impervious liners shall be placed around the manholes judged to be at risk of spilling.
2) Temporary containment areas will be constructed around bypass pumps (see attached detail in Appendix B).

3) Temporary containment dams consisting of sandbags and impervious liners are placed in locations along existing drainages within or adjacent to the work area.
4) Temporary containment dams consisting of sandbags and impervious liners are placed in front of existing culvert pipes.
5) Spill response equipment consists of vacuum equipment and pipe repair equipment and the material will be always on site.
6) Additional spill prevention materials kept at the worksite include:
   - absorbent booms.
   - granular absorbents.
   - absorbent mats.
7) Continuous monitoring of any bypass that will be conducted includes:
   a. Monitoring of air relief valves.
   b. Monitoring of all tie-in points.
   c. Monitoring of all pumps and bypass connections.

2.4 Bypass Plan

Bypass operations will be used to divert flows from existing lines where the project requires replacement activities.

The Sewer Bypass Plan addresses the practices, methods, and materials to be used to maintain any sewer bypass deemed necessary for the construction of new utilities, the removal and/or replacement of any existing sewer services and any other temporary bypass operations needed.

All bypass plans shall be submitted to the NPS Contracting Officer, for approval at least (30) thirty calendar days before any construction activity that would require the need for the bypass. RWQCB will perform their 14-day review within the (30) thirty calendar day period.

2.4.1 Spill Prevention Procedures During Bypass Operations

1) During bypass operations, the Contractor shall provide sufficient staff and equipment to monitor any bypass pipeline and bypass equipment operation continuously 24 hours a day, 7 days a week.
2) Equipment maintenance will be conducted in assigned areas, and a supply of absorbent materials will be on-site for cleaning up minor spills. All sewer bypass pumps must always be in approved spill-guard locations while in operation.
3) Emergency spill response truck and vacuum truck or trailer will be located on-site, or in another approved location, with the sewer bypass pump(s) when the work is ongoing.

4) All Contractor personnel shall be trained in Spill Prevention Control and the Contractor shall submit to the NPS CO written evidence of Spill Prevention Control training for each employee.

5) Any bypass pump(s) shall be always monitored by Contractor personnel while the pumps are running and can be backed up immediately with standby equipment.

6) As the job progresses, the bypass pump(s) and discharge piping will be moved to the next section, along with the spill containment system as necessary. The Contractor project superintendent, Contractor project foreman, and the NPS CO or COR will review the site to determine the best location for the spill containment system to be placed for the next setup.

7) When breaking down the sewer bypass system, for transport to the next site, all equipment including manifolds, gaskets, valves, hoses, balloon plugs, and pumps shall be cleaned, inspected, and maintained to eliminate sewage spills.

8) Gravity shall be used downstream of the construction area in the manhole to capture any construction debris, rocks, or material that may plug into the sewer collection system.

9) All plugs, construction material, and tools that may be used in an active sewer during construction shall use Lanyards or a restraint system and or provide gravity on outlet piping to prevent loss of material into the collection system.

3.0 SPILL RESPONSE PLAN

All efforts should be made to prevent spills from occurring by developing and implementing the appropriate Spill Prevention Plan. However, in the case that a spill should occur, the following Spill Response Plan will be followed.

Upon discovery of any sewage spill, release, leak, or potential for a spill, release, or a leak, all Contractor site personnel are to notify their supervisor immediately and take action to correct the problem causing the potential spill or contain the spill if it has occurred. The Contractor supervisor or designated replacement will initiate notification based on an approved callout list to NPS Utilities Supervisor immediately after being notified by Contractor staff. If the designated supervisor can't be reached, the next level supervisor personnel should have NPS Utility Supervisor contacts and notify Park to report location and return contact telephone numbers.

In the event of a spill or release, Contractor site personnel shall contain the spill within the smallest possible area using appropriate personal and protective measures. Once notification of the Contractor supervisor is made, Contractor site personnel should initiate the following actions to contain and mitigate the spill:

- Dispatch the spill response truck to the spill location.
- Make assessment and dispatch vacuum truck or trailer if necessary.
- All bypass pumps will be shut down; flow through the plug(s) removed from the upstream manhole and reinstate the flow to the existing sewer line if the exiting sewer line can reasonably be used.
- During Pipe Bursting Operations-Provide additional labor and equipment necessary to maintain a fully functioning Active and a backup Redundant Bypass System during the time the main line is under rehabilitation.
- Stop all construction activities or other related work and concentrate all on-site Contractor personnel to minimize the area affected by the spill.
- If the spill cannot be contained on-site with existing equipment and personnel, on-site personnel are to:
    - Contain the spill to the smallest area possible as the situation allows and follow up with requests as needed for additional assistance.

3.1 Notification and Reporting Procedure

The contractor shall be adequately staffed and equipped to fully respond to a spill incident during the contract performance period. Anyone who becomes aware of any sewage spill should notify the Contractor Supervisor who will immediately notify NPS Utilities Supervisor and additional NPS contacts as listed in Table 3-1 below in the order provided. If the designated Contractor Supervisor is not available, the NPS Utilities Supervisor will be contacted.

The contractor shall provide critical information to NPS Utilities Supervisor and additional NPS contacts listed in Table 3-1. NPS Utilities Supervisor will respond to the Contractor by telephone after having contacted additional NPS contacts listed in Table 3-1.

- The contractor will contact NPS Utilities Supervisor to request traffic control if the sewage spill is within the roadway open to the public.
- NPS Utilities Supervisor will contact NPS staff to provide initial traffic control.

TABLE 3-1
Spill Response Contact Information

Order of Contact	Name	Position	Spill Response Function	Telephone Number	
				Office	Cell
1					
2					
3					
4					
5					

If NPS Utilities Supervisor cannot be reached by Contractor, calls shall be made to additional NPS contacts down the Table 3-1 until contact with NPS personnel in addition to NPS Utilities Supervisor is established.

NPS Utilities Supervisor and additional NPS personnel are solely to make all spill notifications to the following regulatory agencies:

1) State Office of Emergency Services (OES)
2) San Francisco Regional Water Quality Control (SFRWQC) Board
3) Marin County Health Department

The contractor shall prepare the spill report as presented in Exhibit 3.1 at the time of the spill, containing site-specific spill data and information. Communication will continue with NPS Utilities Supervisor, as necessary. The NPS will monitor the affected water bodies that the spill has entered and will undertake sampling of the water for further testing and regulatory reporting.

The Contractor shall initiate site clean-up and disinfection following NPS Utilities Supervisor approval and under NPS guidance. Communication shall continue between the Contractor, and NPS Utilities Supervisor to determine causes and corrective measures to prevent additional Spills during construction.

The NPS Utilities Supervisor will coordinate the posting of warning signs at the downstream swimming areas if the spill has entered the Kaweah River.

The Contractor shall make these notifications unless they are properly relieved by the NPS Utilities Supervisor.

3.2 Spill Clean Up

All spill material shall be collected and stored in such a manner as to prevent further contamination of soils or contact with any stormwater runoff.

- Collected spill material shall be stored at the Contractor's staging area for a brief period while proper transportation and disposal of the material can be arranged. The exact location will be determined at the time of the event. Waste manifests of all removal and disposal activities shall be kept on file.
- Call the appropriate support service if necessary.
- Coordinate with the NPS Utilities Supervisor for additional assistance and support.

3.3 Site Disinfection

First, physically remove any evidence of liquid and solid waste from the site. When there are no standing puddles, a "Bacticide" solution or equivalent is sprayed on the affected area. If the contaminated area is adjacent to the Kaweah River and there is a chance of the chlorine getting into the water, the hypochlorite solution will not be applied, only the physical cleanup will be done.

3.4 Spill Reporting Procedure

A written description of all reportable spill events will be made to the NPS COR, by the Contractor Project Manager within (24) twenty-four hours. A reportable Sanitary Sewer Overflow (SSO) spill is defined by the RWQCB as either a Category 1, Category 2, or Category 3 SSO. Categorical spills are defined as follows:

1) **Category 1 SSO** or spill is the category having the greatest threat to public health and is defined as:

   Discharges of untreated or partially treated wastewater of any volume resulting from an enrollee's sanitary sewer system failure or flow condition that:

   a) Reach surface water and/or reach a drainage channel tributary to surface water; or

   b) Reach a municipal separate storm sewer system and are not fully captured and returned to the sanitary sewer system or not otherwise captured and disposed of properly. Any volume of wastewater not recovered from the municipal separate storm sewer system is considered to have reached surface water unless the storm drain system discharges to dedicated stormwater or groundwater infiltration basin (e.g., infiltration pit, percolation pond).

2) **Category 2 SSO** is defined as discharges of untreated or partially treated wastewater of **1,000 gallons or greater** resulting from an enrollee's sanitary sewer system failure or flow condition that **does not** reach surface water, a drainage channel, or a municipal separate storm sewer system unless the entire SSO discharged to the storm drain system is fully recovered and disposed of properly.

3) **Category 3 SSO** is defined as all other discharges of untreated or partially treated wastewater resulting from an enrollee's sanitary sewer system failure or flow condition.

NPS personnel shall be responsible for the following spill reporting timeframes and required regulatory reports determined by the category of spill that occurs and consists of the following requirements:

- Category 1 SSOs greater than or equal to 1,000 gallons discharged to surface water or spilled in a location where it will be discharged to surface water must be reported to Cal OES as soon as possible but no later than 2 hours after becoming aware of the SSO.

- A draft report for Category 1 SSOs must be submitted within 3 business days of becoming aware of the SSO and certified within 15 calendar days of the SSO end date.
- A draft report for Category 2 SSOs must be submitted within 3 business days of becoming aware of the SSO and certified within 15 calendar days of the SSO end date.
- A certified report for Category 3 SSOs must be submitted within 30 calendar days of the end of the month in which the SSO occurred (e.g., SSOs occurring in January must be reported by March 1st).
- An SSO Technical Report is required to be submitted within 45 calendar days after the end date of any Category 1 SSO in which 50,000 gallons of greater are spilled to surface waters.

The initial mandatory SSO report prepared by the Contractor and submitted to NPS shall include the following minimum information:

- Location of SSO according to global positioning system (GPS) coordinates.
- Identify the region in which SSO occurred. Muir Woods is governed by the

  San Francisco Regional Water Quality Board.
- County where SSO occurred. El Portal is in Marin County.
- Describe whether the SSO entered a drainage channel and/or surface water.
- Describe whether the SSO was discharged to a storm drain pipe that was not fully captured and returned to the sanitary sewer system.
- Estimated SSO volume in gallons.
- Estimate of the SSO volume recovered (if applicable).
- SSO source (manhole, clean-out, etc.).
- SSO cause (sewer bypass failure, mainline blockage, etc.).
- Time of SSO notification or discovery.
- Names of all Contractor employees present at the time of the initial spill.
- Names of additional Contractor employees arriving at the site of a spill after initial spill occurrence including estimated arrival time.
- SSO destination or expected to impact.
- Estimated SSO start and end time.

Following each incident, a meeting shall be conducted within (3) three days to determine what occurred and determine what procedures should be implemented to prevent any further occurrences. NPS and Contractor representatives are to be present at this meeting.

EXHIBIT 3.1

CONTRACTOR SSO REPORT

National Park Service
U.S. Department of the Interior

Exhibit 3.1
CONTRACTOR SSO Report

1. Estimated spill volume? _____ gallons

2. Estimated volume of spill recovered? _____ gallons

   Estimated volume of spill not recovered? _____ gallons

   This is a Category 1 spill if > 1,000 gallons of the spill is not recovered.

3. Did the spill discharge to a drainage channel and/or surface water? Yes £ No £
   (if yes, this is a Category 1 spill).

4. Did the spill discharge to a storm drain pipe that was not fully captured and returned to the sanitary sewer system? Yes £ No £ (*if yes, this is a Category 1 spill)*

5. Spill location name: _____

6. Latitude of spill location: _____deg: _____ min. _____ sec. or _____ decimal degrees.

7. Longitude of spill location: _____ deg: _____ min. _____ sec. or _____decimal degrees.

8. Spill Location: street number, street name, cross street, street type, street direction, suite, or apt number:

   _____

   _____

9. Spill Location: County, city, state, zip:

10. Spill Location: Other Description: _____

11. Contact San Francisco Regional Water Quality Control Board: _____

12. Spill appearance point or source of spill: *(check all that apply)*

£ Building or Structure £ Force Main or Pressure Sewer £ Gravity Sewer

£ Manhole £ Other Sewer Structure £ Pump Station

£ Other

13. Spill appearance point explanation: *(if above is "Other")*

_____

_____

_____

14. Final spill destination:

£ Storm Drain £ Street/Curb & Gutter £ Surface

£ Unpaved Surface £ Beach £ Building

£ Other

15. Explanation of destination: *(if above is "Other")*

_____

_____

_____

_____

16. Estimated volume of spill that reached surface water, drainage channel, or gallons not recovered:

_____ gallons.

This is a Category 1 spill if any volume of the spill reaches surface water or drainage channel or if >1,000 gallons of the spill is not recovered.

17. Estimated current spill rate (if applicable): Gallons per minute: _____

18. Estimated spills start date/time: _____

19. Date and time sanitary sewer system agency was notified or discovered spill: _____

20. Estimated Operators arrival date/time: _____

22. Spill cause:

£ Debris General
£ Debris-Rags
£ Flow Exceeded Capacity
£ Grease Deposit (FOG)
£ Operator Error
£ Pipe Structural Problem/Failure
£ Pump Station Failure
£ Rood Intrusion
£ Rainfall Exceeded Design
£ Vandalism
£ Other
£ Bypass Failure

23. Spill cause explanation: *(if above is "Other")*

_____

_____

_____

_____

24. If the spill is caused by wet weather, choose the size of the storm (year):

£ 1 £ 2 £ 5 £ 10 £ 50 £ 100

25. Diameter of sewer pipe at the point of blockage or spill cause (if applicable): _____ inches

26. Material of sewer pipe at the point of blockage or spill cause (if applicable): _____ inches

27. Estimated age of sewer pipe at the point of blockage or spill cause (if applicable): _____ inches

28. Spill response activities *(check all that apply)*:

- £ Cleaned up (mitigated effects of the spill)
- £ Contained all or portion of the spill
- £ Inspected sewer using CCTV to determine the cause
- £ Restored Flow
- £ Returned all or portion of the spill to sanitary sewer system
- £ Other

29. Explanation of spill response activities *(if above is "Other")*:

_____

_____

_____

_____

Category 1 spill only

1) Equals or exceeds 1000 gallons; or

2) A discharge of sewage to surface water and/or drainage channel, or

3) A discharge of sewage to a storm drain that was not fully captured and returned to the collection system

30. Spill response completion date: _____

31. Health warnings posted? Yes £ No £

32. Name of impacted surface water(s) *(if applicable)*: _____

33. Visual inspection results from impacted receiving waters:

_____

_____

34. Is there an ongoing investigation? Yes £ No £

35. (Not Used)

36. (Not Used)

37. (Not Used)

38. Spill corrective action taken *(check all that apply)*:

- £ Cleaned up (mitigated effects of the spill)
- £ Added to the preventative maintenance program
- £ Adjusted schedule/method of preventative maintenance
- £ Enforcement action against FOG source
- £ Plan rehabilitation or replacement of sewer
- £ Repaired sewer
- £ Added to the preventative maintenance program
- £ Other

39. Explanation of spill corrective actions taken *(if above is "Other")*:

_____

_____

_____

The CONTRACTOR is responsible for completing items 1 through 39.

APPENDIX A

SPILL PREVENTION ANALYSIS FORM

SPILL PREVENTION ANALYSIS – INSERT NAME OF OPERATION

Superintendent: _____ Date: _____

Foreman: _____ Page _____ of _____

Location of Pipe Segment (attach applicable map):

Need for Spill Containment System (Y/N): If no, briefly explain why _____

STEP BY STEP PLAN TO IMPLEMENT OPERATION:

1.	**5.**
2.	**6.**
3.	**7.**
4.	**8.**

POTENTIAL SPILL HAZARDS	
1.	**6.**
2.	**7.**
3.	**8.**
4.	**9.**
5.	**10.**

Potential Spill Hazard #	**Precautionary Plan**

Potential Spill Hazard #	Precautionary Plan

Potential Spill Hazard #	Precautionary Plan

Potential Spill Hazard #	Precautionary Plan

Potential Spill Hazard #	Precautionary Plan

SPILL PREVENTION ANALYSIS – For Bypass Maintenance

Superintendent: _____ Date: _____

Foreman: _____ Page _____ of _____

Location of Pipe Segment (attach applicable map):

Need for Spill Containment System (Y/N): If no, briefly explain why _____

STEP BY STEP PLAN TO IMPLEMENT OPERATION:

1. Install dual 10" HDPE bypass pipelines	**5.**
2. Continuously monitor active pipeline	**6.**
3. Maintain a dual pipeline system	**7.**
4. Remove bypass system	**8.**

POTENTIAL SPILL HAZARDS	
1. Damage to dual 10" HDPE bypass pipelines	**6.**
2. Sabotage	**7.**
3. Bypass System Drain and Cleaning during bypass system removal	**8.**
4.	**9.**
5.	**10.**

Potential Spill Hazard # 1	**Precautionary Plan**
Damage to dual 10" HDPE bypass line	**Close valves on each side of the damaged pipe**
	Contain leak and install repair coupling immediately.
	Keep an inventory of spare parts on-site.
	Report to Superintendent

Potential Spill Hazard # 2	Precautionary Plan
Sabotage	Close valves on each side of the damaged pipe.
	Contain leak and install repair coupling immediately.
	Keep inventory of spare parts on-site.
	Report to Superintendent.

Potential Spill Hazard # 3	Precautionary Plan
Bypass System Drain and Cleaning during bypass system removal	Return flow to installed gravity main pipe
	Flush, sanitize, and drain the bypass pipe system
	Use containment when removing the drain
	Use containment when cutting pipe for removal

Potential Spill Hazard #	Precautionary Plan

Potential Spill Hazard #	Precautionary Plan

SPILL PREVENTION ANALYSIS – For Gravity Trunk Main Bypass

Superintendent: _____ Date: _____

Foreman: _____ Page _____ of _____

Location of Pipe Segment (attach applicable map):

Need for Spill Containment System (Y/N): If no, briefly explain why _____

STEP BY STEP PLAN TO IMPLEMENT OPERATION:

1. Build containment	**5.**
2. Set pumps, manifold, and connect pipe	**6.**
3. Allow the system to operate before isolating the gravity mainline.	**7.**
4.	**8.**

POTENTIAL SPILL HAZARDS	
1. System failure	**6.**
2. Pipe leaks	**7.**
3. Containment leaks	**8.**
4.	**9.**
5.	**10.**

Potential Spill Hazard # 1	**Precautionary Plan**
System failure	**Before start-up check all equipment, fittings, and pipe connections for water tightness.**
	Dry test automatic start float system.
	Continuously monitor the system during operations.

Potential Spill Hazard # 2	Precautionary Plan
Sabotage	Continuously monitor and inspect bypass pipe and fittings.
	Have extra pipes, gaskets, and fittings at the immediate bypass location.

Potential Spill Hazard # 3	Precautionary Plan
Containment leaks	Inspect containment liner and repair all holes.

Potential Spill Hazard #	Precautionary Plan

Potential Spill Hazard #	Precautionary Plan

APPENDIX B

SPILL CONTAINMENT AND BYPASS SYSTEM COMPONENTS

Spill Response and Pipe Repair Truck

List of Items included in Truck

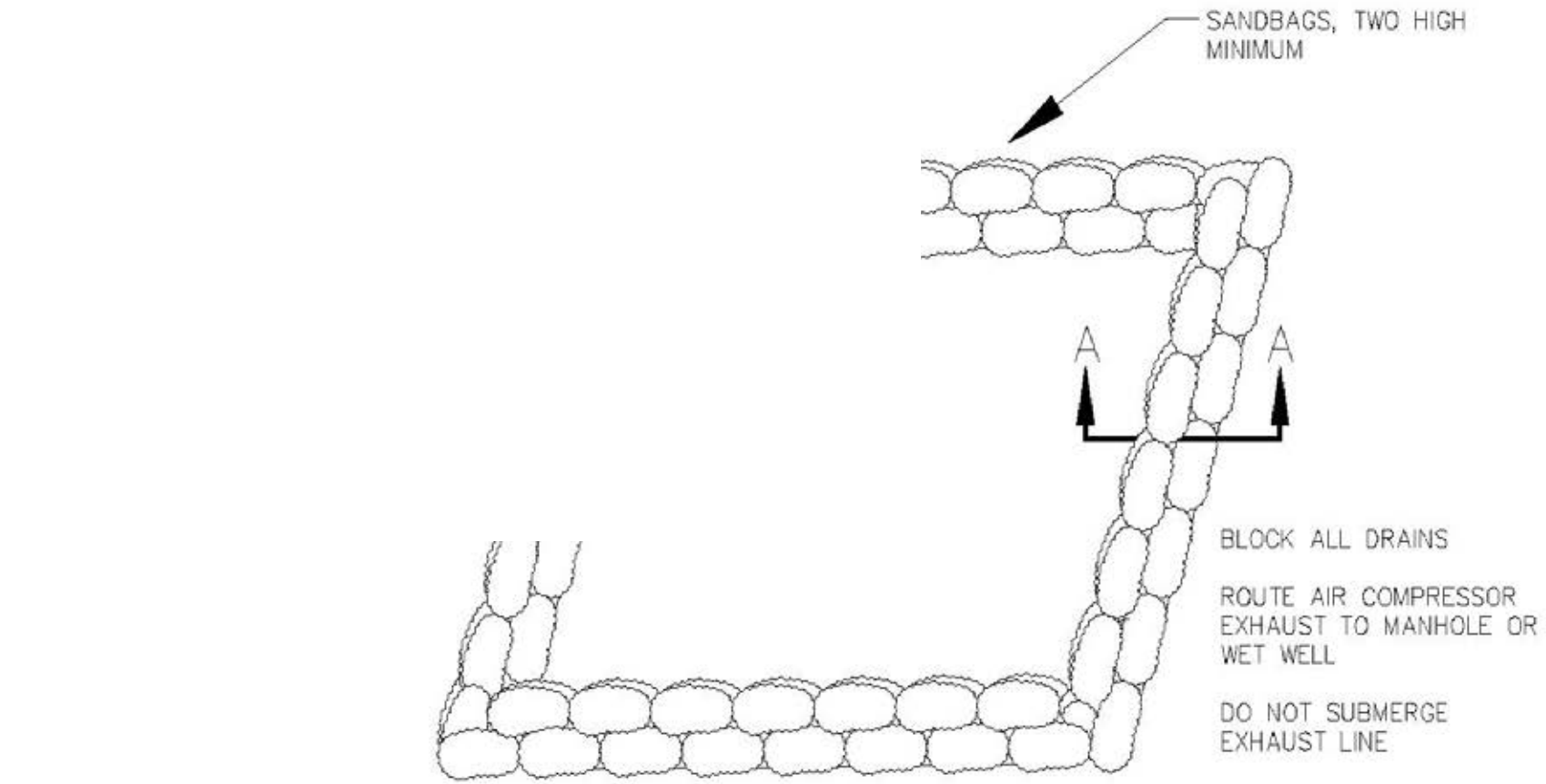
(Not all-inclusive)

---

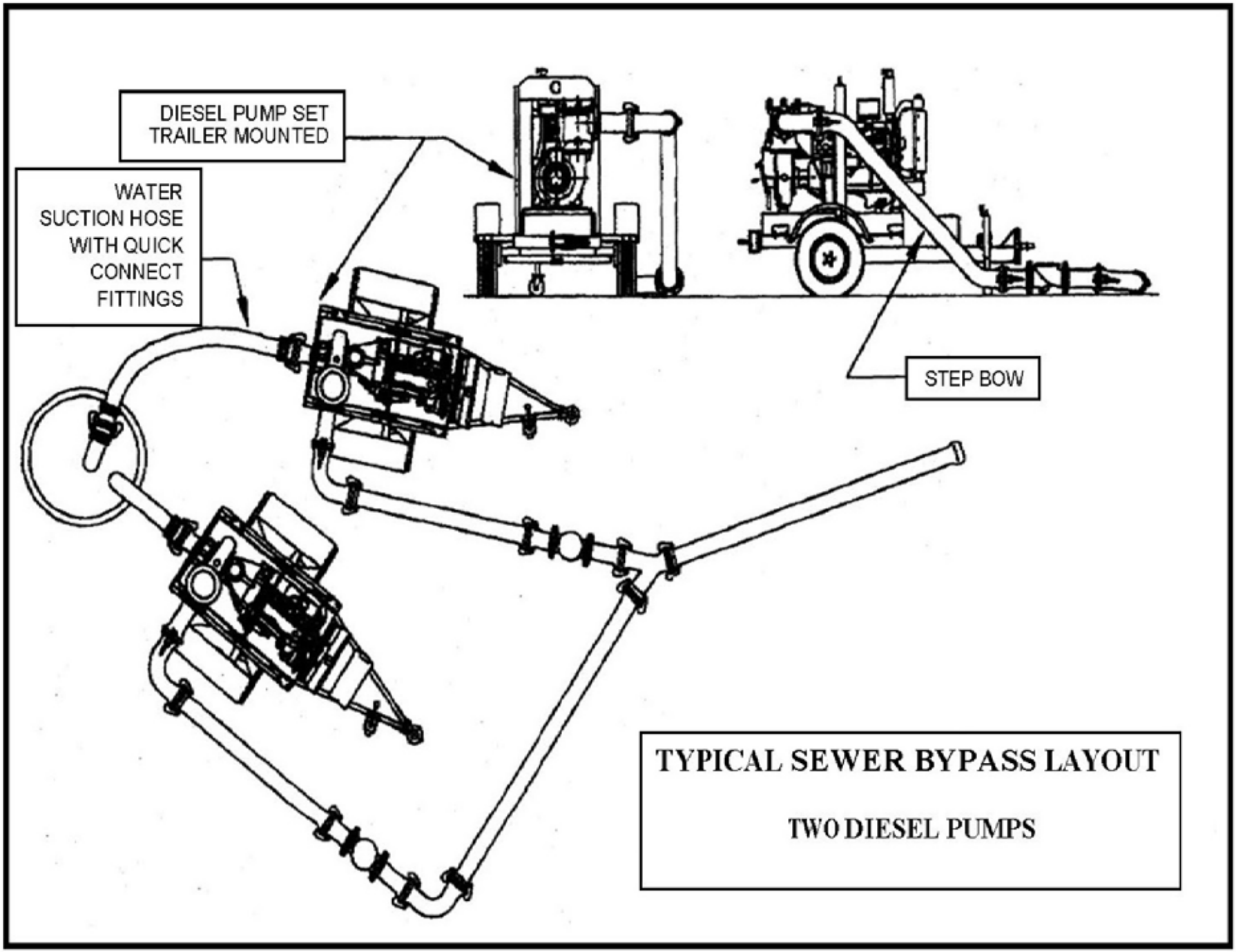
1) Spare liner materials, 10’ X 20’ sheets - 6 each.
2) Mechanical watertight couplings for ***(ENTER EACH SIZE & TYPE OF PIPE)*** pipe - 2 per size and type of pipe.
3) Repair coupling for ***(ENTER EACH SIZE & TYPE OF PIPE)*** - 2 per size and type of pipe.
4) Absorbent pads - 6 each bundle.
5) Absorbent boom - 3 each 15’ booms.
6) 3” portable gas-powered trash pump
7) 10’ suction hose
8) 150’ discharge hose
9) Large trash bags
10) Cleaning station
11) Pipe (ENTER EACH SIZE & TYPE OF PIPE) 10’ long
12) Spare transition couplings
13) PPE (rubber gloves & boots, suits, goggles, and face shields)
14) Hand saw
15) Toolbox (wrenches, socket set, screwdrivers, and pipe wrenches)
16) Spray can with disinfectant

Not included in the truck but stationed at the work area:

1) Pallet of sandbags (minimum of 20)



DESIGNED	SUB SHEET NO.	TITLE OF SHEET: SANDBAG BERM SEWER SPILL PREVENTION AND RESPONSE PLAN	DRAWING NO. STANDARD DETAIL
DRAWN			FIG. NO. SHEET 1
TECH. REVIEW			OF 1
DATE			


DIESEL PUMP SET
TRAILER MOUNTED
WATER
SUCTION HOSE
WITH QUICK
CONNECT
FITTINGS
STEP BOW
TYPICAL SEWER BYPASS LAYOUT
TWO DIESEL PUMPS

SECTION 33 33 33

TEMPORARY SEWER BYPASS PUMPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work covered in this Section includes furnishing, all materials, labor, equipment, power, maintenance, etc. to implement a temporary pumping system to divert the existing flow around the work area for the duration of the project.

1.2 RELATED SECTIONS

A. Section 22 13 13 - “Facility Sanitary Sewers”

B. Section 22 13 16 – “Sanitary Waste & Vent Piping”

1.3 SUBMITTALS

A. The Contractor shall prepare a specific, detailed description of the proposed temporary bypass pumping system and submit it to the park for approval.

B. The contractor is to meet all criteria including document preparation, submittal, and approval set forth under the “Outline for Spill Prevention and Response Plan Development” document attached to the end of this specification: The contractor shall also prepare and submit completed forms from Appendix A - Spill Prevention Analysis Form and Appendix B - Spill Containment and Bypass System Components for review and approval.

C. The Contractor shall submit to the Park detailed plans and descriptions outlining all provisions and precautions to be taken by the Contractor regarding the handling of existing wastewater flows. This plan must be specific and complete, including such items as schedules, locations, elevations, capacities of equipment, materials, and all other incidental items necessary and/or required to ensure proper protection of the facilities, including protection of the access and bypass pumping locations from damage due to the discharge flows, and compliance with the requirements and permit conditions specified in these Contract Documents. No construction shall begin until all provisions and requirements have been reviewed and approved by the Park.

1. The plan shall include but not be limited to details of the following:
    a. Staging areas for pumps.
    b. Sewer plugging method and types of plugs.
    c. Number, size, material, location, and method of installation of suction piping.
    d. Number, size, material, method of installation, and location of installation of discharge piping.

2. Bypass pump sizes, capacity, number of each size to be on-site, and power requirements; Calculations of static lift, friction losses, and flow velocity (pump curves showing pump operating range shall be submitted);
3. Standby power generator size, location; Downstream discharge plan.
4. Method of protecting discharge manholes or structures from erosion and damage.
5. Thrust and restraint block sizes and locations.
6. Sections showing suction and discharge pipe depth, embedment, select fill, and special backfill.
7. Method of noise control for each pump and/or generator.
8. Any temporary pipe supports and anchoring are required.
9. Design plans and computation for access to bypass pumping locations are indicated on the drawings.
10. Calculations for selection of bypass pumping pipe size.
11. Schedule for installation of and maintenance of bypass pumping lines.
12. Plan indicating selection location of bypass pumping line locations.

1.4 RESPONSIBLE PARTY

A. The design, installation, and operation of the temporary pumping system shall be the Contractor's responsibility. The Contractor shall employ the services of a vendor who can demonstrate to the COR that he specializes in the design and operation of temporary bypass pumping systems. The vendor shall provide at least 5 references for projects of a similar size and complexity as this project performed by his firm within the past three years. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.

PART 2 - EQUIPMENT

2.1 PUMPS

A. All pumps used shall be fully automatic self-priming units that do not require the use of foot-valves or vacuum pumps in the priming system. The pumps may be electric or diesel-powered. All pumps used must be constructed to allow dry running for long periods to accommodate the cyclical nature of effluent flows.

1. The Contractor shall provide the necessary stop/start controls for each pump.
2. The Contractor shall include one stand-by pump of each size to be maintained on-site. Back-up pumps shall be online, isolated from the primary system by a valve.

2.2 PIPING

A. Discharge Piping - Dual piping shall be used for system redundancy unless COR has determined in writing that single piping is adequate. To prevent the accidental spillage of flows all discharge systems shall be temporarily constructed of HDPE or rigid pipe with positive, restrained joints. Under no circumstances will aluminum "irrigation" type piping or glued PVC pipe be allowed. Discharge hose will only be allowed in short sections and with specific permission from the Park.

PART 3 – SYSTEM DESCRIPTION

3.1 DESIGN REQUIREMENTS

A. Bypass pumping systems shall have sufficient capacity to pump peak flows as shown on the drawings down to a minimum of 0-gpm and remain operable. The Contractor shall provide all pipeline plugs, pumps of adequate size to handle peak flow, and temporary discharge piping to ensure that the total flow of the main can be safely diverted around the section to be repaired. A bypass pumping system will be required to be operated 24 hours per day.

B. The Contractor shall have adequate standby equipment available and ready for immediate operation and use in the event of an emergency or breakdown. One standby pump for each size pump utilized shall be installed at the mainline flow bypassing locations, ready for use in the event of primary pump failure.

C. Bypass pumping system shall be capable of bypassing the flow around the work area and of releasing any amount of flow up to full available flow into the work area as necessary for satisfactory performances of work.

D. The Contractor shall make all arrangements for bypass pumping when the main is shut down for any reason. The system must overcome any existing force main pressure on discharge.

3.2 PERFORMANCE REQUIREMENTS

A. It is essential to the operation of the existing sewerage system that there be no interruption in the flow of sewage throughout the project. To this end, the Contractor shall provide, maintain and operate all temporary facilities such as dams, plugs, pumping equipment (both primary and backup units and dual piping as required), conduits, all necessary power, and all other labor and equipment necessary to intercept the sewage flow before it reaches the point where it would interfere with his work, carry it past his work and return it to the existing sewer downstream of his work.

B. The design, installation, and operation of the temporary pumping system shall be the Contractor's responsibility. The bypass system shall meet the requirements of NPS, all codes, and regulatory agencies having jurisdiction.

C. The Contractor shall provide all necessary means to safely convey the sewage past the work area. The Contractor will not be permitted to stop or impede the main flows under any circumstances.

D. The Contractor shall maintain sewer flow around the work area in a manner that will not cause surcharging of sewers, or damage to sewers and that will protect public and private property from damage and flooding.

E. The Contractor shall protect water resources, wetlands, and other natural resources.

3.3 FIELD QUALITY CONTROL AND MAINTENANCE

A. Test: The Contractor shall perform leakage and pressure tests of the bypass pumping discharge piping using clean water before the actual operation. The COR will be given 24 hours' advance notice before testing.

B. Inspection: Outside of normal working hours one bypass personnel shall be present to monitor one bypass setup (identified on plans). The contractor shall inspect the bypass pumping system every two hours to ensure that the system is working correctly. The person assigned as the incident commander in charge of a potential spill and one other bypass personnel shall be housed no further than a 12-minute drive time to bypass. At shift changes, the bypass line shall be walked to visibly inspect for leaks and failures.

C. Maintenance Service: The Contractor shall ensure that the temporary pumping system is properly maintained and that at least two responsible operators shall be on hand at all times when pumps are operating.

D. Extra Materials: Spare parts for pumps and piping shall be kept on-site as required. Adequate hoisting equipment for each pump and accessories shall be maintained on the site.

3.4 PREPARATION

A. Precautions

1. The contractor is responsible for locating any existing utilities in the area the Contractor selects to locate the bypass pipelines. The Contractor shall locate his bypass pipelines to minimize any disturbance to existing utilities and shall obtain approval of the pipeline locations from the COR. All costs associated with relocating utilities and obtaining approvals shall be paid by the Contractor.
2. During all bypass pumping operations, the Contractor shall protect the Pumping Station and main and all local sewer lines from damage inflicted by any equipment. The Contractor shall be responsible for all physical damage to the Pumping Station and main and all local sewer lines caused by human or mechanical failure.

3.5 INSTALLATION AND REMOVAL

A. The Contractor shall remove manhole sections or make connections to the existing sewer and construct temporary bypass pumping structures only at the access location indicated on the Drawings and as may be required to provide adequate suction conduit.

B. Plugging or blocking of sewage flows shall incorporate a primary and secondary plugging device. When plugging or blocking is no longer needed for performance and acceptance of work, it is to be removed in a manner that permits the sewage flow to slowly return to normal without surge, to prevent surcharging or causing other major disturbances downstream.

C. When working inside a manhole or force main, the Contractor shall exercise caution and comply with OSHA requirements when working in the presence of sewer gases, combustible or oxygen-deficient atmospheres, and confined spaces.

D. The installation of the bypass pipelines is prohibited in all saltmarsh/wetland areas. The pipeline must be located off streets and sidewalks and on the shoulders of the roads. When the bypass pipeline crosses local streets and private driveways, the contractor must place the bypass pipelines in trenches and cover them with the temporary pavement. Upon completion of the bypass pumping operations, and after the receipt of written permission from the COR, the Contractor shall remove all the piping, restore all property to pre-construction condition and restore all pavement. The Contractor is responsible for obtaining written approval for placement of the temporary pipeline within public ways from the COR.

END OF SECTION

INSERT ATTACHMENT A - SPILL PREVENTION & RESPONSE PLAN

SECTION 33 34 51

DRAINAGE FIELD SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION - SCOPE OF WORK

A. Furnish, deliver, and install a new and fully operational infiltrator drain field bed system complete using materials for bed type disposal field with infiltrators, filter fabric, and gravel to disperse septic tank effluent to meet local environmental requirements.

B. The installer of the infiltrator drain field bed system shall furnish a complete and fully operational dispersal drain field bed system, consisting of PVC gravity piping from septic tank to junction box with distributing zone gates, header vault, and inspection boxes, PVC header piping, infiltration chambers. The installer shall supply detailed installation, operation, and maintenance (O&M) instructions and manuals.

C. The installer of the infiltrator drain field bed system shall demonstrate a record of at least 3 infiltrators drain field bed systems of similar type each in successful service for not less than 10 years. Additionally, the installer of the infiltrator drain field bed system shall demonstrate 2 successful operating installations within the United States having similar climate conditions to the Buckeye Housing area. The infiltrator drain field bed system shall be installed using components manufactured by Infiltrator® Systems, Inc., or other pre-approved equal. The Contracting Officer shall determine whether the other manufacturer will meet the requirements for pre-approved equal.

D. The National Park Service shall require a minimum of 30 calendar days to review and respond in writing to the manufacturer’s pre-approval submittal. For any submittal determined to not meet this specification for pre-approval, the National Park Service shall provide a letter reporting the submittal deficiencies. For any submittal determined to meet this specification for pre-approval, the National Park Service shall provide a letter acknowledging pre-approval that must be included with the final Contractor bid.

1.2 RELATED SECTIONS

A. Section 31 10 00 – Site Clearing

B. Section 31 23 33 - Utility Excavation & Backfill

C. Section 31 25 00 – Erosion & Sediment Control

1.3 REFERENCES

A. Publications

1. Tulare County, California Local Agency Management Program for Onsite Wastewater Treatment Systems (2018)
2. American National Standard - Uniform Plumbing Code - Appendix H (2020)
3. California Plumbing Code Books (2016)
4. California Water Board OWTS Policy: Water Quality Control Policy for Siting, Design, Operation, and Maintenance of Onsite Wastewater Treatment Systems. Tier 1 - Low-Risk New or Replacement OWTS (June 19, 2012)

1.4 SUBMITTALS

A. As specified in Section 01 33 23 - “Submittal Procedures.”

B. Manufacturer’s installation instructions or guide for the following items:

1. Infiltrator Chambers
2. Distribution manifold boxes
3. Infiltrator inspection and access boxes
4. Piping

C. Manufacturer’s operating instructions or guide for the following items:

1. Infiltrator Chambers

1.5 PRODUCT HANDLING

A. Delivery: Handle pipe, infiltrators, and appurtenances carefully to ensure delivery at the project site in sound, undamaged condition. Contracting Officer will reject damaged pipes, infiltrators, and appurtenances on site. The contractor shall replace the damaged pipe, infiltrators, and appurtenances at no additional expense to the Government.

B. Storage: Do not store materials directly on the ground. Adequately support piping, infiltrators, and appurtenances to prevent warpage or damage. Use protective covers where pipes, infiltrators, and appurtenances may be damaged by direct sunlight.

1.6 CLOSEOUT SUBMITTALS

A. As specified in Section 01 77 00 - “Closeout Procedures”.

B. A minimum of one of each type of tool is needed to open covers and appurtenances for each style and size of covers and appurtenances.

C. Operation and maintenance data for review and approval as stated below.

D. Manufacturer's operation and maintenance data for the following:

1. Infiltrators.

PART 2 - MATERIAL AND COMPONENTS

2.1 DISTRIBUTION BOXES, PIPING, INFILTRATOR CHAMBERS, ENGINEERED DRAINFIELD BED FILL MATERIAL, INSPECTION BOXES, AND ASSOCIATED COMPONENTS

A. Treated Effluent PVC Pipe

1. Material shall be a minimum 6" inside diameter PVC schedule 80 or better between Zone Chamber and distribution header boxes and a minimum 3" inside diameter PVC schedule 80 or better between distribution header boxes and infiltrators. PVC SDR 35 can be used with COR approval.

B. Distribution Boxes (Zonal - Hand Operated): Hand-operated gate distribution for zones capable of providing multiple zone gravity distribution systems. Distributing gate assembly shall be manually operated to provide sequential redirection of gravity flow to multiple zones or cells in a distribution field.

1. Boxes are manufactured using precast concrete or HDPE.
2. All fittings, schedule 80 PVC per ASTM specification.
3. Unions, schedule 80 PVC per ASTM specifications
4. PVC SDR 35 can be used with COR approval.

C. Infiltration Chamber: Infiltration chamber capable of meeting a load rating of H-10 (16,000lb) maximum per axle with a minimum of 12 inches of cover. Maximum cover shall not exceed 4 feet.

1. Pre-approved Infiltration Chamber with associated required features:
   a. Infiltrator Systems, Inc. ARC 36 Chamber or Contracting Officer approved equal.
   b. Injection-molded HDPE
   c. Twenty-degree integral articulating joint
   d. Designed to accommodate both gravity-fed and pressure dosed systems
   e. Corrugated chamber design.
   f. Lock and drop joint connections
   g. Universal inlet/outlet endcap
   h. Individual inspection vent ports
   i. Side port coupler component
   j. Diamond plate texture

D. Inspection Boxes: Inspection boxes shall be made of precast concrete or HDPE with locking covers and capable of providing adequate housing for inspection piping as shown on the construction drawings. Covers shall be installed that provide a load rating of H-10 (16,000lb) maximum per axle with a minimum of 12 inches of cover.

1. Pre-approved Inspection Box:
   a. Infiltrator® Systems, Inc. or Contracting Officer approved equal.

PART 3 - EXECUTION

3.1 BED TYPE DISPOSAL FIELD INSTALLATION

A. Excavate to lines and depths as shown on the construction drawings. A pre-construction conference is required to establish the responsibilities and duties among the parties associated with the installation, and operation of the infiltrator drain filed system and its associated components. Conference attendees should include appropriate representatives from the National Park Service, the construction contractor, and the manufacturers of the components of the drainfield system.

B. The contractor shall provide the services of a trained representative to instruct the NPS staff regarding the proper installation and to inspect the proper installation and field testing of each drainfield zone per the manufacturer's recommendations and requirements.

1. The manufacturer's representative shall be on-site for a minimum of one 8-hour day for this task.
2. The manufacturer's inspector shall provide quality control by inspecting and certifying the installation of the drainfield bed system and its associated components complies with Tulare County Environmental Health Department code requirements. The manufacturer's representative shall be on-site for a minimum of one 8-hour day for this task.
3. Note the contractor shall provide all equipment necessary to complete the inspection and field testing program. A letter of completion shall be signed by the manufacturer's inspector within one week after the septic system has been successfully installed in the Buckeye Housing disposal field to supply effluent (clean water during testing) and before system commissioning.

C. The contractor shall also provide the services of a trained representative for training Park staff operators and overseeing drainfield bed operation during system start-up or system commissioning. Upon system commissioning, the manufacturer's trained representative will provide the National Park Service with a written report of the findings during system commissioning. The trained representative shall be on-site for a minimum of one 8-hour day to do a functional check of each drainfield bed zone. During this time, the trained representative will also provide operation training, which shall include familiarization with the infiltrator drainfield bed system and its operational and maintenance requirements as stipulated in the Operation and Maintenance Manual.

D. The contractor shall conduct a system performance evaluation to demonstrate system compliance under Tulare County Code. The contractor is responsible for all testing demonstration costs.

3.2 OPERATION AND MAINTENANCE MANUAL

A. Two Operation and Maintenance (O&M) Manuals shall be furnished during start-up. These manuals shall include maintenance instructions for all components provided as well as detailed part schematics, descriptions, and layout schematic system design for each zone.

END OF SECTION

SECTION 33 36 31

GROUND-LEVEL AWWA D110 TYPE I
PRESTRESSED CONCRETE WASTEWATER STORAGE TANKS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included

1. This section specifies the design qualifications for the Tank Contractor and Designer and requirements for the tank design and construction materials used in the tank.
2. In the event of a discrepancy between this section of the Specifications and any other section of the Specifications, this section shall govern.
3. The tank shall conform to the dimensions and be equipped with the appurtenances shown on the Drawings and as specified herein.
4. The Tank Contractor shall furnish all labor, materials, tools, and equipment necessary to construct, disinfect and test the conventionally reinforced concrete tank and appurtenances as indicated on the drawings, and as specified.

B. Related Work Described Elsewhere

1. Imported Soils and Fill Materials - 31 23 16.10
2. Plumbing and Piping – Division 22

C. Description of System

1. The tank shall consist of a cast-in-place reinforced concrete floor and wall footing, a conventionally reinforced, cast-in-place concrete wall, and column supported flat slab roof.

1.2 QUALITY ASSURANCE

A. Qualifications and Experience

1. Singular Responsibility: This specification intends to require single-party responsibility for the design and construction of the cast-in-place conventionally reinforced concrete tank. The tank design and construction shall be performed by an established Tank Contractor of recognized ability, having at least ten years of experience in the design and construction of conventionally reinforced concrete tanks as specified herein. The structural design and construction of all aspects of the foundation, floor slab, wall, and roof of the conventionally reinforced concrete tank, (including bedding and backfill materials and compaction), shall be performed by the Tank Contractor. The Tank Contractor may subcontract labor for reinforcing steel installation and for concrete slab placement under the Tank Contractor’s direct supervision.

2. All tank work shall be performed by a company that specializes in the design and construction of cast-in-place, conventionally reinforced concrete tanks and with proven capability of meeting all the requirements of these specifications. No company is considered qualified unless it has designed and built in its own name at least five cast-in-place, conventionally reinforced concrete tanks in the last ten years. The company shall have in its own name or under one of its divisions, at least five conventionally reinforced concrete tanks that are located in an area with an S_{DS} of 0.75g or higher and have been in successful service for at least five years.
3. The Tank Contractor shall have in its employ a design professional engineer currently licensed to practice civil engineering in the state of California with a minimum experience of 10 years in the design of conventionally reinforced concrete tanks. The design engineer shall have been the engineer in responsible charge of a minimum of five conventionally reinforced concrete tanks in the past ten years. The design engineer shall have been in responsible charge of the design of a minimum of five conventionally reinforced concrete tanks located in an area with an SDS of 0.75g or higher in the past 10 years.
4. Experience in the design and construction of AWWA D110 tanks, conventionally reinforced tanks having fixed wall bases, and tank core walls incorporating internal stressing systems are not acceptable.

B. Prequalification

1. DN Tanks, Inc., Delaware (Natgun Corporation, Massachusetts, and DYK Incorporated, California, Divisions of DN Tanks) is prequalified for the design and construction of cast-in-place, conventionally reinforced concrete tanks. Additional Tank Contractors seeking prequalification shall make a complete submittal to the Contracting Officer for review and approval no later than ten days before the date set for receipt of the bid, in accordance with Section 1.3A. The submittal shall include detailed design drawings and calculations meeting the requirements of these specifications, the company's record of previous experience in the design and construction of circular cast-in-place, conventionally reinforced concrete tanks constructed in their own name, including the experience of the design engineer meeting the requirements of Section 1.2 A.3. Within 5 days before the date of receiving bids, the Contracting Officer will publish a list of additional prequalified Tank Contractors.
2. Experience in the design and construction of AWWA D110 tanks, conventionally reinforced tanks having fixed wall bases, and tank core walls incorporating internal stressing systems are not acceptable.
3. All Tank Contractors not prequalified in accordance with Section 1.2 will be rejected.

C. Codes & Standards

1. All Codes shall be considered the most current version of that code unless noted otherwise.
   a. ACI 301 Specifications for Structural Concrete
   b. ACI 305 Hot Weather Concreting
   c. ACI 306 Cold Weather Concreting
   d. ACI 309R Guide for Consolidation of Concrete
   e. ACI 318 Building Code Requirements for Reinforced Concrete and Commentary
   f. ACI 350 Code Requirements for Environmental Engineering Concrete Structures and Commentary

g. ACI 350.1 Tightness Testing of Environmental Engineering Concrete Structures and Commentary
h. ACI 350.3 Seismic Design of Liquid Containing Concrete Structures and Commentary
i. ASTM A123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
j. ASTM A185 Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
k. ASTM A475 Standard Specification for Zinc-Coated Steel Wire Strand
l. ASTM A615/A615M Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
m. ASTM A706/A706M Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
n. ASTM C31 Standard Practice for Making and Curing Concrete Test Specimens in the Field
o. ASTM C33 Standard Specification for Concrete Aggregates
p. ASTM C39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
q. ASTM C231 Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
r. ASTM C618, Type F Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
s. ASTM C920 Specification for Elastomeric Joint Sealants
t. ASTM D1056 Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
u. ASTM D1556 Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
v. ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 Ft. - lbf/ft^3) 2700 KN-M/M3)
w. ASTM D2000 Classification System for Rubber Products in Automotive Applications
x. ASCE Standard 7 Minimum Design Loads for Buildings and Other Structures
y. AWWA C652 Standard for Disinfection of Water-Storage Facilities
z. US Army Corps of Engineers Specification CRD-C-572, Specification for PVC Waterstop

D. Design Criteria

1. The conventionally reinforced concrete tank shall be designed and constructed following the provisions of ACI 350, ACI 350.3, ASCE 7, and IBC.
2. The Tank Contractor shall use the following loadings and requirements in the design calculation:
   a. Capacity (Useable): 120,000 gallons.
   b. Dimensions: 29.5 ft. inside diameter, 24 ft. water depth.
   c. Dead Load: shall account for 2’ soil cover. Unit weight of concrete 150 pounds per cubic foot; steel 490 pounds per cubic foot.
   d. Live Load: shall be the weight of all the liquid when the reservoir is filled to overflowing. Unit weight of liquid 62.4 pounds per cubic foot.
   e. Total Roof Live Load: 100.00 psf. Plus additional live loading will allow for a ¾ ton pickup truck to drive over and or park on the roof of the tank for short periods.

f. Foundation Loads: the tank foundation shall be proportioned so that soil pressure shall be less than the soil bearing capacity. The allowable NET soil bearing capacity is 4,000 psf (assumed). The allowable gross soil bearing capacity is 7,000 psf (min).
g. Seismic Criteria:
    i. Seismic Design Criteria: Seismic design shall be based on the applicable sections of ACI 350.3, ASCE 7, and the local jurisdictional building code. The comparative value of 80% as specified in ASCE 7, Section 15.4.1, paragraph 6 shall be used to determine the total base shear from ASCE 7. Impulsive and convective forces, as well as fluid spectral velocity, shall be calculated utilizing each code and the maximum value of each component shall be used to calculate the total base shear. The wall bearing pads cannot be considered as contributing to the shear resistance during a seismic event.
    ii. ASCE 7 Design Criteria:
        1) Mapped MCER Spectral Accelerations for Short Periods; Ss:
        2) Mapped MCER Spectral Accelerations for 1-Second Period; S1:
        3) Site Class:
        4) Response Modification Factor, R:
        5) Long-period Transition Period, TL:
        6) Importance Factor, I:
    iii. ACI 350.3-06 Design Criteria:
        1) Mapped Spectral Accelerations for Short Periods; Ss:
        2) Mapped Spectral Accelerations for 1-Second Period; S1:
        3) Site Class:
        4) Importance Factor, I:
        5) Impulsive Structural Coefficient, Ri:
        6) Convective Structural Coefficient, Rc:
    iv. Sloshing Height: The sloshing height shall be determined using the maximum value calculated for the fluid displacement based on ACI 350.3 of ASCE 7. The effects of the “sloshing wave” shall be accounted for by increasing the freeboard between the normal operating surface and the underside of the roof, or a roof capable of resisting the uplift of such a wave designed. A minimum freeboard height of 12 inches, unless shown otherwise on the drawings, above the design liquid level shall be utilized. Any confined portion of the convective (sloshing) mass shall be calculated and applied as an additional impulsive mass.
    v. Base Restraint Cable Design:
        1) The base restraint cables shall be designed for the total base shear obtained from the maximum values of impulsive and convective components and the dynamic effects of backfill. The allowable cable stress is 0.75 fpu.
        2) For the total base shear obtained from the loading conditions of ASCE 7 that incorporate an overstrength factor (Omega Factor), the allowable cable stress shall be increased by 20%. The Omega factor shall be 2.0 for all loading cases.
h. Wind Loads: shall be as required by ASCE 7
i. Vent Capacity Requirements:
    i. Maximum Fill Rate: 13.4 cfm.
    ii. Maximum Draw Down Rate: 200 cfm.
j. Overflow Design Capacity: 100 GPM.

3. The Tank Contractor shall design the tank cast-in-place wall based on the following design criteria and requirements:
   a. The minimum total wall thickness at any height shall be 12 inches.
   b. The minimal "final" circumferential force to contain the water load at the bottom of the wall shall be:

      P_{cw} = 62.5 (R) (H) (lbs/ft of height).

      Where R = inside radius of the wall (feet).
      H = maximum overload water height (feet).

      This force shall taper uniformly to zero at the top of the maximum overload water height. The maximum allowable stress in the reinforcing to counteract the water load shall be 20,000 psi. No contribution from the wall concrete or backfill shall be used to counteract the internal water load.

   c. The minimum circumferential mild-steel reinforcing for differential temperature and dryness bending shall be no less than 0.30 percent of the cross-sectional area of the tank core wall. This steel shall be additive to the steel required for the water load above. The minimum combined circumferential steel reinforcing at any location shall be no less than 0.50 percent of the cross-sectional area of the tank core wall. The minimum vertical steel reinforcing at any location shall be 0.50 percent of the cross-sectional area of the tank core wall. The maximum spacing of vertical and circumferential reinforcing shall be 12 inches. Both the circumferential and vertical steel shall be placed equally on both faces of the tank core wall.
   d. The cast-in-place tank core wall shall be supported by solid neoprene bearing pads allowing free radial movement of the wall relative to the wall footing. The walls shall be tied circumferentially to the wall footing with seismic cables consisting of hot-dip galvanized strands encased in closed cell sponge rubber sleeves. A PVC waterstop connection shall be provided between wall and wall footing.
   e. The minimum pad thickness and width under the cast-in-place tank core wall shall be 0.5 inches and 5 inches, respectively.
   f. All neoprene or natural rubber pad sections shall be based on continuous loading values not to exceed those allowed in the neoprene design manual.
   g. No reduction in ring compression or tension in the cast-in-place tank core wall will be taken due to restraint at the bottom.
   h. Friction between wall and rubber bearing pads and lateral soil pressures shall not be considered in resisting seismically generated shear forces between the wall footing and the wall between. These forces shall be resisted by positive connections taking the loads in the tangential direction only and at the same time allowing free radial motion of the wall.
   i. Walls that are precasted, shotcreted or walls that incorporate internal stressing systems shall not be considered.
4. The Tank Contractor shall design the wall footing based on the following design criteria and requirements:
   a. The circumferential wall footing reinforcing, for differential dryness purposes, shall have a minimum total cross-sectional area no less than 0.5% of the wall footing section excluding any reinforcement requirements for bursting forces due to water loads.

b. Bursting forces caused by liquids acting on wall footings shall be taken up fully by reinforcing steel in the radial or circumferential direction at steel stresses not exceeding 20,000 psi. No credit shall be given to the radial slide resistance effects of soils on footings.
c. Hinged or fixed wall-to-wall footing connections shall not be considered.
d. Radial and circumferential bar sizes shall not exceed 3/4 inches.
e. Splices in parallel bars shall be adequately staggered to avoid more than one splice at any point around the circumference of the wall footing.
f. The minimum width of the wall footing shall be 4.0 feet and the minimum thickness shall be 1.25 feet.

5. The Tank Contractor shall design the tank floor based on the following design criteria and requirements:
   a. The floor thickness shall be no less than 6 inches nominal with a plus or minus construction tolerance of 1/2 inch.
   b. The floor reinforcing in each direction shall be no less than 0.5% of the nominal floor section with a maximum bar spacing of 12 inches. Floor thicknesses in excess of 8 inches shall have 2 layers of steel with the bottom mat at least 2 inches off the ground.
   c. Post-tensioning of floors shall not be considered.
   d. Tanks utilizing footings having any projections extending below the elevation of the bottom of the slab, which could in any way restrain slab shrinkage, must include floors having radial joints crossing the center of the tank at 90^{o} or their equivalent unless the floor reinforcing in each direction is no less than 1/2 percent of the nominal floor section.
6. Flat Slab Roof
   a. The roof shall be cast-in-place, flat-slab reinforced concrete with a minimum thickness of 9 inches.
   b. The concrete cover over regular reinforcing steel in flat roof slabs shall be 2.0-inch nominal with a plus or minus 1/4" construction tolerance.
   c. The interior columns shall have a minimum diameter of 18 inches.
   d. Column shall be reinforced with vertical and spiral reinforcement
   e. The roof shall be supported by solid neoprene or natural rubber bearing pads, according to the specifications herein, allowing free radial movement of the wall and roof. The roof shall be tied circumferentially with seismic connections to the tank wall, designed by the Tank Contractor which permits free radial movement of wall and roof.
      i. All neoprene or natural rubber pad sections shall be based on continuous loading values not to exceed those allowed in the neoprene design manual.
      ii. The minimum bearing pad thickness and width under the roof slab shall be 0.5 inches and 2 inches, respectively.
      iii. The remaining voids between wall and roof, not taken up by the solid neoprene or natural rubber pads, shall be filled with closed-cell rubber pads and soft mastic to ensure a substantially unrestrained free movement of wall and roof.
   f. Non-prestressed steel-reinforced concrete flat slabs shall conform to the applicable requirements of ACI 350, including the sanitary environmental durability coefficients factor with special attention to crack control.
   g. The design shall provide a weather-tight roof to minimize cracking and to prevent leakage and contamination of the contents. Consideration shall be given to the exposure conditions. Reinforcement of concrete slabs shall also be provided to resist temperature stresses.
   h. Alternate roof designs such as post-tensioned, pre-tensioned, precast, or waffle-type roofs shall not be considered.

1.3 SUBMITTALS

A. Prequalification Submittals Ten Days Before Bid Date

1. Tank Contractors not previously prequalified shall submit preliminary design drawings and calculations showing the dimensions of the tank, details of the type of construction, and sizes of principal members. The drawings and calculations shall be of sufficient detail to show compliance with the specification and all required standards and shall be signed and sealed by an Engineer registered in the state the tank is to be constructed.
2. Tank Contractors not previously prequalified shall submit a complete experience record for the tanks they have designed and built in their own name. The record shall include the Tank Contractor's experience in the design and construction of conventionally reinforced concrete tanks. The record shall also indicate the size of the tank, the name and address of the Owner, the year of construction, and the name of the Engineer for each project.
3. Tank Contractors not previously prequalified shall submit the name of the tank designer currently in its employ, and his/her experience as the designer of record for conventionally reinforced concrete tanks, including the size of the tank, seismic parameters, the name and address of the Owner, the year of construction and the name of the Engineer.
4. Tank Contractors not previously prequalified shall submit the resumes for each member of the project team including the tank superintendent and project manager that will be used for this project.

B. Design Submittal after Execution of Contract

1. Design calculations and drawings in quadruplicate, showing details and procedures of construction, shall be submitted to the Contracting Officer for approval after execution of the Contract. After approval by the Contracting Officer, one set of the drawings and calculations will be returned to the Tank Contractor, and any changes found necessary by the Contracting Officer shall be made by the Tank Contractor.
2. Approval by the Contracting Officer of the drawings and calculations submitted by the Tank Contractor will not in any way relieve the Tank Contractor of full responsibility for the accuracy and completeness of the drawings and calculations.
3. Design calculations and drawings shall be stamped by a professional engineer currently licensed to practice civil engineering in the state of California experienced in the design of conventionally reinforced concrete tanks.
4. The Contractor shall submit final construction documents for the concrete tank, sealed by a professional engineer, licensed in the State of California, with design experience of conventionally reinforced concrete tanks for approval by the Contracting Officer. Sealed tank construction documents shall include at a minimum design calculation, final construction plans, and specifications. The Contractor shall coordinate all other construction elements to the approved, Contractor submitted, tank construction documents before construction.

C. Construction Submittals for Review Before Use

1. Design proportions for all concrete. Concrete strengths of trial mixes.
2. Admixtures to be used in the concrete and their purpose.

3. Reinforcing steel shop drawings showing fabrication and placement.
4. Catalog cuts or shop drawings of all appurtenances, i.e., hatch, vent, ladders, waterstops.
5. Sheeting and Shoring Plan: Shoring system design calculations and drawings are required for the construction of the underground water utility storage tank and shall be prepared, stamped, and submitted by a professional engineer licensed to practice civil engineering in the state of California and experienced in the design of shoring systems for soil types and depths encountered on this project.
   a. Refer to Paragraph 1.5 below and Section 01 35 23 - "Safety Requirements."

1.4 GUARANTEE

A. The Tank Contractor shall guarantee the structure against defective materials or workmanship for one year from the date of completion. If any materials or workmanship prove to be defective within one year, they shall be replaced or repaired by the Tank Contractor at the Tank Contractor's expense.

1.5 ADDITIONAL SAFETY RESPONSIBILITIES

B. The Contractor shall select, install, and maintain shoring, sheeting, bracing, and sloping as necessary to maintain safe excavations. The Contractor shall be responsible for ensuring such measures: 1) comply fully with 29 CFR Part 1926 OSHA Subpart P Excavations and Trenches requirements, 2) provide the necessary support to the sides of excavations, 3) provide safe access to the Engineer's sampling and testing within the excavation, 4) provide safe access for backfill, compaction, and compaction testing, and 5) otherwise maintain excavations in a safe manner that shall not endanger property, life, health, or the project schedule. All earthworks shall be performed in strict accordance with applicable law, including local ordinances, applicable OSHA, Cal-OSHA, California Civil Code, and California Department of Industrial Safety requirements.

PART 2 - PRODUCT

2.1 CONCRETE

A. Concrete shall conform to ACI 301.

B. Cement shall be Portland cement Type I or Type II.

C. Admixtures, other than air-entraining, superplasticizers, shrinkage reducing, and water-reducing will not be permitted unless approved by the Contracting Officer.

D. Concrete for tank wall and roof construction shall have a minimum compressive strength of 4,000 psi at twenty-eight days and maximum water to cement ratio of 0.42.

E. Concrete for the tank floor, footings, pipe encasement, and all other work shall have a minimum compressive strength of 4,000 psi at twenty-eight days, shall not be air-entrained, and have maximum water to cement ratio of 0.42. The coarse and fine aggregate shall meet the requirements of ASTM C33. Coarse aggregate shall be No. 467 with 100% passing the 1½ inch sieve. Superplasticizers, water-reducing, and shrinkage-reducing (if applicable) admixtures shall be incorporated into the floor concrete. If fibers are used, they shall be virgin polypropylene or cellulose fibers, Microfiber by Grace, Fibermesh 150 by Propex, UltraFiber 500 by Buckeye, or equal. Fiber lengths shall be a maximum of ¾ inches. The number of fibers added to the concrete mix shall conform to the Manufacturer's recommendations.

F. Proportioning for concrete shall be following ACI 301.

G. All concrete shall have a maximum water-soluble chloride ion concentration of 0.06% by weight of cement.

2.2 REINFORCING STEEL

A. Reinforcing steel shall be new billet steel Grade 60, as shown on the Drawings, meeting the requirements of ASTM A615. Welded wire fabric and weldable reinforcing steel shall conform to ASTM A185 and ASTM A706, respectively

B. Reinforcing steel shall be accurately fabricated and shall be free from loose rust, scale, and contaminants, which reduce bond.

C. Reinforcing steel shall be accurately positioned on supports, spacers, hangers, or other reinforcements and shall be secured in place with wire ties or suitable clips. Rebar chair supports may be either steel with plastic tips, turned up legs, or plastic.

D. Circumferential reinforcing shall be continuous through vertical wall joints.

E. Continuous reinforcing is required through the floor and roof joints, where applicable, and shall have Class A galvanized coating or epoxy coating.

2.3 BASE RESTRAINT CABLES

A. The tank designer shall use base restraint cables to resist earthquake loads. Base restraint cables shall be hot-dip galvanized seven-wire strands and shall be manufactured following ASTM A416 before galvanizing, and ASTM A475 after galvanizing. Only seven-wire strands will be allowed.

B. Hot-dip galvanized seven-wire strand shall have a nominal strand diameter of 0.375 in, 0.50 in, or 0.60 in. 0.375-inch diameter strand shall have a MUS after galvanization of 21.36 kips and a min. yield at 1% extension of 15.60 ksi. 0.50-inch diameter strand shall have a MUS after galvanization of 38.25 kips and a min. yield at 1% extension of 28.00 ksi. 0.60-inch diameter strand shall have a MUS after galvanization of 54.20 kips and a min. yield at 1% extension of 40.70 ksi. All strands shall have a minimum weight of Zinc Coating of 0.85 oz/sq. ft.

C. Neoprene sleeves for base restraint cables shall be closed-cell conforming to ASTM D1056, Type 2, Class A, and Grade 3. The sleeves shall have a compression deflection limited to 25% at 9 to 13 psi, hardness of 60 to 80 durometer, a minimum tensile strength of 175 psi, a minimum elongation of 180%, and a maximum compressive set of 35%.

2.4 ELASTOMERIC MATERIALS

A. A 9-inch minimum waterstop with a center bulb shall be polyvinyl chloride meeting the requirements of the Corps of Engineers Specification CRD-C 572. Splices shall be made per the Manufacturer's recommendations subject to the approval of the Contracting Officer. Waterstop shall be manufactured by Greenstreak Plastic Products Company, Inc., or equal.

B. Bearing pads shall be natural rubber or neoprene.

1. Natural rubber bearing pads shall contain only virgin natural polyisoprene as the raw polymer and the physical properties shall comply with ASTM D2000 Line Call-Out M 4 AA 414 A1 3.
2. Neoprene bearing pads shall have a hardness of 40 to 50 durometer, a minimum tensile strength of 1,500 psi, a minimum elongation of 500%, and a maximum compressive set of 50%. Pads shall meet the requirements of ASTM D2000 Line Call-Out M 2 BC 410 A1 4 B14 or M 2 BC 414 A14 C12 F17 for 40 durometer material.

C. Sponge filler shall be closed-cell neoprene or rubber conforming to ASTM D1056, Type 2, Class A, and Grade 1 or 3. Compression deflection is limited to 25% at 2 to 5 psi.

D. Polysulfide or polyurethane sealant will be a two or three-component elastomeric compound meeting the requirements of ASTM C920. Sealants shall have permanent characteristics of the bond to metal surfaces, flexibility, and resistance to extrusion due to hydrostatic pressure. Air-cured sealants shall not be used.

E. The remaining voids below the wall, not taken up by the solid neoprene or natural rubber pads, shall be filled with closed-cell rubber pads and soft mastic to ensure a substantially unrestrained free movement of the wall and flat slab roof.

2.5 EXTERIOR COATINGS FOR EXPOSED SURFACES

A. Concrete stain shall be applied to the exterior roof portion of the tank and any exposed concrete portions of the tank per specification Section 09 90 00, General Painting, Concrete Stain & Coating Requirements, and tank manufacturer's recommendations.

B. If required, additional decorative coating shall be applied to the above-grade exterior wall surfaces using two coats of a non-cementitious, high build, 100% acrylic resin polymer such as "Tammscoat Smooth" textured protective coating, "Tnemec Envirocrete 156" or equal.

2.6 APPURTENANCES

A. The Contractor shall provide and install all appurtenances as shown on the drawings. Appurtenances shall include the following:

1. Inlet-Outlet Piping.
2. Overflow Piping, dry well, and weir.
3. Roof Hatch: A 3 feet 6 inches x 3 feet 6-inch minimum square 316 stainless steel hatch with lockable, hinged cover and curb frame. The hatch shall include a roof ventilator design with stainless steel insect 20 x 20 screen. The hatch shall have a lift handle, padlock tab, padlock, and a cover hold open mechanism. All hardware shall be stainless steel unless otherwise noted on the drawings. Locate hatch as shown on drawings.
4. Interior Ladder: The ladder shall extend from the floor to the hatch. The ladder shall be made out of 6061-T6 Aluminum and have an OSHA-approved Stainless Steel fall prevention device (if required) consisting of a sliding, locking mechanism, and safety belt. Location as shown on the drawings.

PART 3 – EXECUTION

3.1 SAFETY

A. Tank Contractor to conform to and enforce all Local and Federal OSHA safety rules and regulations.

3.2 CLEARING, GRUBBING, AND STRIPPING

A. All trees, shrubs, brush, stumps, roots, and other unsuitable material shall be removed to a minimum distance of 10 feet outside the edge of the tank foundation, plus additional areas necessary for the tank construction. The limits of clearing shall be as shown on the drawings and/or as approved by the Engineer.

B. No burning will be allowed unless approved by the Engineer and local authorities. All trees and vegetation shall be disposed of off-site unless approved otherwise by the Engineer.

C. All topsoil shall be stripped from the proposed construction work area and stockpiled on site.

3.3 EXCAVATION AND BACKFILL

A. The excavation shall be dewatered as required during construction. The dewatering method used shall prevent disturbance of the tank foundation soils.

B. In the event the subgrade material is disturbed or over excavated by the Contractor during excavation, it shall be removed and replaced with compacted select fill, at the Contractor’s expense.

C. A minimum of 6 inches of leveling base material shall be placed on top of the engineered fill, as described in item 3.3 E.

D. In areas to be filled (bottom of the excavation), the exposed surface should be scarified to at least an 8-inch depth, moisture conditioned to at least optimum moisture content, and compacted to at least 95 percent relative compacted based on ASTM D1557. The Contracting Officer shall inspect the subgrade for conformance with the Geotechnical Investigation" report recommendations for its suitability for the tank foundation. Before any select fill is to be placed against rock surfaces, the rock shall be relatively free of all vegetation, dirt, clay, boulders, scale, excessively cracked rock, loose fragments, ice, snow, and other objectionable substances. All free water left on the surface of the rock shall be removed.

E. A leveling base material consisting of a minimum 6 inches thick layer of compacted select fill shall be placed beneath the entire tank foundation. If required by the Tank Design, a non-woven geotextile fabric such as Mirafi 1100N, Propex 4545, or equal, shall be placed between the subgrade and leveling base material as shown on the drawings or directed by the tank builder. Select fill shall conform to the provisions of Section 26 (Caltrans) for ¾ inch maximum Class 2 Aggregate Base and should be compacted to at least 95 percent relative compaction based on ASTM D1557.

F. The surface elevation of the leveling base shall be fine graded to a tolerance of plus zero inches to minus 1/2 inch over the entire foundation areas. Fine grading tolerances for floor pipe encasements shall be plus zero inches to minus 6 inches.

G. The tank shall be backfilled and rough graded to the contours shown on the drawings. The fill shall be placed in a lift not exceeding 8 inches in loose thickness, moisture conditioned to at least optimum moisture content, and compacted to at least 95 percent relative compaction. Unless another material is specified by the Contracting Officer, materials used for backfilling shall be suitable on-site material.

H. Frozen material shall not be used for backfilling nor shall fill material be placed on snow, ice, or frozen material. Rock or concrete spoils (greater than 6 inches) shall not be used in backfill within 2 feet of the tank wall.

3.4 FLOOR

A. The floor and wall footings shall be constructed to the dimensions shown on the Approved Shop Drawings.

B. Before placement of the floor reinforcing, a 6-mil polyethylene moisture barrier shall be placed over the leveling base material. Joints in the polyethylene shall be overlapped a minimum of 6 inches.

C. Before placement of the floor concrete, all piping that penetrates the floor shall be set and encased in concrete.

D. The vertical water stop shall be placed and supported so that the bottom of the center bulb is at the elevation of the top of the footing. The water-stop shall be supported without puncturing any portion of the water-stop other than pre-manufactured holes, grommets, or hog rings for tying at 12 inches o.c. The water-stop shall be spliced using a thermostatically controlled sealing iron and each splice shall be successfully spark tested before encasement in concrete.

E. Floors over 20,000 sq. ft. in surface area, at the option of the Tank Contractor, may have one or more construction joints. Such construction joints shall be approved by the Contracting Officer before placement and shall include a continuous water-stop and galvanized or epoxy-coated reinforcement through the joint.

F. The floor shall be cured by applying one coat of curing compound, curing blankets, and/or flooding with water, and shall remain saturated for a minimum of seven days.

3.5 CAST-IN-PLACE CORE WALL

A. The wall shall have a minimum thickness of 12 inches and be poured without any horizontal joints. The wall design shall be such that wall sections can be poured full height without creating horizontal cold joints.

B. The out of round tolerance is 3/4 inch in 50 feet, 3/8 inch in 10 feet, and 3/16 inch in 24 inches from the true curvature specified at any point on the wall.

C. The maximum permissible variation in the vertical alignment, from the bottom to the top of the wall, is plus or minus 3/8 inch.

D. The allowable tolerance in the average wall thickness for poured walls shall not vary more than 1/8 inch either way. All transitions from plus to minus shall be gradual, even and smooth, and without abrupt changes in the surfaces.

E. Removal of wall forms shall not be started any sooner than twelve hours of accumulated time with the ambient air temperature above 50°F after completion of the wall pour. Pour back of adjacent wall sections shall commence no sooner than thirty-six hours of accumulated time with the ambient air temperature above 50°F after completion of the preceding, adjacent wall pour.

F. The use of slipform construction on liquid-retaining walls will not be permitted on any part of the tank unless the Contractor can satisfactorily demonstrate to the Contracting Officer that there will not be any "tearing" of the core wall.

G. Concrete in the cast-in-place core wall may be deposited from the top of the wall form such that no separation of the coarse aggregate from the mortar takes place.

3.6 COLUMNS AND COLUMN FOOTINGS

A. The columns and column footings shall be constructed as shown on the approved shop drawings.

B. All column footings shall project above the floor and not below the floor. The size of these footings shall be determined based on the soil bearing capacity.

C. Any reinforcing steel added to the floor steel shall be without laps. The addition of such bars shall result in an even spacing of reinforcing bars including the floor reinforcing bars.

D. Concrete in circular spirally tied columns, having no horizontal reinforcing crossing into the region bounded by the vertical reinforcement, may be deposited from the top of the column form such that no separation of the coarse aggregate from the mortar takes place.

E. Removal of column forms shall not be started any sooner than twelve hours of accumulated time with the ambient air temperature above 50°F after completion of the column pour.

3.7 CAST-IN-PLACE FLAT SLAB ROOF CONSTRUCTION

A. Roofs over 20,000 sq. ft. in surface area may, at the option of the Tank Contractor, have one or more construction joints. Such construction joints shall be approved by the Contracting Officer before placement and shall include a continuous waterstop and galvanized or epoxy-coated reinforcement through the joint.

B. The roof shall be constructed to the dimensions and slope provided on the approved drawings. Provisions shall be made to ensure proper slope and reinforcing cover.

C. Roof formwork shall not vary from slope shown, more than ¼ inch in 10 feet or ½ inch maximum in 20 feet or more.

D. A curing compound that is compatible with the waterproofing coating system, if required, shall be applied to the roof per the Manufacturer's recommendations. Water curing may be used in conjunction with the curing compound.

3.8 CONCRETE

A. All concrete shall be conveyed, placed, finished, and cured as required by pertinent ACI standards.

B. Weather Limitations

1. Unless specifically authorized in writing by the Contracting Officer, concrete shall not be placed without special protection during cold weather when the ambient temperature is below 35 degrees Fahrenheit and when the concrete is likely to be subjected to freezing temperatures before the initial set has occurred and the concrete strength has reached 500 psi. Concrete shall be protected following ACI 306. The temperature of the concrete shall be maintained following the requirements of ACI 301 and ACI 306. All methods and equipment for heating and for protecting concrete in place shall be subject to the approval of the Contracting Officer.
2. During hot weather, concreting shall be following the requirements of ACI 305.
3. Placement of concrete during periods of low humidity (below 50%) shall be avoided when feasible and economically possible, particularly when large surface areas are to be finished. In any event, surfaces exposed to drying wind shall be covered with polyethylene sheets immediately after finishing, flooded with water, or shall be water cured continuously of the time the concrete has taken the initial set. Curing compounds may be used in conjunction with water curing, provided they are compatible with coatings that may later be applied, or they are degradable.

C. Finishes

1. The tank shall be given the following finishes:
    a. The floor slab shall receive a bull float finish or Fresno finish. The top of the wall footing, exterior to the waterstop, shall receive a steel trowel or magnesium trowel finish.
    b. Column footings shall receive a steel trowel finish on the top surface and a form finish on the sides.
    c. Columns shall have a form finish.
    d. The interior surface of the tank wall shall have a form finish.
    e. The top surface of the roof shall receive a light broom finish and a form finish on the bottom and edge surfaces.

D. Concrete Curing

1. Cure concrete per the methods specified herein for the different parts of the work and described in detail in the following paragraphs. These methods are considered to be minimum for curing. The conditions that exist in the field during placement and curing may require additional curing procedures and efforts to ensure proper protection and curing of the concrete. Select and implement the appropriate method commensurate with climatic conditions.
2. Cure floor slab using Method 1, 3, or 4 as specified below.
3. Cure exterior walls using Method 2 or 4 as specified below.
4. Cure roof slab using Method 3 or 4 as specified below
5. Cure concrete for not less than 7 days after placing per the following methods:
    a. Method 1, Water Spray Method: Tightly close off concrete surfaces to be cured by bulkheads or other means or surround completely with tight enclosures, and keep the concrete surfaces moist by sprinkling, spraying, or other means.
    b. Method 2, Wet-Burlap-Mat Method: Thoroughly wet and cover concrete surfaces to be cured with wet burlap mats as soon as the forms have been stripped or as soon as the concrete has set sufficiently to avoid marring the surface. Keep the entire concrete surface and burlap continuously and completely wet during the entire curing period.
    c. Method 3, Curing Blanket Method:
        i. Thoroughly wet concrete surfaces to be cured and covered with curing blankets as soon as the concrete has been set sufficiently to avoid marring the surface. The curing blankets shall be weighted to maintain close contact with the concrete surface during the entire curing period. Should the curing blankets become torn or otherwise ineffective, keep surfaces moist and replace damaged sections. The curing blankets shall consist of one of the following two types:
            1) Sheets of heavy waterproof sisal-kraft paper laid with the edges butted together and with the joints between strips sealed with 2-inch-wide strips of sealing tape or with the edges lapped not less than 3 inches and fastened together with waterproof cement to form continuous watertight joints; or
            2) Sheets of clean polyethylene, having a minimum thickness of 4 mils, laid with edges butted together and with the joints between sheets sealed with 1-inch-wide strips of acetate tape.
        ii. During the curing period, do not permit traffic of any nature or depositing of objects, temporary or otherwise, on the curing blankets.

d. Method 4, Curing Compound Method:
   i. Spray the surface with two coats of liquid curing compound. Apply per the manufacturer's instructions to cover the surface with a uniform film that will seal thoroughly. Apply a second coat at 90 degrees to the first coat.
   ii. Apply curing compound immediately after completion of the finish on unformed surfaces and within two hours after removal of forms on formed surfaces. Repair formed surfaces within the said two-hour period; provided, however, that any such repairs which cannot be made within the said two-hour period shall be delayed until after Method 1, 2, or 3 has been applied. When repairs are to be made to an area on which the curing compound has been applied, first sandblast the area to remove the curing compound, then repair.
   iii. Wherever curing compound may have been applied to surfaces against which concrete subsequently is to be placed and to which it is to adhere, remove the curing compound entirely by abrasive blasting before the placing of new concrete.
   iv. Where the curing compound method is used, exercise care to avoid damage to the seal during the curing period. Should the seal be damaged or broken before the expiration of the curing period, repair the damaged portions immediately by the application of an additional curing compound.

E. Testing

1. For all concrete, two sets of five cylinders for the first 50 cubic yards, and one set of five cylinders for every 100 cubic yards thereafter are placed on the same day. Two cylinders shall be tested at seven days, two at twenty-eight days, and one held as a spare.
2. Slump, air content, and temperature testing shall be performed on each truck where cylinders are taken.
3. All concrete testing shall be following ASTM C31 and C39, at the expense of the Tank Contractor, and shall be conducted by an independent testing agency approved by the Engineer.

3.9 DISINFECTION

A. The Tank Contractor shall, after tank construction, thoroughly clean the interior of the tank.

B. The Tank Contractor shall notify the Contracting Officer before disinfecting the tank. Disinfection shall meet with the approval of the Contracting Officer, AWWA C652, and the appropriate state agency.

C. The tank floor and interior of the wall shall be disinfected by using a solution of chlorine and water per Method 3 of AWWA C652.

D. Before placing the tank in service, a bacteriological test shall be taken, and successful results received. Testing shall be by an independent testing laboratory at the expense of the Tank Contractor.

3.10 WATER TIGHTNESS TEST

A. Upon completion, the tank shall be tested to determine water tightness. The tank shall be filled with potable water to the maximum level. Water will be furnished to the tank by the Government. The test shall consist of measuring the liquid level over the next twenty-four hours to determine if any change has occurred. If a change is observed and exceeds the maximum allowance, the test shall be extended to a total of five days. If at the end of five days the average daily change has not exceeded the maximum allowance, the test shall be considered satisfactory.

B. The test period shall be at least the theoretical time required to lower the water surface by 3/8 inch assuming a loss at the maximum allowable rate. The test period shall be no longer than five days.

C. The liquid volume loss for twenty-four hours shall not exceed $1/20^{th}$ of 1% of the tank capacity, 0.0005 x tank volume, as outlined in ACI 350.1 test HST-050. If the liquid volume loss exceeds this amount, it shall be considered excessive, and the tank shall be repaired and retested.

D. Damp spots will not be permitted at any location on the tank wall. Damp spots are defined as spots where moisture can be formed on a dry hand. All such areas shall be repaired, as necessary.

E. Damp spots or standing water on the footing may occur upon tank filling and are permissible within the allowable volume loss. Measurable flow in this area is not permissible and shall be corrected.

3.11 CLEAN-UP

A. The premises shall be kept clean and orderly at all times during the work. Upon completion of construction, the Tank Contractor shall remove or otherwise dispose of all rubbish and other materials caused by the construction operation. The Tank Contractor shall leave the premises in as good a condition as it was found.

END OF SECTION

DIVISION 40

PROCESS INTERCONNECTIONS

SECTION 40 05 00

COMMON WORK RESULTS FOR PROCESS INTERCONNECTIONS

PART 1 - GENERAL

1.1 SUMMARY

A. The General Conditions apply to all work of this specification, which shall be done as shown on the plans, and as specified, and shall be properly coordinated with work in other Specifications.

B. The drawings and these specifications are complementary to each other; what is called for by one shall be as binding as if called for by both. If there is any conflict between what is shown on the drawings and what is written in the specifications, the details described on the drawings shall take precedence and the contractor shall communicate the conflicts to the Contracting Officer promptly.

C. Related Requirements:

1. Division 31 - Earthwork.
2. Division 40 - Process Interconnections

D. Safety

1. The contractor shall be familiar with and shall always conform to the regulations of the "OSHA General Industry Occupational Safety and Health Standards," "OSHA Safety and Health Regulations for Construction," "A Guide to Workplace Safety and Health in the State of California", and other applicable state and municipal (Cal/OSHA, DOSH) standards and regulations.

E. Protection of Work Area

1. The contractor shall be familiar with possible/potential utilities that may impact construction work, and plan work accordingly.
2. The contractor shall verify the possible locations for all underground utilities before beginning excavation work for pipe installation.
3. The contractor shall protect existing site improvements from damage during the construction of the underground pipelines.

F. Types of pipes and pipe fittings specified in this section include the following:

1. Stainless Steel Piping
2. Ductile iron
3. Miscellaneous Piping Materials/Products.

G. Pipes and pipe fittings furnished as part of factory-fabricated equipment are specified as part of equipment assembly in Division-43 sections.

1.2 COORDINATION

A. Section 01 31 00 - Project Management & Coordination.

B. Coordinate Work of this Section with piping and equipment connections specified in other Sections and indicated on Drawings.

1.3 CITED STANDARDS

A. Codes and Standards:

1. Welding: Qualify welding procedures, welders, and operators following ASME B31.1, or ASME B31.9, as applicable, for shop and project site welding of piping work.

1.4 QUALITY CONTROL

A. Manufacturer's Qualifications: Firms regularly engaged in the manufacture of pipes and pipe fittings of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications:

1. A firm with at least three years of history of successful experience on projects of similar nature.
2. Licensed as a firm in the contractor state of origin and the State of California.
3. Have a publicly registered bonding capacity of sufficient amount to cover this work and all other work in progress by the Contractor.
4. All workmen employed on the project shall carry state licenses as journeyman or apprentice pipefitters with additional certification for welders.

C. Welding Certification:

1. Each welder shall have passed a qualification test within the past six months.
2. The test report shall certify that the welder is qualified to weld the material to be used at the job site.
3. The contractor shall submit three copies of each welder's qualification test report to the Project Manager for approval before commencing the work. No welder shall be used on the project until so certified.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, installation instructions, and dimensioned drawings for each type of pipe and pipe fitting. Submit piping schedule showing manufacturer, pipe or tube weight, fitting type, and joint type for each piping system.

B. Welding Certifications: Submit reports as required for piping work.

C. Brazing Certifications: Submit reports as required for piping work

D. Maintenance Data: Submit maintenance data and parts lists for each type of mechanical fitting. Include this data, product data, and certifications in the maintenance manual; per the requirements of Division 1.

1.6 DELIVERABLES, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Except for concrete, corrugated metal, hub-and-faucet, clay, and similar units of pipe, provide factory-applied plastic endcaps on each length of pipe and tube. Maintain endcaps through shipping, storage, and managing as required to prevent pipe end damage and eliminate dirt and moisture from inside of pipe and tube.

C. Care shall be taken in loading, transporting, and unloading to prevent injury to the pipe or coatings. Under no circumstances shall the pipe be dropped or skidded against each other. Slings, hooks, or pipe tongs shall be padded and used in a manner to prevent damage to the exterior surface or internal coating or lining of the pipe. If any part of the coating or lining is damaged, the repair shall be made by the manufacturer.

D. Inspection: Accept materials on Site in the manufacturer's original packaging and inspect for damage.

E. Deliver materials in manufacturer's packaging; include handling instructions.

F. Where possible, store pipe and tube inside and protected from the weather. Where necessary to store outside, elevate above grade and enclose with durable, waterproof wrapping.

G. Protect flanges and fittings from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

H. Store piping and appurtenances according to manufacturer instructions.

I. Protect piping and appurtenances from oxidation by storing off the ground.

J. Stored pipe shall be kept safe from damage and away from traveled ways. The interior of all pipes, fittings, and other appurtenances shall be kept free from water, dirt, or foreign matter always.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Piping Materials

1. Provide pipe and tube of type, joint type, grade, size, and weight (wall thickness or Class) indicated for each service. Where type, grade, or class is not indicated, provide proper selection as determined by Installer for installation requirements, and comply with governing regulations and industry standards.

B. Pipe/Tube Fittings

1. Provide factory-fabricated fittings of type, materials, grade, class, and pressure rating indicated for each service and pipe size. Provide sizes and types of matching pipe, tube, valve, or equipment connection in each case. Where not otherwise indicated, comply with governing regulations and industry standards for selections, and with pipe manufacturer's recommendations where applicable.

C. Steel Pipes and Pipe Fittings

1. Black Steel Pipe: Seamless or ERW, ASTM A 53.
2. Galvanized Steel Pipe: ASTM A 53.
3. Galvanized Seamless Steel Pipe: ASTM A 53.
4. Electric-Resistance-Welded Steel Pipe: ASTM A 135.
5. Electric-Fusion-Welded Steel Pipe: ASTM A 671, A 672, or A 691.
6. Cast-Iron Flanged Fittings: ANSI B16.1, including bolting.
7. Cast-Iron Threaded Fittings: ANSI B16.4.
8. Malleable-Iron Threaded Fittings: ANSI B16.3; plain or galvanized as indicated.
9. Unions: ANSI B16.39; 300 lb. ground joint malleable iron, hexagonal, selected by Installer for proper piping fabrication and service requirements, including style, end connections, and metal-to-metal seats (iron, bronze, or brass); plain or galvanized as indicated.
10. Dielectric Unions: 175 psig WSP at 250˚F. Equal to Walter Vallet Company V-line insulating coupling.
11. Threaded Pipe Plugs: ANSI B16.14.
12. Steel Flanges/Fittings: ANSI B16.5, including bolting and gaskets of the following material group, end connection, and facing, except as otherwise indicated.
    a. Material Group: Group 1.1.
    b. End Connections: Butt-welding.
    c. Facings: Raised face.
    d. Steel Pipe Flanges for Waterworks Service: AWWA C207.
13. Forged-Steel Socket-Welding and Threaded Fittings: ANSI B16.11, except MSS SP-79 for threaded reducer inserts; rated to match schedule of connected pipe.
14. Forged Branch-Connection Fittings: Except as otherwise indicated, provide type as determined by Installer to comply with installation requirements.
15. Pipe Nipples: Fabricated from the same pipe as used for the connected pipe; except do not use less than Schedule 80 pipe where length remaining unthreaded is less than 1-1/2", and where pipe size is less than 1-1/2", and do not thread nipples full length (no close nipples).

D. Cast-Iron Soil Pipes and Pipe Fittings

1. Hubless Cast-Iron Soil Pipe: FS WW-P-401.
2. Cast-Iron Hub-and-Spigot Soil Pipe: ASTM A 74.
3. Cast-Iron Hub-and-Spigot Soil Pipe Fittings: Match soil pipe units; complying with the same standards (ASTM A 74).
4. Compression Gaskets: ASTM C 564.

E. Acid Resistant Cast Iron

1. Bell and faucet type, high silicon iron alloy "Duriron", with chemical resistant packing and caulked lead joints.
2. POLYPROPYLENE PIPE: Orion Blueline, flame retardant, Schedule 40, with Schedule 40 fittings, heat fusion-welded joints. Alternate manufacturers, GSR, Enfield. Meet material standards of ASTMD4101, joint standards of ASTM-D2657.

F. Grooved Piping Products (only where acceptable and as shown on plans.)

1. As Installer's option, mechanical grooved pipe couplings, and fittings may be used for piping systems having operating conditions not exceeding 230o F (110o C), excluding steam piping and any other service not recommended by the manufacturer, instead of welded, flanged, or threaded methods, and may also be used as unions, seismic joints, flexible connections, expansion joints, expansion compensators, or vibration reducers.
2. Coupling Housings Description: Grooved mechanical type, which engages grooved or shouldered pipe ends, encasing an elastomeric gasket that bridges pipe ends to create a seal. Cast in two or more parts, secure together during assembly with nuts and bolts. Permit degree of contraction and expansion as specified in the manufacturer's latest published literature. (Victaulic style 77) For rigid joints (Victaulic "Zero Flex" style 07).
   a. Coupling Housings: Malleable iron conforming to ASTM A 47.
   b. Coupling Housings: Ductile iron conforming to ASTM A 536.
   c. Standard: Enamel coated; options hot-dip galvanized.
3. Gaskets: Mechanical grooved coupling design, pressure-responsive so that internal pressure serves to increase seal's tightness, constructed of elastomers having properties as designated by ASTM D 2000.
   a. Water Services: PTFE, with green color code identification.
   b. Other Services: As recommended by the Manufacturer.
4. Bolts and Nuts: Heat-treated carbon steel, ASTM A 183, minimum tensile 110,000 psi.
   a. Exposed Locations: Tamper-resistant nuts.
5. Branch Stub-Ins: Upper housing with a full locating collar for rigid positioning engaging a machine-cut hole in the pipe, encasing elastomeric gasket conforming to pipe outside diameter around the hole, and lower housing with positioning lugs, secured together during assembly with nuts and bolts.
6. Fittings: Grooved or shouldered end design to accept grooved mechanical couplings.
   a. Malleable Iron: ASTM A 47.
   b. Ductile Iron: ASTM A 536.
   c. Fabricated Steel: ASTM A 53, Type F for 3/4" to 1-1/2"; Type E or S, Grade B for 2” to 20”.
   d. Steel: ASTM A 234.

7. Flanges: Conform to Class 125 cast iron and Class 150 steel bolt-hole alignment.
    a. Malleable Iron: ASTM A 47.
    b. Ductile Iron: ASTM A 536.
8. Specialties:
    a. Inline strainers.
    b. Suction diffusers.
9. Grooves: Conform to the following:
    a. Standard Steel: Square cut.
    b. Lightweight Steel: Roll grooved.
    c. Ductile Iron: Radius cut grooved, AWWA C606.
10. Manufacturer: Subject to compliance with requirements, provide grooved piping products of one of the following:
    a. ITT Grinnell Corp.
    b. Stockham Valves & Fittings, Inc.
    c. Victaulic Co. of America.
    d. Gustin-Bacon
    e. Grippin.

G. Manufacturers:

1. Manufacturer uniformity: conform with the requirements specified in Basic Mechanical Requirements, under "Product Options."
2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering piping materials and specialties that may be incorporated in the work include, but are not limited to, the following:
    a. Pipe Escutcheons:
        1) Chicago Specialty Mfg. Co.
        2) Sanitary-Dash Mfg. Co.
        3) Grinnell
    b. Dielectric Waterway Fittings:
        1) Epco Sales, Inc.
        2) Victaulic Company of America
    c. Dielectric Unions:
        1) Eclipse, Inc.
        2) Perfection Corp.
        3) Watts Regulator Co.
    d. Strainers:
        1) Armstrong Machine Works.
        2) Hoffman Specialty ITT; Fluid Handling Div.
        3) Spirax Sarco.
        4) Victaulic Co. of America. (low-pressure applications only)
        5) Watts Regulator Co.
    e. Expansion Joints:
        1) Flexonics Div.; UOP, Inc.
        2) Hyspan Precision Products, Inc.
        3) Keflex, Inc.
        4) Metraflex Co.
        5) Vibration Mountings and Controls, Inc.

f. Flexible Connectors:
   1) Flexonics Div.; UOP, Inc.
   2) Hyspan Precision Products, Inc.
   3) Keflex, Inc.
   4) Metraflex Co.
   5) Vibration Mountings and Controls, Inc.

H. Piping Specialties:

1. Escutcheons: Chrome-plated, stamped steel, hinged, split-ring escutcheon, with set screw. Inside diameter shall closely fit pipe outside diameter or outside of pipe insulation where the pipe is insulated. Outside diameter shall completely cover the opening in floors, walls, or ceilings.
2. Unions: Malleable-iron, Class 150 for low-pressure service and class 250 for high-pressure service; hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends.
3. Dielectric Unions: Provide dielectric unions with appropriate end connections for the pipe materials in which installed (screwed, soldered, or flanged), which effectively isolate dissimilar metals, prevent galvanic action, and stop corrosion.
4. Dielectric Waterway Fittings: electroplated steel or brass nipple, with an inert and non-corrosive, thermoplastic lining.
5. Y-Type Strainers: Provide strainers full line size of connecting piping, with ends matching piping system materials. Screens shall be Type 304 stainless steel, with 3/64" perforations at 233 per square inch.
   a. Provide strainers with a 125 psi working pressure rating for low-pressure application pressure applications, and a 250 psi pressure rating for the high-pressure application.
   b. Threaded Ends, 2" and Smaller: Cast-iron body, screwed screen retainer with centered blowdown fitted with a pipe plug.
   c. Threaded Ends, 2-1/2" and Larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with a pipe plug.
   d. Flanged Ends, 2-1/2" and Larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with a pipe plug.
   e. Grooved Ends, 2-1/2" and Larger: Tee pattern, ductile-iron or malleable-iron body and access end cap, access coupling with EPDM gasket.

I. Expansion Joints

1. Rubber Expansion Joints: Construct of duck and butyl rubber with full-faced integral flanges, internally reinforced with steel retaining rings. Provide steel retaining rings over the entire surface of flanges, drilled to match flange bolt holes, and provide external control rods.
2. Expansion Joints for Grooved Piping: Provide expansion joints constructed of cut grooved short pipe nipples and couplings, designed by the manufacturer to suit the intended service. Select couplings and gasket materials to match the balance of the piping system.

J. Flexible Connectors

1. Braided Flexible Pump Connector: Stainless-steel annular corrugated metal surrounded with a woven braid of high tensile stainless-steel flange connection. Minimum 125 psi pressure rating, similar to Keflex KSSPC.
2. Flexible Connector: Stainless steel annular, close pitch hose with stainless steel braid. Flanged or threaded connection, Minimum 125 psi pressure rating, similar to Keflex KFCS.

K. Sleeves

1. Sheet-Metal Sleeves: 10-gauge, galvanized sheet metal, round tube closed with the welded longitudinal joint.
2. Steel Sleeves: Schedule 40 galvanized, welded steel pipe, ASTM A53, Grade A.

L. Mechanical Sleeve Seals

1. Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing a watertight seal and electrical insulation.

M. Miscellaneous Piping Materials/Products:

1. Welding Materials: Except as otherwise indicated, provide welding materials as determined by Installer to comply with installation requirements.
2. Soldering Materials: Except as otherwise indicated, provide soldering materials as determined by Installer to comply with installation requirements. Use no lead-bearing solders in domestic water applications.
   a. Tin-Antimony Solder: ASTM B 32, Grade 95TA.
   b. Silver-Lead Solder: ASTM B 32, Grade 96TS.
3. Brazing Materials: Except as otherwise indicated, provide brazing materials as determined by Installer to comply with installation requirements.
4. Gaskets for Flanged Joints: ANSI B16.21; full-faced for cast-iron flanges; raised-face for steel flanges, unless otherwise indicated.
5. Piping Connectors for Dissimilar Non-Pressure Pipe: Elastomeric annular ring insert, or elastomeric flexible coupling secured at each end with stainless steel clamps, sized for an exact fit to pipe ends and subject to approval by the plumbing code.

2.2 MANUFACTURER

A. Subject to compliance with requirements, provide piping connectors of the following:

1. Fernco, Inc.
2. Mission.
3. Or approved equal.

PART 3 - EXECUTION

3.1 PREPARATION - None

3.2 INSTALLATION

A. Install pipes and pipe fittings per recognized industry practices which will achieve permanently-leakproof piping systems, capable of performing each indicated service without piping failure. Install each run with minimum joints and couplings, but with the adequate and accessible union, flanges, etc., for disassembly and maintenance/replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align piping accurately at connections, within 1/16" misalignment tolerance. Do not cold spring. Store filler weld materials per codes.

1. Comply with ANSI B31 Code for Pressure Piping.
2. Locate piping runs, except as otherwise indicated, vertically and horizontally (pitched to drain), and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown or described by diagrams, details, and notations or, if not otherwise indicated, run piping in the shortest route which does not obstruct usable space or block access for servicing the building and its equipment. Hold piping close to walls, overhead construction, columns, and other clearance to 1/2" where furring is shown for enclosure or concealment of piping, but allow for insulation thickness, if any. Where possible, locate insulated piping for 1" clearance outside insulation. Wherever possible in finished and occupied spaces, conceal piping from view, by locating it in column enclosures, in hollow wall construction, or above suspended ceilings; do not encase horizontal runs in solid partitions, except as indicated. Provide high point vents, low point drains with valves, and extension to drain for all piping
3. All piping in the press room, mechanical rooms, fan rooms, etc., shall be exposed.
4. Do not conceal or embed piping in walls, floors, or other structures.
5. Make changes in direction or size with manufactured fittings. Anchor and support piping for free expansion and movement without damage to piping, equipment, or the building.
6. Piping shall be arranged to maintain headroom and keep passageways clear.
7. Provide unions at connections to equipment and elsewhere as required to facilitate maintenance.
8. Run full pipe size through shutoff valves, gas cocks, balancing valves, etc. Change pipe size within three pipe size diameters of final connection to equipment, coils, etc.
9. All piping shall be erected to ensure proper draining. Air piping shall pitch down in the direction of flow a minimum of 1" per 40 feet.
10. Use fittings for all changes in direction and all branch connections.
11. Install strainers on the supply side of each control valve, pressure reducing or regulating valve, solenoid valve, and elsewhere as indicated.
12. Install unions adjacent to each valve and at the final connection to each piece of equipment and plumbing fixture having 2" and smaller connections, and elsewhere as indicated.
13. Install Flanges in piping 2-1/2" and larger, where indicated, adjacent to each valve, and at the final connection to each piece of equipment.
14. Install dielectric unions to connect piping materials of dissimilar metals in dry piping systems (air blower, compressed air).

15. Install dielectric fittings to connect piping materials of dissimilar metals in wet piping systems (water, wastewater). Insulating fittings are not required between bronze valves and steel pipe or between copper coil headers and steel pipe.
16. Electrical Equipment Spaces: Do not run piping in or through, the electrical room, transformer vaults, and other electrical or electronic equipment spaces and enclosures or above electrical gear unless authorized and directed. Install a drip pan under piping that must be run through electrical spaces.

B. Expansion And Contraction

1. Make all necessary provisions for expansion and contraction of piping.
2. Use grooved joint couplings, expansion compensator, offsets, or loops as required to prevent undue strain.
3. At piping connection to heat exchangers provide expansion (joint) as shown on drawings.

C. Flexible Connectors:

1. At air blowers/pumps, engines, and at all rotating or vibrating pieces of equipment, provide and install flexible connectors to accommodate alignment and vibration.
2. At air blowers/pumps provide and install a series of three grooved joint couplings or braided flexible pump connectors.

D. Protective Coatings

1. All underground steel pipes shall be wrapped with Scotchwrap No. 50 tape to give not less than two complete layers on the underground piping system, or piping shall have "X-tru Coat", factory-applied plastic protective covering, or pipe shall be coated and wrapped with coal tar enamel and Kraft paper, all with coated and taped joints.

E. Piping System Joints

1. General: Provide joints of the type indicated in each piping system.
2. Threaded: Thread pipe following ANSI B2.1; cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint compound or pipe joint tape (Teflon) where recommended by the pipe/fitting manufacturer, on male threads at each joint, and tighten the joint to leave not more than 3 threads exposed.
3. Brazed: Braze copper tube-and-fitting joints where indicated, in accordance with ASME B31.
4. Soldered: Solder copper tube-and-fitting joints where indicated, in accordance with recognized industry practice. Cut tube ends squarely, ream to full inside diameter, and clean outside of tube ends and inside of fittings. Apply solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting, and solder in a manner which will draw solder full depth and circumference of joint. Wipe excess solder from the joint before it hardens.
5. Welded:
    a. Weld pipe joints per recognized industry practice and as follows:
    b. Weld pipe joints only when the ambient temperature is above 0°F where possible, with minimum pipe preheat to 50 °F.

c. Bevel pipe ends at a 37.5° angle where possible, smooth rough cuts, and clean to remove slag, metal particles, and dirt.
d. Use pipe clamps or tack-weld joints with 1" long welds; 4 welds for pipe sizes to 10", 8 welds for pipe sizes 12" to 20".
e. Build up welds with a stringer-bead pass, followed by hot pass, followed by cover or filler pass. Eliminate valleys at the center and edges of each weld. Weld by procedures that will ensure the elimination of unsound or un-fused metal, cracks, oxidation, blowholes, and non-metallic inclusions.
f. Do not weld-out piping system imperfections by tack-welding procedures; refabricate to comply with requirements.
g. At Installer's option, install forged branch-connection fittings wherever branch pipe is indicated, or install regular "T" fitting.
h. At Installer's option, install forged branch-connection fittings wherever a branch pipe of size smaller than the main pipe is indicated, or install a regular "T" fitting.

6. Flanged Joints: Match flanges within the piping system, and at connections with valves and equipment. Clean flange faces and installs gaskets. Tighten bolts to provide uniform compression of gaskets.
7. Lead Joints: Tightly pack joint with joint packing material. Do not permit packing to enter the bore of the finished joint. Clean joint after packing. Fill the remaining joint space with one pouring of lead to indicate the minimum depth measured from the face of the bell. After the lead has cooled, calk the joint tightly by use of a hammer and caulking iron.
8. Hubless Cast-Iron Joints: Comply with the coupling manufacturer's installation instructions.
9. Plastic Pipe/Tube Joints: Comply with manufacturer's instructions and recommendations, and with applicable industry standards:
   a. Heat Joining of Thermoplastic Pipe: ASTM D 2657.
   b. Making Solvent-Cemented Joints: ASTM D 2235, and ASTM F 402.
10. Grooved Pipe Joints: Comply with fitting manufacturer's instructions for making grooves in pipe ends. Remove burrs and ream pipe ends. Assemble joints per the manufacturer's instructions.

3.3 TESTING

A. Clean exterior surfaces of installed piping systems of superfluous materials and prepare for the application of specified coatings (if any). Flush out piping systems with clean water before proceeding with required tests. Inspect each run of each system for completion of joints, supports, and accessory items.

1. Inspect pressure piping in accordance with procedures of ASME B31 and AWWA C600.

B. Pressure Testing:

1. Unless otherwise specified or indicated on the drawings, all pipes shall be pressure tested before acceptance.
2. Conduct pressure testing according to AWWA C600 and the following:
   a. Test Pressure: Not less than 200 psig or 50 psi above maximum static pressure, whichever is greater.
   b. Conduct a hydrostatic test for at least two hours.

c. Slowly fill with water section to be tested; expel air from piping at high points. Install corporation cocks at high points. Close air vents and corporation cocks after air is expelled. Raise pressure to specified test pressure.
d. Observe joints, fittings, and valves under test. Remove and renew cracked pipe, joints, fittings, and valves showing visible leakage. Retest.
e. Correct visible deficiencies and continue testing at the same test pressure for an additional two hours to determine the leakage rate. Maintain pressure within plus or minus 5 psi of test pressure. Leakage is defined as the quantity of water supplied to piping necessary to maintain test pressure during the period of the test.
f. Compute maximum allowable leakage by the following formula:

$$L = SD\left(\sqrt{P}/C\right)$$

Where:

L = testing allowance, in gph.
S = length of pipe tested, in feet.
D = nominal diameter of pipe, in inches.
P = average test pressure during the hydrostatic test, in psig.
C = 148,000.

3. When the pipe under test contains sections of various diameters, calculate allowable leakage from the sum of computed leakage for each size.
   a. When the test of pipe indicates leakage greater than allowed, locate the source of leakage, make corrections, and retest until leakage is within allowable limits.
   b. Correct visible leaks regardless of the quantity of leakage.

C. After installation, inspect for proper supports and interferences.

END OF SECTION

SECTION 40 05 60

VALVES: GENERAL STATEMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work covered in this Section includes all valves, operators, and valve appurtenances.

1.2 RELATED SECTIONS

A. Gate Valves - Section 33 12 16

B. Sanitary Sewer Cleanouts & Valves - Section 33 05 71

1.3 REFERENCES

A. American National Standards Institute (ANSI)

1. B1.20.1, Pipe Threads, General Purpose
2. B16.1, Cast Iron Pipe Flanges, and Flanged Fittings
3. B16.5, Pipe Flanges, and Flanged Fittings
4. B16.18, Cast Copper Alloy Solder Joint Pressure Fittings Class 25, 125, 250 and 800

B. American Water Works Association (AWWA)

1. C111, Rubber-Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings
2. C207, Steel Pipe Flanges for Waterworks Service - Sizes 4 through 144 inches.

C. National Electrical Manufacturers Association (NEMA)

1. MG1, Motors, and Generators

1.4 SUBMITTALS

A. Certifications and testing consistent with Contractor Quality Control – Section 01 40 00

B. Certification that products being used meet requirements of standards referenced.

C. Shop Drawings consistent with Submittals - Section 01 33 23 and including:

1. Product technical data including:
2. Valve pressure/temperature rating
   a. End connection type and rating

b. Valve material of construction
c. Special linings
d. Valve dimensions and weight
e. Valve flow coefficient conversion
f. Manufacturer's installation instructions for the actuator

D. Operation and Maintenance Manuals consistent with affected Sections.

PART 2 - PRODUCTS

2.1 VALVES

A. End Connections

1. Provide end connections for valves as defined in the Piping Specification Schedules presented in “Valves General Statement” - Section 33 12 00.
2. Assure end connections meet the following standards
   a. Screwed: ANSI B1.20.1
   b. Flanged: ANSI B16.1 or B16.5 or AWWA C207
   c. Bell and faucet or mechanical (gland) type: AWWA C111
   d. Soldered: ANSI B16.18

2.2 ACCESSORIES

A. Valve Boxes

1. Provide service boxes of cast-iron construction and cover marked “WATER” or “W.” The specific style of box and cover shall be as shown. The service box shall be long enough to reach from the pipe to at least 1” above the final ground surface elevation.
2. Extend service boxes to the required length using “Buffalo” screw adjustment.
3. Provide boxes with housings of sufficient size to completely cover the top of the valve and complete with identifying covers.
4. Design valve boxes so that traffic load on top of the box is not transmitted to the valve.

B. Valve Stands

1. Provide cast-iron frames, with a 5¼” shaft, and extension stem adjustable for elevation. The specific style of the stem shall be as shown.
2. Fit stands with roller or ball bearings designed to take thrust.
3. Assure adequate provision for lubrication and protect operating parts from the weather.
4. Furnish operating nuts constructed of Grade C bronze finished all over, suitably splined to connect with hand-wheel or gear and with threads which will engage smoothly with those of lifting shaft.
5. Provide wheel-operated stands with hand-wheels of the same diameter as those specified for the valve being operated.
6. Provide valve stands of non-rising stem or rising stem depending on the valve that the stand will operate.
7. For O.S.&Y. valves, provide a valve with a special yoke attachment and furnish indicating NRS floor-stand.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before installation, inspect interconnecting piping and end connections to assure compatibility.

B. Before installation, inspect and verify the condition of the valve and appurtenances. Installation constitutes the installer's acceptance of product conditions for satisfactory installation.

C. Assure exposed piping is sufficiently supported to bear the weight of the valve when it is installed.

3.2 PREPARATION

A. Correct defects or conditions which may interfere with or prevent a satisfactory installation.

3.3 ERECTION / INSTALLATION / APPLICATION

A. Provide per manufacturer's instructions.

B. Protect all bolts with corrosion-resistant paint and polyethylene wrapping.

C. Setting Outside Valves

1. Locate valves installed in trenches indicated on the Drawing.
2. Set valves plumb.
3. Place valve boxes directly over valves with the top of the box being brought to the surface of the finished grade.
4. After installation, carefully backfill each side of the box.

D. Support exposed valves to minimize bending of the valve end connections because of pipe loading.

3.4 FIELD QUALITY CONTROL

A. Repair or remove and replace defective material.

3.5 ADJUSTING

A. Make all adjustments to valves, operators, and appurtenant equipment before Project acceptance by Contracting Officer.

END OF SECTION

SECTION 40 71 13.13

INLINE MAGNETIC FLOWMETERS

PART 1- GENERAL

1.1 SUMMARY

A. Electromagnetic flow meters for permanent installations above ground in the existing Lift Station. The meters shall utilize bipolar pulse DC coil excitation to measure voltage induced by the flow of conductive liquid through a magnetic flux. The voltage shall be linearly proportional to flow velocity from 0.033 to 33 feet per second.

1.2 SUBMITTALS

A. Furnish complete Product Data, Shop Drawings, Test Reports, Operating Manuals, Record Drawings, Manufacturer's certifications, Manufacturer Field Reports

B. Product Data:
   1. Dimensional Drawings.
   2. Materials of Construction:
      a. Sensor.
      b. Liner.
      c. Electrodes.
      d. Flanges.
   3. Measurement accuracy.
   4. Range and rangeability.
   5. Enclosure Rating.
   6. Classification Rating.
   7. Power:
      a. Voltage.
      b. Wattage.
   8. Output Options

1.3 QUALITY ASSURANCE

A. Manufacture facilities shall be certified to the quality standards of ISO Standard 9001 - Quality Systems - Model for Quality Assurance in Design/Development, Production, Installation, and Servicing.

B. Examine the complete set of Contract Documents and verify that the instruments are compatible with the installed conditions including:

   1. Process conditions: Fluids, pressures, temperatures, flows, materials, etc.

2. Physical conditions:
    a. Installation and mounting requirements.
    b. Location within the process.
    c. Accessories: Verify that all required accessories are provided and are compatible with the process conditions and physical installation.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store all instruments in a dedicated structure with space conditioning to meet the recommended storage requirements provided by the manufacturer.

B. Any instruments that are not stored in strict conformance with the manufacturer's recommendation shall be replaced.

1.5 PROJECT OR SITE CONDITIONS

A. Provide instruments suitable for the installed site conditions including but not limited to material compatibility, site altitude, process and ambient temperature, and humidity conditions.

1.6 WARRANTY

A. The meter shall have a standard one-year warranty from the date of shipment and if the meter is commissioned by a factory-certified technician, the warranty is extended to three years from the date of shipment.

1.7 MAINTENANCE

A. Provide all parts, necessary for maintenance and calibration purposes throughout the warranty period. Deliver all of these supplies before project substantial completion.

1.8 LIFECYCLE MANAGEMENT

A. Instrument documentation, like original calibration certificates, manuals, and product status information shall be accessed via a web-enabled system with a license. The instrument-specific information shall be accessed via its serial number. When services are provided by an authorized service provider the services information like subsequent field calibrations shall be archived and accessible via this web-enabled system.

PART 2 – PRODUCTS

2.1 MANUFACTURER

A. McCrometer Ultra Mag Series

B. Endress+Hauser Promag 400 Series

C. Or Approved Equal.

2.2 MANUFACTURED UNITS

A. Magnetic flowmeters obtain the flow velocity by measuring the changes in the induced voltage of the conductive fluid passing across a controlled magnetic field. The flow meter shall be a flanged sensor (by application and instrument schedule) and transmitter which may be mounted integral (compact) to the sensor or remote with interconnecting cables up to 650 feet in length.

1. The flow metering system shall be microprocessor-based and possess a non-volatile memory to store the sensor calibration and transmitter setup information. The electronics shall be interchangeable for meters sizes 1”- 90”.
2. The sensor shall be the proper size to measure the design flow rate of the piping and measure bi-directional flow as a standard.
3. The sensor shall consist of a stainless steel flow tube with ANSI B16.5 or AWWA C207 carbon steel or stainless steel flanges. The flanges shall be Class 150 for 24” and smaller, and AWWA Class D for 28” and larger (listed by the application and instrument schedule).
   a. Sensors from 1”-12” shall have fixed or rotating lap joint flanges.
   b. Sensors from 14”-90” shall have the flanges welded to the sensor body.
4. The sensor liner and electrode material shall be chosen to be compatible with the process fluid. All fluids require a minimum conductivity of 5µS/cm (20µS/cm for deionized water).
5. The sensor tube shall be lined with polyurethane, hard rubber, or PTFE following NSF-61 based upon the size of the flow meter and the process media conditions.
6. The sensor shall house two measuring electrodes, a grounding electrode, and one for physical empty pipe detection. The electrodes shall be bullet-nosed shaped and made of 316L SS or Alloy C22 (listed by the application and instrument schedule).
7. The external sensor housing shall enclose the coil assemblies and internal wiring. The materials shall be designed and constructed to prevent moisture ingress and promote corrosion resistance.
8. The electrode circuit shall have a minimum impedance of 10^{12} ohms to overcome moderate coating buildup.
9. The sensor shall be rated for NEMA 4X service as standard.
10. In the event of industrial treatment or corrosive/brackish environments, the flow sensor shall be painted and certified according to ISO-12944 corrosion class. Third-party modification or sensor preparations will not be accepted without type test documentation to support the exposure conditions, depth, and duration of resistance.

11. The meter components shall include two (2) grounding rings that are in conformance with the manufacturer's bore and material recommendation for the meter's intended service and are designed to protect and shield from abrasion of the liner's edge interface at the meter's end.
12. The unit shall be rated to operate at an ambient operating temperature range of -5 to 140 degrees Fahrenheit (-20 to 60 degrees Celsius).

B. The transmitter shall be a three-stage microprocessor controller mounted integrally or remotely as specified in the instrument schedule. The transmitter shall incorporate a universal 100-240 VAC/18-30 VDC power supply. The transmitter housing will carry a NEMA 4X rating and shall be constructed to prevent moisture ingress, promote corrosion resistance, and be impervious to saline environments.

1. The transmitter shall allow local programming that can be operated through the enclosure window without opening the electrical enclosure.
2. The transmitter display shall indicate simultaneous flow rate and total flow with 3 totalizers (forward, reverse, and net total) and user-selectable engineering units, readout of diagnostic error messages, and support 12 standard languages.
3 The transmitter shall safeguard against entering invalid data for the particular meter size and all programming parameters shall be access-code protected with a minimum requirement of dual passwords according to data sensitivity.
4. The transmitter output shall be specified, as either:
    a. 4-20mA HART®, 0-20mA, pulse/frequency/switch.
    b. Modbus RS-485
    c. Profibus® DP
    d. Or a standard, unmodified form of Ethernet (ex. EtherNet/IP™)
5. The transmitter output(s) shall be integral to the magnetic flowmeter transmitter electronics; using an external third-party signal converter is unacceptable.
6. There shall be no limitation of transmitter operational capability or diagnostic dependency between integral and compact mounting orientation.
7. The transmitter output selected must be supported by add-on instructions (AOI), Level 3 add-on profiles (AOP), device drivers (DD), general station description (GSD) files, instructions, and pre-engineered code.
8. The transmitter shall support commissioning options via a service interface or device driverless operation via an internal web server accessible through a transmitter accessible RJ-45 Ethernet port.
9. The transmitter shall retain all setup parameters and accumulated measurements internally in non-volatile memory in the event of power failure. Data retention shall be for a minimum of 5 years without auxiliary main or battery power. The memory unit shall be transferrable from a damaged unit or used for a duplicate device with no loss of device parameters or data stored.
10. The transmitter shall be protected against voltage spikes from the power source with internal transient protection. Power consumption shall be no more than 16 VA, independent of meter size.
11. The transmitter and sensor shall include a method to verify flow meter performance to the original manufacturer specifications.
    a. The system shall be traceable to factory calibration using a third-party, attested onboard system according to ISO standards.
    b. The verification technique shall not require external handhelds, interfaces, special tooling or electrical access for a verification to be performed.

c. The transmitter shall store up to eight verifications in the microprocessor.
d. Verification of the system shall be possible at any time, locally or remotely, on-demand, and under process conditions.
e. The verification report shall be compliant with common quality systems such as ISO 9000 7.6.a to prove the reliability of the meter specified accuracy.

2.3 ACCESSORIES

A. Stainless steel tag - labeled to match the contract documents.

B. Provide grounding rings, as per the manufacturer's recommendations, if required

2.4 SOURCE QUALITY CONTROL & CALIBRATION

A. Magnetic flowmeters shall be factory calibrated on an ISO-17025 accredited test stand per "General Requirements for the Competence of Testing and Calibration Laboratories" with certified accuracy traceable to NIST.

B. Evidence of accreditation shall originate from a national verification agency such as A2LA.

C. Each meter shall ship with a certificate of a 2-point calibration report exceeding the stated standard accuracy of 0.5% of the rate.

1. Optional calibration to 0.2% of the rate shall be performed for flow rates from 10 to 100 percent of full-scale for velocities ranging between 1.9 to 10 feet per second.
2. An optional performance calibration for a Flat Accuracy Specification shall be performed In the event of a low initial design flow rate.
3. Repeatability shall be 0.25 percent of the rate.

D. A real-time computer-generated printout of the actual calibration data points shall indicate apparent and actual flows. The flow calibration data shall be confirmed by the manufacturer and shipped with the meters to the project site.

E. The minimum calibration shall be a 3-point calibration including 1, 3, and 10 feet per second velocities for every meter and transmitter system. The manufacturer shall archive all calibration reports for future reference.

F. The manufacturer shall provide complete documentation covering the traceability of all calibration instruments.

G. The manufacturer shall provide ISA data sheet ISA-TR20.00.01 as the latest revision of form 20F2321. The manufacturer shall complete the form with all known data and model codes and dash out the inapplicable fields. Incomplete data sheets submitted will result in a rejected submittal.

2.5 SAFETY

A. All electrical equipment shall meet the requirements of ANSI/NFPA 70, National Electric Code latest edition.

B. All devices shall be certified for use in hazardous areas: Class 1, Div. 2, Groups B/C; temperature rating T3 (200 deg. C)

C. All devices shall be suitable for use as non-incendive devices when used with appropriate non-incendive associated equipment. Devices with intrinsically safe ratings will normally be acceptable with the vendor's approval.

D. Electrical equipment housing shall conform to NEMA 4X classification.

E. Non-intrinsically safe electrical equipment shall be approved by a Nationally Recognized Testing Laboratory (NRTL) such as FM, UL, CSA, etc. for the specified electrical area classification.

F. Electrical equipment specified as intrinsically safe shall qualify as "simple apparatus" or NTRL approved intrinsically safe equipment per ANSI/ISA-RP12.6 "Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations," latest edition.

G. Device failure modes, self-monitoring characteristics, and remedy diagnosis shall follow NAMUR standards NE 43 and NE 107

PART 3-EXECUTION

3.1 EXAMINATION

A. Examine the complete set of plans, the process fluids, pressures, and temperatures, and furnish instruments that are compatible with the installed process condition.

B. Examine the installation location for the instrument and verify that the instrument will work properly when installed.

3.2 INSTALLATION

A. As shown on installation details and mechanical Drawings.

B. As recommended by the manufacturer's installation and operation manual.

C. Specific attention should be given to the following technical requirements:

1. Verify ground rings (if required) have been installed according to the manufacturer's recommendations.
2. Reduced inlet installations must be accompanied by the manufacturer's documented evidence of third-party testing and data collection in comparison to a traceable standard.

3.3 FIELD QUALITY CONTROL

A. Each instrument shall be tested before commissioning and the ENGINEER shall witness the interface capability in the PLC control system and associated registers.

1. Each instrument shall provide direct programming capability through the PLC
2. Each instrument shall provide direct control of totalizer reset functions through the PLC
3. Each instrument shall be supported with a device profile permitting direct integration in the PLC

B. The ENGINEER shall witness all instrument verifications in the field.

C. Manufacturers' Field Services are available for start-up and commissioning by a Factory field service representative or a manufacturer’s authorized service provider (ASP) – the warranty against manufacturing defects is three years.

1. The manufacturer representative shall verify the installation of all installed flow tubes and transmitters.
2. The manufacturer representative shall notify the ENGINEER in writing of any problems or discrepancies and proposed solutions.
3. The manufacturer representative shall perform field verification at the time of installation for long-term analysis of device linearity, repeatability, and electronics health. A comparative report shall be generated for each meter tested.
4. The manufacturer representative shall generate a configuration report for each meter.

3.4 ADJUSTING

A. Field verify the factory setup of all instruments per the Manufacturer’s instructions.

B. The transmitter and sensor to include a method to verify flow meter performance to the original manufacturer specifications. Verification should be traceable to factory calibration using a third-party, attested onboard system according to ISO standards.

C. The verification report should be compliant with common quality systems such as ISO 9000 to prove the reliability of the meter specified accuracy. Return factory calibrated devices to the factory if they do not meet the field verification requirements for calibration.

3.5 PROTECTION

A. All instruments shall be fully protected after installation and before commissioning. Replace any instruments damaged before commissioning:

1. The ENGINEER shall be the sole party responsible for determining the corrective measures.

END OF SECTION

SECTION 40 71 69

OPEN CHANNEL FLOWMETERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This Section includes all Palmer-Bowlus Flumes required for the complete installation of the work.

1.2 RELATED SECTIONS

A. Submittal Procedures – Section 01 33 23

1.3 REFERENCES

A. Design, fabricate, a Palmer-Bowlus Flumes with materials per the manufacturer's recommended procedures and the following codes and standards:

1.	ASTM A193	Stainless Steel Anchor Bolts
2.	ASTM D256	Izod Impact Strength
3.	ASTM D570	Water Absorption Rate
4.	ASTM D638	Standard Test Method for Tensile Properties of Plastics.
5.	ASTM D695	Compressive Properties of Rigid Plastic
6.	ASTM D696	Coefficient of Linear Expansion
7.	ASTM D790	Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
8.	ASTM D792	Density and Specific Gravity at 230 C
9.	ASTM D1056	Polymer Grade
10.	ASTM D2583	Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.
11.	ASTM D2584	Resin, Glass & Filler Content
12.	ISO1438/1-1980	Open Channel Flow Measurement

B. Composition: The Palmer-Bowlus Flume laminate shall be per the recommendations shown in the Quality Assurance Report for Reinforced Thermoset Plastic (RTP) Corrosion Resistant Equipment prepared under the sponsorship of the Society of the Plastics Industry, Inc. (SPI), and the Material Technology Institute (MTI) of the Chemical Process Industry for "Hand Lay-Up Laminates," and shall meet the specifications for Type I, Grade 10 laminates shown in Appendix M-1 of said report.

C. The manufacturer shall be experienced in the design and manufacture of specific Palmer-Bowlus Flumes and accessories for a minimum period of 20 years.

D. The manufacturer must provide a warranty for 25 years against corrosion and free of defects in workmanship and materials for two years from the date of shipment.

1.4 SUBMITTALS

A. Submit under provisions of Section 01 33 23.

B. Product Data: Test results of representative fiberglass reinforced plastic laminate.

C. Shop Drawings: Show:

1. Critical dimensions, jointing, connections, fasteners, and anchors.
2. Materials of construction.
3. Sizes, spacing, and location of structural members, connections, attachments, openings, and fasteners.
4. Color(s).

D. Samples: 8-inch square sample of representative fiberglass reinforced plastic laminate.

E. Manufacturer's installation instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Ship all Palmer-Bowlus Flumes with suitable packaging to protect products from damage.

B. Store products indoors on a smooth flat surface, free of sharp objects, or in a weather-protected area until installation. Protect from construction traffic and damage. If laid horizontally, the flume shall be placed in such a way as to avoid structural damage.

PART 2 - PRODUCTS

2.1 MATERIALS

A. The flume body shall be:

1. Engineered composite fiberglass reinforced plastic (FRP).
   a. Molded in one piece to create a seamless corrosion barrier impervious to moisture.

2.2 PALMER-BOWLUS FLUMES

A. Acceptable Manufacturers:

1. Plasti-Fab, Inc.; P.O. Box 100 9665 SW Tualatin-Sherwood Rd. Tualatin, Oregon 97062; Tel. (503) 692-5460, Fax (503) 210-0602, www.plasti-fab.com.

2. TRACOM, Inc.; 6575-A Industrial Way, Alpharetta, Georgia 30004; Tel. (877) 435-8637, Fax (770) 664-6565, www.tracomfrp.com.
3. OpenChannel Flow, Inc.; Atlanta, Georgia or Boise, Idaho; Tel. (855) 481-1118, www.openchannelflow.com.
4. Or Approved Equal.

B. The flume fabrication, engineering, and customer support shall all be provided by the same company. Outsourcing any of these components is not acceptable.

C. To assure quality control and single-source accountability the same manufacturer shall fabricate and fully assemble the flume and all components.

D. Flume Type: Provide flumes of the following type(s):

1. Permanent type (4D+1" length): Size: 6-inch, Provided with integral anchor clips drilled for 3/8" connection, minimum two (2) per side, maximum center to center spacing 18 inches.

2.3 DESIGN CRITERIA

A. The flume shall be dimensioned and shaped according to Harold V. Palmer and Fred D. Bowlus' design. Dimensional tolerances for large flumes shall be plus or minus 1/8" (3mm) maximum in the throat, and plus or minus 1/4" (6mm) maximum elsewhere.

B. The composition of the Flume laminate shall be per the recommendations shown in the Quality Assurance Report for Reinforced Thermostat Plastic (RTP) Corrosion Resistant Equipment prepared under the sponsorship of the Society of the Plastics Industry, Inc. (SPI) and the Material Technology Institute of the Chemical Process Industries, Inc. (MTI) for "Hand Lay-up Laminates" and shall meet the specifications for Type 1, Grade 10 laminates shown in Appendix M-1 of said report.

1. Visual inspection for defects shall be made without the aid of magnification and defects shall be classified as to type and level as shown in Table 1 of ANSI/ASTM D2563-0, approved 1977, (or any subsequent revision). Allowable surface tolerances are as follows:

DEFECTS	**ALLOWABLE TOLERANCE**
Cracks, Crazing, Blisters, Chips, Pits, Dry Spots, Fish Eyes, Burned Areas, Entrapped Air	None
Wrinkles and solid blisters, not to exceed 1/8"	Maximum Deviation: 10% of the thickness
Surface porosity (pinholes or pores in the laminate surface)	None
Exposed Glass Exposure of cut edges	None
Scratches	None more than .002" deep (.05mm)
Foreign Matter	None

C. Maximum Fiber Stress

1. Ultimate or yield, whichever applies, does not exceed 2.5 times the working stress.

2.4 CONSTRUCTION

A. Flume

1. Flume throat size shall be A 6-INCH
2. Palmer-Bowlus Flume body shall be manufactured of fiberglass reinforced polyester, free of irregularities.
3. Each Flume shall be molded individually to the exact dimensions specified.
4. The thickness of the walls and floor of the flume shall be not less than ¼" (6mm) thick.
5. Flumes shall be manufactured of reinforced thermoset plastic.
6. The flume shall have UV Stabilizing pigment in the Resin to provide long-term protection from UV.
7. Pultruded fiberglass reinforced plastic bracing at top of the flume (inlet and outlet), T-304 stainless steel hardware.
8. Flume inside surface shall be smooth, isophthalic gelcoat of 10 - 20 mil (0.25 - 0.51mm) thickness.
9. The flume shall have a minimum of 2-inch top flanges.
10. Anchor clips shall be drilled for ¾-inch.
11. The surface shall be free of exposed reinforcing fibers.
12. The minimum glass content shall be 30% exclusive of gelcoat surfaces.
13. Molded-in stiffening ribs, maximum 12-inch center to center spacing
14. The flume shall be structurally designed to maintain dimensional integrity with a full head of water while being free-standing.
15. Flume shall have a molded-in head gage with dual graduation

B. Accessories:

1. Stilling well:
   a. 8-inch diameter minimum, attached.
2. 5-mil mylar, laminated, high visibility staff gauge:
   a. graduated in tenth and hundredths of a foot.
3. 2-inch bushing for the ultrasonic mounting stand.
4. Adjustable T-304 stainless steel and aluminum ultrasonic mounting stand (for 3/4 inch NPT sensor).
5. Inlet and/or outlet pipe stubs with flexible boots and T-316 stainless steel bands.

2.5 PHYSICAL PROPERTIES

A. Structural characteristics for a 1/8” (3mm) glass mat laminate shall meet the following minimum physical properties:

Tensile strength	Minimum 14,000 psi (1,034 ksc)
Flexural Modulus	1,000,000 psi (70,307 ksc)
Flexural Strength	Minimum 20,000 psi (1,406 ksc)
Compressive Strength	22,000 psi (1,547 ksc)

Impact Strength	9.0 ft-lbs/in. (1.24 kgf.m/25mm)
Water absorption	0.13% (in 24 hours)
Barcol hardness (ASTM D 2583)	50

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that the flume dimensions are correct and project conditions are suitable for installation. Do not proceed with installation until condition deficiencies have been corrected.

3.2 INSTALLATION

A. Thoroughly clean and remove all shipping materials before setting

B. Install products following the manufacturer's recommendations, the plans or blueprints, etc.

C. Ensure that the product is installed plumb and level end-to-end and side-to-side. The top spreaders shall be left on the flume until after the installation is complete. They may be removed after the grout has cured if desired.

D. Set the flume at the elevation indicated on the engineer's drawings.

E. Embed flume in concrete; pour concrete in maximum 6-inch lifts. Extra care shall be exercised during the first pour to insure that grout flows smoothly under the floor, and an even fill is achieved. The first lift shall be allowed to set so that excessive hydraulic forces are not transferred to the bottom of the flume by later lifts.

F. The contractor shall provide sufficient shoring and bracing of the floor and sidewalls to prevent lifting, floating, buckling, or bulging of the sides and bottom during installation. The side locking clips are not intended to be used as anchorage points. Their function is to key the flume into the grout or concrete.

3.3 ADJUST AND CLEAN

A. Check flume for being level in both directions, meeting dimensional requirements, and clean surfaces per the manufacturer's instructions.

B. Remove trash and debris, and leave the site in a clean condition.

END OF SECTION

SECTION 40 73 26

GAUGE PRESSURE TRANSMITTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes Pressure gages.

B. Related Requirements:

1. Section 22 05 00 “Common Work Results for Plumbing

1.3 REFERENCE STANDARDS

A. ASME International:

1. SME B1.20.1 - Pipe Threads, General Purpose, Inch
2. ASME B40.100 - Pressure Gauges and Gauge Attachments

B. NSF International:

1. ISO Standard 9001
2. NSF/ANSI 46 - Wastewater Treatment System Components and Devices.

1.4 SUBMITTALS

A. Section 01 33 23 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturer information for system materials and component equipment, including connection requirements.

C. Shop Drawings:

1. Indicate system materials and component equipment.
2. Submit installation requirements and other details.

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

E. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 77 00 - Closeout Procedures: Requirements for submittals.

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

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Section 01 77 00 - Closeout Requirements: Requirements for maintenance materials.

B. Section 01 78 23 - Operation & Maintenance: Requirements for maintenance materials.

C. Extra Stock Materials:

1. Gages: Furnish 20 percent spare gages, with a minimum of one gage for each range used.

1.7 QUALITY ASSURANCE

A. Materials in Contact with Wastewater: Certified to ISO Standards.

B. Pressure Gauge shall incorporate ISO Type 80 Wafer Isolation Ring or Type 81 Bolt-Thru Isolation Ring.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 01 67 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in the manufacturer's original packaging and inspect for damage.

C. Store materials according to manufacturer instructions.

D. Protection:

1. Protect materials from moisture and dust by storing them in a clean, dry location remote from construction operations areas.
2. 'Provide additional protection according to manufacturer instructions.

1.9 WARRANTY

A. Section 01 67 00 - Product Requirements: Requirements for warranties.

B. Section 01 77 00 - Closeout Procedures: Requirements for warranties.

C. Furnish a one-year manufacturer's warranty for pressure gauges.

PART 2 - PRODUCTS

2.1 PRESSURE GAUGES

A. Manufacturers:

1. Ashcroft - Model Series: Duragauge Pressure Gauge;
2. Ametek;
3. Wika;
4. ProSense;
5. or Equal.

B. Type: Differential - Compound.

C. Dials:

1. Nominal Diameter: minimum 4-inches (100-mm).
2. Face: White, laminated plastic dials with black graduations.
3. Scale: Extend over arc not less than 270 degrees.
4. Reading Capacity: Minimum 1000 psi
5. Ranges and Graduation Units: As indicated in the Drawings.

D. Cases:

1. Liquid filled with glycerin.
2. Stainless Steel case and wetted parts.
3. Windows:
   a. Material: Clear, shatterproof glass.
   b. Thickness: 1/8 inch.
   c. Provide gasket.

E. Connection:

1. Location: Bottom.
2. Socket:
   a. 1/4-inch NPT male thread.
   b. Extend a minimum of 1-1/4 inches below gage cases.
   c. Provide wrench flats.
3. Mounting: Stem.

F. Measuring Element:

1. Bourdon Tubes:
   a. Material: Stainless steel to the brass socket.
   b. Provide welded, stress-relieved joints.
   c. ISO Type 80 Wafer Isolation Ring or Type 81 Bolt-Thru Isolation Ring.
   d. Or Equal, not contact element
2. Movement:
   a. Rotary.
   b. Material: Stainless steel.
   c. Teflon coated pinion gear and segment
3. Accuracy:
   a. Comply with ASME B40.100 Grade 2A.
   b. Plus and minus 0.5 percent of the full-scale range.

G. Adjustment:

1. Provide for zero-reading adjustment.
2. Adjusting Screws: Accessible from the rear of the case without the need for disassembly.

H. Accessories:

1. Isolation Shutoff Cocks: Furnished by gage manufacturer.
2. Built-in pressure snubber.

2.2 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.

B. Provide shop inspection and testing of the completed assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 73 40 - Execution: Requirements for installation examination.

B. Section 01 77 00 - Closeout Procedures

C. Verify that items provided by other Sections of Work are ready to receive Work of this Section.

3.2 INSTALLATION

A. According to manufacturer instructions.

B. Coordinate location and orientation of gages and seal assemblies with final piping and equipment installations.

C. Ensure that gages are located to be easily read during operation and easily accessible for maintenance.

3.3 FIELD QUALITY CONTROL

A. Section 01 73 40 - Execution: Requirements for testing, adjusting, and balancing.

B. Section 01 77 00 - Closeout Procedures: Quality and operation test

C. Equipment Acceptance:

1. Adjust, repair, modify or replace components failing to perform as specified and rerun tests.
2. Make final adjustments to equipment under the direction of the manufacturer's representative.

3.4 DEMONSTRATION

A. Section 01 73 40 - Execution: Requirements for demonstration and training.

B. Section 01 77 00 - Closeout Procedures: Requirements for demonstration and training.

C. Section 01 79 00 - Demonstration and Training: Requirements for demonstration and training

D. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to NPS (Government's) personnel.

END SECTION

DIVISION 46

WATER & WASTEWATER EQUIPMENT

SECTION 46 53 00

BIOLOGICAL TREATMENT SYSTEM

PART 1 - GENERAL

1.1 DEFINITIONS

A. Wherever used in these specifications and printed with initial bold capital letters, the terms listed below will have the meanings indicated which apply to both the singular and plural thereof.

1. *Bid* - The offer or proposal of a Bidder submitted on the prescribed form setting forth the prices for the work to be performed.
2. *Bidder* - The individual or entity who submits a Bid directly to the Owner.
3. *Contractor* - The individual or entity with whom Owner has entered into the agreement.
4. *Engineer* - The individual or entity named as such in the agreement.
5. *Inspector* - The specific individual designated by the Owner, Engineer, Contractor, and Manufacture to ensure quality control by inspecting and certifying that the installation of the Orenco AX-MAX treatment system complies with the Manufacturer's recommendations and requirements.
6. *Manufacturer* - A supplier, fabricator, distributor, material man, or vendor having a direct contract with the Contractor or Owner to furnish materials or equipment to be incorporated in the work by the contractor.
7. *Owner* - The individual or entity with whom Contractor has entered into the agreement and for whom the work is to be performed.
8. *Operator* - The individual or entity with whom the owner has entered into an agreement and for whom operation and maintenance shall be performed.

1.2 GENERAL DESCRIPTION

A. The MANUFACTURER shall furnish a complete advanced treatment package(s), consisting of a pump, discharge assembly, ball valve, check valve, splice box, treatment system, and controls.

1.3 SUBMITTALS

A. The MANUFACTURER shall furnish 6 sets of shop drawings and technical datasheets. The submittals shall clearly specify the materials of construction, and equipment compatibility, along with drawings for each unique package being supplied.

1.4 OR-EQUAL EVALUATIONS

A. Throughout the equipment specifications, the term “or approved equal” will be found. For this project, the term “approved equal” shall mean equal in the judgment of the ENGINEER. Should the CONTRACTOR seek approval of a product other than the brand or brands named in the specifications, it shall furnish written evidence that such product conforms in all respects to the specified requirements, and that it has been used successfully elsewhere under similar conditions. It will not be the responsibility of the MANUFACTURER specified within these specifications to provide research, documentation, or data supporting the difference between the “or equal” and the specified product. This will be the sole responsibility of the CONTRACTOR seeking approval.

B. Where the specified requirements involve conformance to recognized codes or standards, the BIDDER shall furnish evidence of such conformance in the form of test or inspection reports, prepared by a recognized agency, and bearing an authorized signature. Manufacturers’ standard data and catalog cut sheets will not be considered sufficient in themselves, and the engineer will not be responsible for seeking further data from the manufacturer, or for otherwise researching the product. Failure to provide complete data will be a cause for the rejection of the product. The submission shall include any impacts that could be expected from the alternative product and shall also indicate any product that would require a license or royalty, the actual fees, and a note that these fees would be handled by the BIDDER. The BIDDER shall provide submissions; meeting the above parameters no less than TWO WEEKS before BID opening for review by the ENGINEER for CONTRACTORS seeking approval of “or equal” products or systems shall provide, at minimum, the following.

C. Product/System submittals, including, but not limited to;

1. The number of years the MANUFACTURER has been in the business of manufacturing relevant products/systems.
    a. Size of company, including
        1) The number of employees related to relevant products/systems.
        2) The number of engineers on staff related to relevant products/systems.
    b. Product specifications and a detailed description of how each product or component is “equal” to the specified product, system, or component. A side-by-side comparison is required.
        1) Equipment/system warranty along with exclusions.
        2) Performance claims, including, but not limited to
            a) Treatment design
                · Surface area
                · Maintenance frequency
            b) Pump motor description
                · Manufacturer and origin
                · Length of service
                · Number of units in operation
                · Life-cycle cost (repair and replacement frequency)
                · Warranty

c) Pump liquid end description
- Manufacturer and origin
- Length of service
- Number of units in operation
- Life-cycle cost (repair and replacement frequency and cost). Note liquid ends must be removable, repairable, and cleanable.
- Warranty

d) Corrosion resistance
e) Pump Lead description
- Lead must be SOOW, extra heavy-duty cord (600V) CSA approved.

f) Control panel components
- Manufacturer and origin
- Length of service
- Number of units in operation
- Warranty
- Enclosure description

c. Evidence of successfully obtaining approval for a system with similar permit requirements with the regulating authority
d. Summary of product/system track record and history, including, but not limited to:
1) Number of similarly sized systems
2) A detailed summary of, at minimum, 10 similarly sized systems, at least 5 years old, including, but not limited to
a) Project name, location, and application
b) Years in operation
c) Current average daily flows and design flows
d) Operator name and contact information

2. BIDDER shall specify and furnish documentation related to the manufacturer (or representative) support services, including, but not limited to
a. Installation training program and support material
b. Installation oversight program and support material
c. Operator training program and support material
d. Startup services program and support material

1.5 EXPERIENCE CLAUSE

A. The equipment furnished shall be manufactured and supplied by a company experienced in the design and manufacture of advanced treatment systems. MANUFACTURERS shall have a minimum of 10 years of experience in the design and manufacturer of advanced treatment systems of similar size and equipment specified. MANUFACTURERS shall have a minimum of 25 successful installations of advanced treatment systems.

1.6 MANUFACTURER

A. The MANUFACTURER shall be Orenco Systems®, Inc. or approved equal. The MANUFACTURER shall furnish a complete factory-built advanced treatment system. The MANUFACTURER shall supply detailed installation and O&M instructions. and evidence of an adequate service provider network shall be submitted to the ENGINEER. The MANUFACTURER shall also submit evidence that the local supplier has spare parts, equipment repairability, and experienced service personnel. The MANUFACTURER shall also provide the following support personnel:

1. A professional engineer or personnel under the direct supervision of a professional engineer dedicated to supporting the project through design, construction, and O&M.
2. Asset Management Department is dedicated to assisting operators with operational and maintenance activities.

1.7 WARRANTY

A. The advanced treatment system MANUFACTURER shall provide a 3-year warranty for the entire treatment system, including, but not limited to the pump, pump vault, hose, valve assembly, control panel, and splice box. Warranty term shall ensue after OWNER'S acceptance and system startup procedures are complete. The MANUFACTURER shall submit detailed exclusions from the warranty or additional cost items required to maintain the equipment in warrantable condition. The warranty shall be documented in product literature.

1.8 SERVICEABILITY

A. The advanced treatment system components shall be completely serviceable, with easy access to the pump(s), effluent screen, treatment system, and floats. The pump shall be designed for removal without removing the effluent screen and floats.

1.9 PUMPS

A. The pump must be approved for use in the treatment unit as described in these specifications.

1. The pump shall be 3/4 to 2.0 hp, 230 VAC, single phase, 60 Hz, two-wire motor, with 30 feet long extra heavy duty (SOOW) electrical cord with ground.
2. The pumps must be submersible High-Head Effluent pumps, lightweight for easy removal and maintenance.
3. Pumps shall be UL and CSA listed for use with effluent.
4. The pumps must have a minimum 24-hour run dry capability without water lubrication.
5. The pumps shall have a 1/8-inch bypass orifice to ensure flow circulation for motor cooling and to prevent air binding. The pump intake screen must be 1/8-inch mesh polypropylene.

6. The pump shall have a floating impeller design to protect against the upthrust and increase pump life.
7. The pump's liquid ends must be repairable (by replacing impellers and/or diffusers) for a better long-term cost of ownership.
8. The motor must be rated for continuous use and frequent cycling, at least 100 cycles per day.
9. The motor cable must be suitable for Class 1, Division 1, and 2 applications.
10. The pump shall have internal thermal overload protection and internal lightning protection.
11. All pumps shall undergo 3-point (Deadhead, Design Flow, and Design Flow + 30%) wet testing at the factory to confirm performance.

PART 2 - PRODUCTS

2.1 PUMPS/OPERATING CONDITIONS

A. PF300512 - Pre-Anoxic Return (Rnox) Pump

1. The pump shall comply with the general requirements outlined in Part 1 (above). Orenco Systems®, Inc., Model PF300512 series or engineer-approved equal 1/2Hp, 230 VAC, single phase, 60 Hz, two-wire motor, with 10 - 30 feet long extra heavy duty (SO) electrical cord with ground. The pump shall be UL and CSA listed as an effluent pump.

B. PF751012 Secondary Treatment and Discharge Pumps

1. All pumps shall comply with general requirements outlined in section I (above). Orenco Systems®, Inc., Model PF7510 series or engineer-approved equal 1Hp, 230 VAC, single phase, 60 Hz, two-wire motor, with 1- 30 feet long extra heavy duty (SO) electrical cord with ground. The pump shall be UL and CSA listed as an effluent pump.

2.2 AX-MAX ADVANTEX® TREATMENT SYSTEM

A. The treatment system shall be an Orenco Systems®, Inc. AdvanTex® AX-MAX facility. The facility shall be a complete, fully plumbed wastewater treatment system for receiving and processing septic tank effluent. The facility shall include the following units:

1. Stage 1 – Biological Treatment
   a. AX-MAX200-28 - The unit shall have an overall length of 28 ft, a width of 7.5 ft, and a height of 8ft. The structure shall be constructed of fiberglass-reinforced plastic with a thickness of 4 inches. The unit shall include a piping network that recirculates water from the recirculation tank atop the hanging textile media. The media shall be hanging textile media with a specific area of over 363 square feet.
   b. AX-MAX175-28 - The unit shall have an overall length of 28 ft, a width of 7.5 ft, and a height of 8ft. The structure shall be constructed of fiberglass-reinforced plastic with a thickness of 4 inches. The unit shall include pumps that recirculate water from the recirculation tank atop the hanging textile media. The media shall be hanging textile media with a specific area of over 363 square feet.

2.3 AX-MAX VENTILATION SYSTEM - INDIVIDUAL UNIT FANS

A. An Orenco Systems®, Inc. ventilation system shall be provided in the AX-MAX Series Treatment Facility or approved equal. The fan shall be UL recognized, 0.8 Hp, 115/230VAC, 1.4A/0.7A, 3400 RPM, and provide up to 245 CFM at 0" H2O. The exhaust from the ventilation fan shall be forced through an enclosure with an adequate amount of activated carbon to remove any odors for a period of over 1 year.

2.4 SPLICE BOX CONDUIT SEALS AND SEALANTS

A. As part of the treatment package, all AX-Max units will include re-installed splice boxes and UL-listed waterproof butt splice connectors. The use of a UL-approved conduit seal kit accessible above ground shall be required to prevent the passage of gases, vapors, or flames through the conduit to the control panel. An additional UL classified sealant shall be added to the splice box coupling to prevent condensation accumulation in the splice box. The following UL approved sealants shall be used:

1. UL classified moisture-cure polyurethane quick-drying foam or ENGINEER-approved equal with an R-5 rating for each inch of foam.
2. UL classified silicone sealant or ENGINEER-approved equal consisting of a neutral cure silicone, non-acetic, non-corrosive silicone able to withstand temperatures to 450° F.

2.5 CONTROLS

A. Controls and alarms shall be listed per UL 508. Panels shall be repairable in the field without the use of soldering irons or substantial disassembly.

B. A dedicated phone line, Ethernet cable, or In Gateway 601 series cellular modem, model IG601 shall be installed. The panel is required to allow real-time connectivity with the telemetry control panel and alarm communication. Phone dialers shall not be considered equivalent.

C. The panel shall be Orenco Systems®, Inc. TCOM™ control panel or engineer-approved equal, meeting the following:

1. Data Collection and Utilization: Logs data for system conditions and events such as daily flows, pump run time, pump cycles, and alarm conditions. Logs shall store data for at least a year.
2. Downloadable Logs: Download logs into a *.dif or ASCII format for simple conversion to common spreadsheet or word processor programs.
3. Multi-Level Password Security: Only qualified personnel can remotely access the site.
4. Program Logic Rules: Simple "If … then" declarations.
5. Rules can be written based on several operands, including the following:
6. Input/output status
7. Point status
8. Date: mm/dd/yy format
9. Time of day: 24-hour clock
10. Timers

11. Historical data (allows for control optimization or detection of trends)
12. Schedule functions to control digital “Points” based on date or day of week/time.
13. Automatic daylight savings time adjustment.
14. Automatic call-out to pagers during alarm conditions when the panel detects trends that could lead to system failure.

D. In addition, the unit shall have the capability of real-time direct connection to the panel via laptop serial port, to allow the operator real-time access to detailed logged data and the ability to change point values.

1. Standard Components
    a. Motor-Start Contactor: 17 FLA, 1-2 hp, 60 Hz; 2.5 million cycles at FLA (10 million at 50 percent of FLA for 230VAC.
    b. HOA 3- Way Toggle Switch: Single-pole switch, Hands (manual) Off, Auto ON. 20 amps, 1 hp.
    c. Controls Circuit Breaker: 10 amps, OFF/ON switch. Single-pole 120 VAC. DIN rail mounting with thermal-magnetic tripping characteristics.
    d. Pump Circuit Breaker: 20 amps, OFF/ON switch. Single-pole for 120 VAC or double-pole for 230 VAC. DIN rail mounting with thermal-magnetic tripping characteristics.
    e. Audio Alarm: 80 dB at 24", warble-tone sound.
    f. 120VAC Ground Fault Interrupter (GFI)
    g. Current Sensor: 120 VAC with adjustable high & low alarm setpoints.
    h. Visual Alarm: 7/8" diameter red lens, “push-to-silence.” NEMA 4, 1-watt bulb, 115 VAC.
    i. Panel Enclosure: NEMA 4X rated, constructed of UV-resistant fiberglass or NEMA 4, constructed of steel; hinges and latch are stainless steel. Conduit couplings provided.
    j. Remote Telemetry Unit: ATRTU-Net; self-powered 24 VDC at 10 mA max, 8 digital inputs, 8 analog inputs expandable to 16 with expansion board. On-board modem (9600 baud), Ethernet port (10 base T, RJ45jack), and Modbus port (R5422/485 terminals).
    k. Touch Screen Display: interface module with 5.7 color touch screen.
    l. Flow Meter - Siemans, electromagnetic flowmeter model MAG 3100, with 5000/6000 series transmitter. In addition to logging daily flows, the flowmeter shall log flows on an hourly basis.
2. Optional Components
    a. Pump Run Light: 7/8" green lens. NEMA 4, 1-watt bulb, 120 VAC.
    b. Effluent Alarm: 95db at 24", warble-tone sound.
    c. Flashing Light: Lexan lens, flanged base, red, UL-recognized.
    d. Heater: Anti-condensation heater, self-adjusting, radiates additional wattage as the temperature drops.
    e. Surge Arrestor: AG2401 120/230V, three 18” leads, rated for a maximum of 32,000amps, UL/CSA listed.
    f. 3- Way (main, auto, off) manual transfer/disconnect switch
    g. Event Counter: 120 VAC, 6-digit, non-resettable.
    h. Elapsed Time Meter: 120 VAC, 7-digit, non-resettable. Limit of 99,999 hours; accurate to 0.01 hours

2.6 INSTALLATION

A. All treatment, pumping system, and electrical components shall be installed following the MANUFACTURE'S recommendations, the engineer's plans, and all state and local regulations.

2.7 LOCATION

A. The pump control panel shall be mounted within the adjacent control building nearest the tank and pump. The panel, when possible, should be mounted to protect it from the weather. The panel should be located at a convenient height (usually about five feet above the ground) and where it will be accessible for maintenance.

PART 3 – EXECUTION

3.1 PRECONSTRUCTION CONFERENCE

A. Before any work at the site is started, a conference attended by the OWNER, CONTRACTOR, ENGINEER, MANUFACTURE, OPERATOR, and others as appropriate will be held to establish a working understanding among the parties as to the work involved in installing each component of the treatment system. At this conference, the OWNER, CONTRACTOR, ENGINEER, and MANUFACTURE shall designate, in writing, a specific individual to act as INSPECTOR for the installation of the treatment system. Any cost or fees associated with the services of the INSPECTOR or the ENGINEER during construction will be the responsibility of the OWNER.

3.2 INSTALLATION AND FIELD-TESTING TRAINING

A. The MANUFACTURER shall provide the services of a trained representative to instruct the installing CONTRACTOR'S crew and INSPECTOR regarding the proper installation and field testing of each component per the MANUFACTURE'S recommendations and requirements. The MANUFACTURER shall have a trained representative provide installation and field-testing training services for a minimum of 1 visit of a minimum of 1 eight-hour day at the beginning of construction.

3.3 QUALITY CONTROL

A. To ensure quality control, the INSPECTOR shall inspect and certify that an initial installation of the AdvanTex® system complies with the MANUFACTURE'S recommendations and requirements.

B. Upon completion of the inspection, the INSPECTOR, in coordination with the ENGINEER, shall perform or direct the CONTRACTOR to perform any required adjustments to the equipment and place it into operation under the supervision of the ENGINEER. All equipment and materials required to perform the testing shall be the responsibility of the CONTRACTOR. A letter of completion shall be signed by the INSPECTOR and copies faxed, emailed, or mailed to the ENGINEER and MANUFACTURE within 1 week of the AdvanTex® system being installed and before System Commissioning.

C. The MANUFACTURER shall provide the services of a trained representative for a minimum of 1 visit of a minimum of 1 eight-hour day for quality control during construction.

3.4 SYSTEM COMMISSIONING

A. The MANUFACTURER shall provide the services of a trained representative for training the OWNER'S service provider and inspecting the AdvanTex® installation. The inspection will include items covered by the installation training. Upon system commissioning, the MANUFACTURER'S trained representative shall provide the ENGINEER with a written report of findings. The ENGINEER should then perform or direct the CONTRACTOR to perform any required adjustments to the equipment and place it into operation. All equipment and materials required to perform additional testing shall be the responsibility of the CONTRACTOR. The MANUFACTURER shall submit to the ENGINEER and OWNER, a detailed start-up checklist, according to the manufacturer's inspection and startup procedures.

B. The MANUFACTURER shall provide the services of a trained representative for a minimum of 1 visit of a minimum of 1 eight-hour day for system commissioning.

PART 4 - OPERATION & MAINTENANCE

4.1 OPERATION AND MAINTENANCE MANUALS

A. The MANUFACTURER shall provide 5 operation and maintenance manuals, 4 to be sent to the OWNER, and 1 sent to the ENGINEER.

4.2 SPARE PARTS

A. The MANUFACTURER shall provide a spare nozzle, spare pump, and spare control panel parts.

4.3 OPERATION AND MAINTENANCE TOOLS

A. AX LATERAL BRUSH CLEANING KIT

1. MANUFACTURER shall provide a minimum of one (1) AX Lateral Brush Cleaning Kit. This kit shall include 90-inch lateral cleaning brush used to clean 1-1/4" diameter laterals and shall be Orenco Systems®, Inc., OM-AX-LAT BRUSH CLEANING KIT, or ENGINEER-approved equal.

B. AX SHEET CLEANING WAND

1. MANUFACTURER shall provide a minimum of one AX sheet-cleaning wand. Wand shall be Orenco Systems®, Inc. model OM-AX-CLEANING WAND or ENGINEER-approved equal. The cleaning wand shall have the ability to connect to a standard garden hose and fit in between AX sheets to spray off debris.

C. FIELD TEST KIT

1. MANUFACTURER shall provide a field test kit to monitor the following parameters:
   a. pH
   b. Alkalinity
   c. Ammonia (NH_3-N)
   d. Nitrate/Nitrite (NO_3-N / NO_2-N)
   e. Dissolved Oxygen (DO)
   f. Chlorides
   g. Turbidity
   h. Temperature
2. The field test kit shall include:
   a. pH test strips (0-14 pH)
   b. Alkalinity test strips (0-240 ppm)
   c. Ammonia (NH_3-N) test strips (0-6 ppm)
   d. Nitrate/Nitrite (NO_3-N / NO_2-N) test strips (0-50 ppm)
   e. Dissolved Oxygen (DO) kit (1-12 ppm)
   f. Chloride titrators (30-600 ppm & 300-6000 ppm)
   g. Turbidity kit (0-200 NTUs)
   h. Thermometer (0-240° F)

D. BIOTUBE® CARTRIDGE CLEANING CRADLE

1. MANUFACTURER shall include a minimum of 1 Biotube® cleaning cradle. Cradle shall be Orenco Systems®, Inc. Model OM-BIOTUBE CRADLE or ENGINEER-approved equal for housing the Biotube Effluent Filter cartridges for cleaning and maintenance.

E. BIOTUBE® CARTRIDGE CLEANING BRUSH

1. MANUFACTURER shall include a minimum of 1 Biotube® brush. The brush shall be Orenco Systems®, Inc. Model OM-BIOTUBE BRUSH or ENGINEER-approved equal for cleaning the Biotube Effluent Filter cartridges.

F. SCUM MEASURING DEVICE

1. MANUFACTURER shall provide a minimum of 1 scum measuring utility gauge. The gauge shall consist of a minimum 3/8” diameter stainless steel rod with an incremental scale for measuring scum levels. The rod shall be bent at a 90-degree angle at the base to aid in identifying the scum “by feeling.” The gauge shall be Orenco Systems®, Inc. Model SMUG or ENGINEER-approved equal.

G. SLUDGE MEASURING DEVICE

1. MANUFACTURER shall provide a minimum of 1 SLUDGE JUDGE® ULTRA or ENGINEER-approved equal. Unit shall be constructed of polycarbonate treated with an ultraviolet stabilizer, durable in cold temperatures, and can withstand heat up to 280° F. The measuring device shall be 3/4” in diameter and marked with tape to designate 1 ft increments.

END OF SECTION

APPENDIX A

Golder Associates, Inc. Geotechnical Exploration Report

REPORT

Geotechnical Exploration

Rehabilitate Ash Mountain Wastewater Systems Sequoia National Park, California

Submitted to:

HECO Engineers
32 N. Main Street
PO Box 235
Payette, ID 83661

Submitted by:

Golder Associates Inc.
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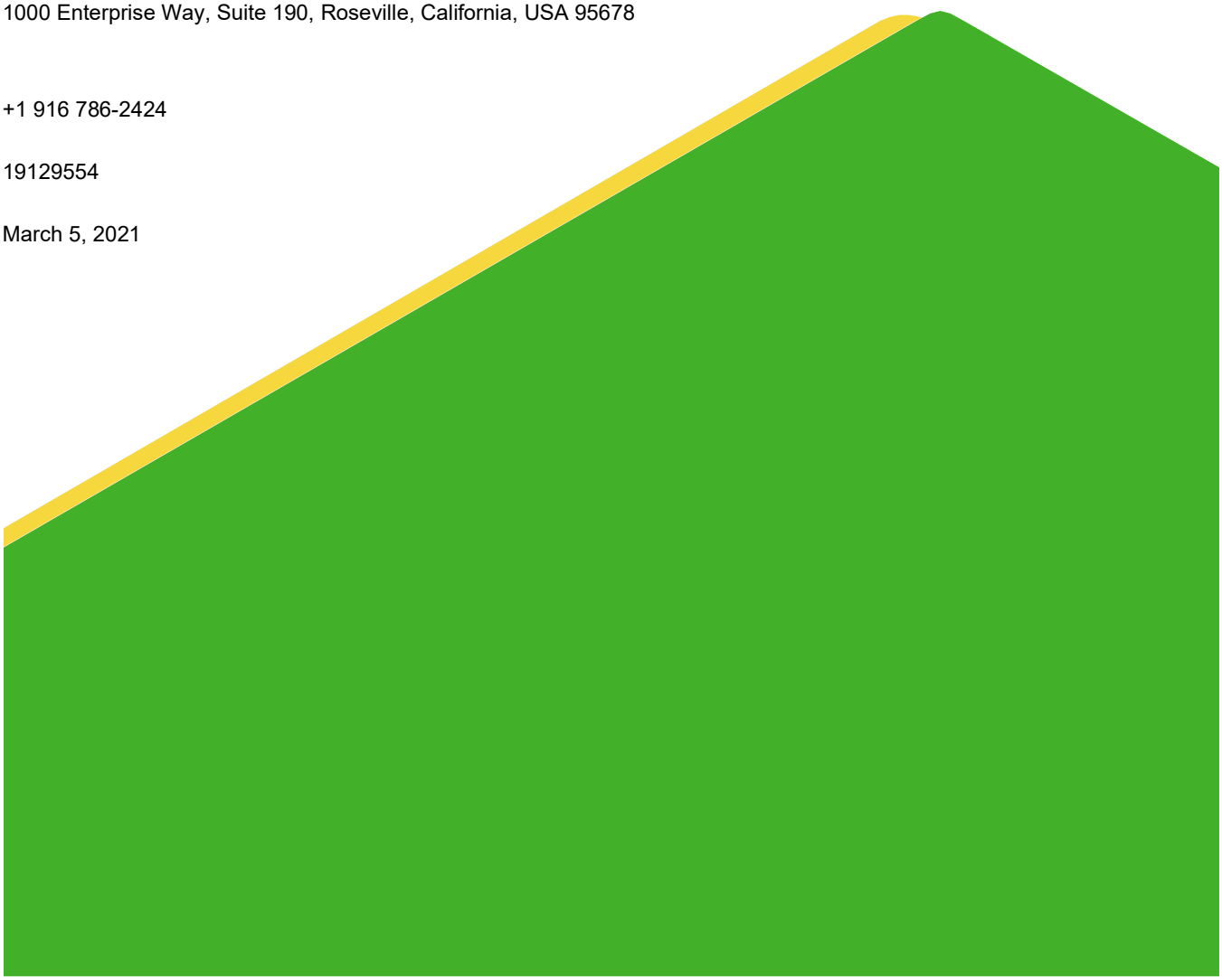
March 5, 2021



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1.0 INTRODUCTION

Golder Associates Inc. (Golder) is pleased to submit this report to HECO Engineers (HECO) which presents the findings of our geotechnical exploration of the proposed subsurface wastewater disposal locations related to the Rehabilitate Ash Mountain Wastewater Systems Project within the Ash Mountain developed areas of Sequoia National Park, located in Tulare County, California. Sequoia National Park, and subsequently the sites of our exploration, is within the jurisdiction of the National Park Service (NPS). Our exploration was performed at two nearby but separate sites within the developed areas of Ash Mountain, Ash Mountain NPS headquarters, and Buckeye Housing community, which are shown in Figure 1.

This report has been prepared in accordance with our approved and agreed upon scope presented in Golder proposal number P19129554 dated January 22, 2020, and per NPS Contract No. 140P8519D0001, Task Order No. 140P8620F0008, Rehabilitate Ash Mountain Wastewater Systems – PMIS 184085, 246176 and 181622.

After Golder completed the initial scope of work and submitted the draft report, NPS and HECO identified two additional locations to evaluate for potential subsurface wastewater disposal system sites. Under a separate, follow-on scope of work, additional geotechnical explorations were completed between November 16 and November 19, 2020. The report of its findings, titled “Additional Geotechnical Exploration - Rehabilitate Ash Mountain Wastewater Systems, Sequoia National Park, California”, dated March 2021 (Golder 2021), is included as Appendix D to this report. As described in (Golder 2021) ground conditions that may be suitable for a subsurface wastewater disposal system were identified at the additional November 2020 exploration locations at the Buckeye Housing site.

Appendix E contains important information pertaining to the proper interpretation and use of this report.

1.1 Project Understanding and Background

It is Golder’s understanding that the existing critical system components at the Ash Mountain and Buckeye Wastewater Treatment Facilities are at the end of their life cycle and need to be replaced. The replacement of these existing critical system components will reduce the risk of a shutdown of visitor and administrative services in the Ash Mountain developed areas, as well as to protect natural resources by preventing an inadvertent discharge of untreated wastewater. We understand that the subsurface conditions and percolation rates of the existing soils at the existing wastewater disposal sites needed to be investigated to assess their suitability to accommodate an underground disposal field to receive discharged effluent. Based on discussions with HECO, we understand the proposed disposal depths are approximately 1 to 15 feet below the existing ground surface (feet-bgs) at each of the proposed treatment locations.

There are three proposed wastewater disposal locations, one at Ash Mountain and two at Buckeye Housing. The Ash Mountain site currently consists of two lined ponds that are used as part of the existing, operational wastewater treatment plant at the site. It is our understanding that the wastewater treatment plant is to be replaced and a subsurface wastewater disposal system will be explored as one of the alternative effluent discharge methods. The first Buckeye Housing site consists of a lined pond and the second site consists of an old, unlined pond. It is our understanding that the lined pond is not used regularly but rather only periodically as needed, and that the old, unlined pond is no longer used. The two locations at the Buckeye Housing site were identified for assessment with the expectation that one of them would be selected for the installation of a subsurface disposal system, if such a system is feasible.

1.2 Scope of Work

Golder's scope of work for the project consisted of:

- Preparing a site-specific Health and Safety Environmental Plan to identify and mitigate hazards related to work conducted in the field.
- Performing a desktop literature review of readily-available information regarding groundwater levels in the vicinity of the two sites.
- Performing a site reconnaissance with NPS personnel to delineate the project limits and observe existing site conditions.
- Performing a geotechnical exploration to evaluate the site-specific subsurface conditions, which included:
  - Advancing ten vertical test borings up to approximately 25.1 feet-bgs.
  - Advancing six shallow percolation boreholes to approximately 4 feet-bgs and performing subsequent percolation tests in each of these boreholes.
  - Conducting geotechnical laboratory testing on selected representative soil samples.
- Measuring depth to groundwater in the existing NPS monitoring well at the Buckeye Housing site.
- Preparing this report that includes the following:
  - A site plan that shows test boring and percolation test locations.
  - A summary of the geotechnical exploration and subsurface conditions encountered.
  - Test boring and percolation test hole logs.
  - Laboratory testing results.
  - Percolation testing results.
  - Summary of our literature review of readily-available information regarding groundwater levels in the vicinity of the sites.
  - Geotechnical considerations for the proposed subsurface wastewater disposal systems at the sites.

2.0 GEOLOGIC SETTING

Both the Ash Mountain site and Buckeye Housing site are located in the Sierra Nevada geomorphic province. The Sierra is a tilted fault block that is nearly 400 miles long. The rocks are mainly igneous and metamorphic units of diverse composition and age, including volcanic and metasedimentary interlayered rocks. In the central and southern Sierra, plutonic igneous rocks, mostly silicic (granitic), form the multiple intrusions of the Sierra Nevada batholith and are believed to constitute approximately 60 percent of the exposed rock. Sedimentary and volcanic rocks that overlie the basement are most prominent in the central and northern Sierra.

Formation of the Sierra Nevada mountain range began during the Paleozoic Era approximately 475 million years ago with seafloor deposition of sediments originating from the ancestral North American continent which was drifting west. Toward the end of the Paleozoic, these seafloor sediments became folded as the Pacific plate

collided with the North American plate. Paleozoic deposits are exposed on the western edge of the forest in the upper foothills zone. These Paleozoic strata include metasedimentary and metavolcanic rocks such as slate, phyllite, greenstone, hornfels, gneiss, graywacke, crystalline limestone, and chert. During the subsequent Mesozoic Era, which began approximately 225 million years ago, these sea floor sediments were increasingly folded, tilted, and fed into the subduction zone formed between the Pacific and North American plates. Rocks on the subducting Pacific plate melted, forming magma. Some of this molten rock was expelled from volcanoes. The rest cooled in place, forming the Sierra Nevada batholith. As time progressed, many of the sea floor volcanic and sedimentary rocks became metamorphosed. Crustal uplifting began, forming a folded mountain range, which is the Sierra Nevada mountain range (USDA 1996).

2.1 Local Geology

Rocks within the vicinity of the sites are primarily Cretaceous granites and granodiorites of the Sierra Nevada batholith that intruded masses of Mesozoic metasedimentary and metavolcanics rocks. Quaternary till and talus are the main surficial deposits in the area (USGS 2013).

The geologic unit underlying the Ash Mountain site is mapped as Granite of Frys Point (Early Cretaceous) (Kfp), a medium- and coarse-grained biotite granite that lacks mafic inclusions but is locally cut by diorite and granodiorite dikes in some areas. Small intrusions of fine- and medium-grained hornblende diorite and quartz diorite (Kd) of Cretaceous age are mapped less than 1,000 feet south and west of the Ash Mountain site. A large landslide deposit (Qls) consisting of bouldery and hummocky landslide debris of Holocene to Pleistocene age is shown as bordering the Ash Mountain site to the north (USGS 2013). According to USGS (2013), this landslide deposit consists of a surficial bouldery mantle on the steep south slope of Ash Peaks Ridge. Furthermore, USGS (2013) indicates that this landslide deposit is not recent, and that it may have been generated by high rainfall during the Pleistocene Era.

The Buckeye Housing site's geology is unmapped on the USGS (2013) map but is based on outcrops observed by Golder during our fieldwork as well as residual soil encountered during drilling; the geology consists of an intrusive igneous rock (either granite or diorite). Based on the USGS (2013) map, the Buckeye Housing site is likely within the Granite of Frys Point (Kfp) or Diorite (Kd) units described above. A less-detailed, smaller-scaled map (CGS 2010) generally maps the area at and around the Buckeye Housing site as granitic rocks (granite, quartz monzonite, granodiorite, and quartz diorite) and metamorphic rocks.

A map of the local geology is shown in Figure 2.

3.0 GEOTECHNICAL EXPLORATION

Golder conducted a geotechnical field exploration to characterize the subsurface conditions at the three proposed subsurface disposal locations from March 23 through March 26, 2020. The explorations consisted of advancing geotechnical test borings, augering shallow percolation test holes, performing percolation tests in the shallow augered holes, laboratory testing on selected representative soil samples, and measuring the depth to groundwater at the existing NPS monitoring well near the Buckeye Housing Old Unlined Pond. The following test borings and percolation tests were completed:

- Ash Mountain: seven test borings (AM-B-1, AM-B-1a, and AM-B-2 through AM-B-6).
- Buckeye Housing Lined Pond: two test borings (BE-B-1 and BE-B-1a) and three percolation test holes and tests (BE-TP-1 through BE-TP-3).

- Buckeye Housing Old Unlined Pond: one test boring (BE-B-2) and three percolation test holes and tests (BE-TP-4 through BE-TP-6).

The locations of the test borings and percolation test holes are shown in Figures 3 through 5.

Prior to the commencement of the field work, the proposed exploration locations were cleared of underground utilities by Underground Service Alert (USA) as required by California state law. HECO also contracted a private utility locator to locate and mark existing underground utilities at the sites prior to the exploration activities. Additionally, since the geotechnical exploration was conducted on federally owned property, it was not required to obtain drilling, encroachment, or similar permits from Tulare County. A NPS representative was on-site during drilling and augering to monitor for potential archaeological disturbances.

Our exploration was completed in compliance with NPS's restrictions for the Buckeye Housing site and despite periods of inclement weather (i.e., rainfall). NPS required all work at the Buckeye Housing locations to cease by 5:00 pm each day due to the proximity of this site to residences. Per the direction of HECO, Golder completed the percolation testing under conditions of ongoing rain showers that were prevalent during the week of the exploration.

The following sections describe each of the components of the geotechnical exploration in detail.

3.1 Geotechnical Drilling and Sampling

Geotechnical drilling and soil sampling were conducted on March 24 and 25, 2020, and consisted of advancing seven test borings at Ash Mountain (Figure 3), two test borings at the Buckeye Housing Lined Pond (Figure 4), and one test boring at the Buckeye Housing Old Unlined Pond (Figure 5). Test borings were advanced by Taber Drilling (Taber), under subcontract to Golder, using a track-mounted CME 55 solid stem auger drill rig. Test borings were advanced to a depth of approximately 7.8 to 25.1 feet-bgs at Ash Mountain and approximately 15.2 to 15.8 feet-bgs at the Buckeye Housing site.

During drilling, representative soil samples were recovered at approximately 2.5- to 5-foot vertical intervals to characterize the subsurface conditions. Samples were obtained using a 1.5-inch inside diameter (ID) and 2-inch outside diameter (OD) split-spoon sampler following standard penetration test (SPT) procedures according to ASTM D1586, "Standard Method for Penetration Test and Split Barrel Sampling of Soils." This sampling method consists of driving the split-spoon sampler to a depth of up to 18 inches into the undisturbed soil at the bottom of the boring at each sampling interval. The sampler was driven with a 140-pound, hydraulic wire-line automatic hammer falling 30-inches per drop. The number of hammer blows required to drive the sampler the final 12 inches is known as the standard penetration resistance (N) value, which provides an index of the relative density of granular soils and the relative consistency of fine-grained soils. All recovered samples were stored in air-tight plastic bags to prevent moisture loss.

Groundwater was not encountered at the time of drilling in any of the test borings at the Ash Mountain or Buckeye Housing sites. Potential seasonal fluctuations of the groundwater levels, if any, could not be measured as part of our exploration and Golder could not locate any readily available information/data regarding potential seasonal groundwater fluctuations at the site, this is further described in Section 3.4.

Drilling was observed by a Golder geologist, who logged the soil and groundwater (if encountered) conditions encountered in the test borings, recorded the N-values, and obtained soil samples for further classification and laboratory testing. Soil samples were classified in the field in accordance with Golder's technical procedures and

the Unified Soil Classification System (USCS) (ASTM D2487). At the completion of drilling, each test boring was backfilled either with native cuttings or neat cement grout. The coordinates and existing ground surface elevations noted for each test boring were estimated using Google Earth and are approximate as the test boring locations were not surveyed.

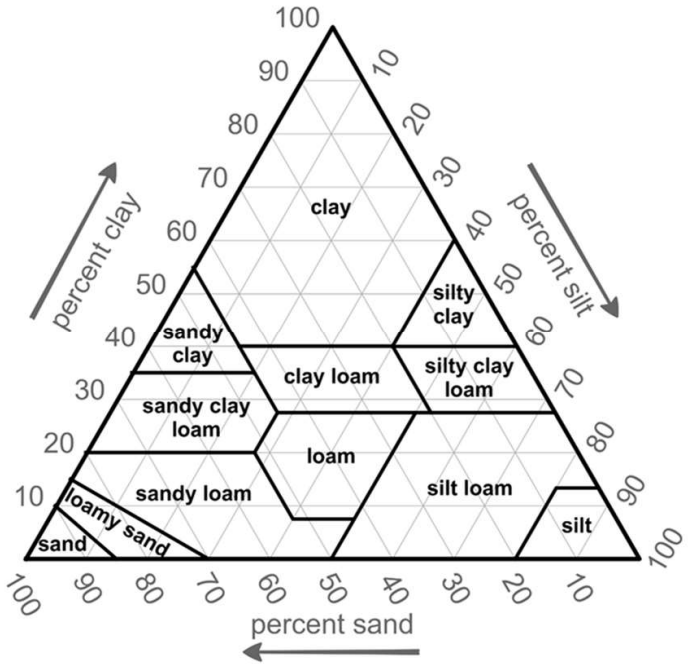
Summary logs of the test borings are provided in Appendix A.

3.2 Percolation Tests

3.2.1 Percolation Test Holes

Based on our discussions and agreement with HECO, percolation tests were performed only at the Buckeye Housing sites. Additionally, as stated in Section 3.0, per direction from HECO, percolation testing was performed despite scattered rain showers during the week of our exploration.

The bottoms of both the lined and unlined ponds at the Buckeye Housing site were accessible; therefore, fairly shallow percolation test holes could be advanced to perform corresponding percolation tests that are nominally within the proposed disposal depths. However, the bottoms of the ponds at the Ash Mountain site were not accessible; therefore, percolation test holes would have been advanced, and tests performed, from the ground surface and would have been at least 10 feet deep. It was not feasible to excavate test pits to this depth and performing the percolation tests this deep would have been challenging. Hence, as agreed by HECO, percolation testing was not undertaken at the Ash Mountain site as part of the current study. Instead, application and percolation rates for the soils within the proposed disposal depth (approximately 10 to 15 feet-bgs) at the Ash Mountain site can be estimated using Tables 204 and 203 of the Tulare County Local Agency Management Program's Onsite Wastewater Treatment Systems (LAMP 2018) based on classification of the soil type(s) encountered. The LAMP uses the United States Department of Agriculture (USDA) soil classification system, which is based on soil texture. Graphic 1 illustrates the relationship between sand, clay, and silt content to determine soil texture.



Graphic 1. USDA Soil Texture Relationship

Initially, percolation test holes were advanced by Doulos Environmental (Doulos) under subcontract to Golder by excavating a shallow test pit to 3 feet-bgs, followed by hand augering a 6-inch diameter hole an additional 1 foot-bgs. This procedure was implemented at the first percolation test hole location at the old, unlined pond and residual soil was encountered at approximately 2 feet-bgs. The residual soil was difficult and time consuming to excavate and hand auger. Additionally, it rained overnight which caused the percolation hole at the bottom of the test pit to fill with water. Therefore, in order to keep the exploration program within the agreed upon schedule and budget, as well as limit the water flowing into the percolation test holes, all six of the percolation test holes were advanced directly to a depth of approximately 4 feet-bgs by either Doulos using a 9-inch diameter auger attachment on the excavator or by Taber using the 6-inch diameter solid stem auger on the drill rig. The soil encountered in the percolation test holes was logged by Golder and bulk samples from each hole were collected for laboratory testing.

Percolation test holes were constructed in general accordance with the Tulare County LAMP's percolation testing guidance document. Accordingly, percolation test holes were constructed by placing approximately 2-inches of pea gravel at the bottom of the hole, followed by placing a slotted 1-inch polyvinyl chloride PVC casing inside the hole and adding pea gravel in the annular space around the PVC casing to keep the hole from collapsing.

The locations of the percolation test holes at the lined pond and unlined pond locations are shown in Figures 4 and 5, respectively. The coordinates and existing ground surface elevations noted for each percolation test hole were estimated using Google Earth and are approximate as these locations were not surveyed. Summary logs of the percolation test holes are provided in Appendix A.

3.2.2 Presoaking Activities

Once the PVC casing and pea gravel were installed in each percolation test hole, clean water was poured down the casing to begin the pre-soaking process. The water levels in the borings were determined by using an electronic water level indicator to measure the depth to water relative to the top of the PVC casing. NPS provided an on-site water hose to facilitate pre-soaking and percolation testing activities.

Pre-soaking activities were conducted on the afternoon of March 25, 2020 and consisted of filling each percolation boring with 1 to 4 feet of clean water. It should be noted that at the time of pre-soaking there was water in three of the six percolation borings (BE-TP-2, -5 and -6) due to scattered rain showers throughout the day of March 25. After approximately one hour, the water level in each percolation hole was measured to verify that at least 1 foot of water remained in the hole. The water was allowed to soak into the boreholes overnight.

3.2.3 Percolation Testing

Percolation testing was conducted in all six percolation test holes the following day on March 26, 2020. After pre-soaking overnight, the percolation test holes were filled with water to approximately 2- to 3-feet above the bottom of the hole. The depth to water was then measured in each percolation test hole at 30-minute intervals until the completion of the test. Section 401.4, subsection 2, paragraph c of the LAMP (2018) specifies percolation test measurement requirements. Part iii of paragraph c provides instruction, as follows, for collecting readings and computing the corresponding percolation rate:

> *Readings shall be taken at 30-minute intervals. Refill as necessary to maintain 6 inches of water over the pea gravel bottom at each interval. Readings shall be taken until two consecutive readings do not vary by more than ten percent per reading, with a minimum of 3 readings. The last 30-minute interval is used to compute the percolation rate. If 4 inches or more of water seeps*

from the hole during the 30-minute interval, readings may be taken at 10 minute intervals. Readings shall be taken until 2 consecutive readings do not vary by more than ten percent per reading with a minimum of 3 readings. The last 10-minute interval is used to compute the percolation rate.

Readings are considered as the change in water level over one 30- or 10-minute interval.

None of the percolation holes met the criteria for the 10-minute interval readings, so the depth to water was measured at each percolation test hole approximately every 30 minutes for four hours. Water was added intermittently to the percolation test holes to keep the water level at least 6 inches above the bottom of the percolation hole as required by the LAMP (2018).

Following the completion of percolation testing, the PVC casings were removed from the borings, and the borings were backfilled with native soil cuttings and restored to the original ground level.

Percolation rates were calculated in accordance with Section 401.4.2.c.iii of the LAMP (2018) and are summarized in Table 1. Detailed percolation test data sheets are provided in Appendix B.

Table 1: Summary of Percolation Testing

Percolation Test Hole	Measured Percolation Rate (minutes per inch)[1]
BE-TP-1	50
BE-TP-2	Cannot Calculate[2]
BE-TP-3	Cannot Calculate[2]
BE-TP-4	Cannot Calculate[2]
BE-TP-5	250
BE-TP-6	Cannot Calculate[2]

Notes:
[1] Indicates the raw, measured percolation rate and does not include a factor of safety.
[2] Indicates a meaningful percolation rate could not be calculated because the water levels in the percolation test hole did not change appreciably.

3.3 Geotechnical Laboratory Testing

Representative soil samples from the geotechnical test borings and percolation test holes were selected and transported to Gulf Shore Construction Services Inc. in Rancho Cordova, California for the following geotechnical laboratory tests:

- Particle size analysis (ASTM D6913)
- Atterberg limits (ASTM D4318)
- Moisture content (ASTM D2216)
- Soil chemistry for corrosion potential (California Test Methods 643, 417, and 422)

The results of the geotechnical laboratory testing are summarized on the test boring logs and presented in detail in Appendix C.

3.4 Available Information Regarding Groundwater Levels

Golder measured the depth to groundwater at the existing NPS monitoring well located approximately 175 feet west of the unlined pond at the Buckeye Housing site. Groundwater was measured at 110.5 feet-bgs in the monitoring well on March 24, 2020. We do not have information regarding the construction of the well (e.g., the screened interval, etc.).

In addition to measuring the groundwater level at the existing NPS monitoring well, Golder performed a desktop literature review in search of readily-available information regarding groundwater levels in the vicinity of the sites. We reviewed and discovered the following:

- California Department of Water Resources (DWR) Groundwater Information Center Interactive Map Application (GCIMA) (https://gis.water.ca.gov/app/gicima/)
  - No information was provided near the sites.
- DWR Water Data Library (WDL) (http://wdl.water.ca.gov/waterdatalibrary/)
  - No information was provided near the sites.
- United States Geological Survey (USGS) Groundwater Ambient Monitoring & Assessment (GAMA) (https://ca.water.usgs.gov/gama/)
  - An interactive map shows a domestic well is approximately 0.5 miles west of the Buckeye Housing site (Project ID: S4-TUSK-HLS13, USGS Station ID: 362800118510001). However, no information is provided regarding the depth to groundwater in this well.
- USGS National Ground-Water Monitoring Network (NGWMN) (https://cida.usgs.gov/ngwmn/index.jsp)
  - No information was provided near the sites.
- USGS National Water Information System (NWIS) (https://waterdata.usgs.gov/nwis)
  - No information was provided near the sites.
- State Water Resources Control Board (SWRCB) GeoTracker
  - An investigation was conducted at a site approximately 500 feet south of the Buckeye Housing unlined pond area. A groundwater sample was collected at approximately 12 feet-bgs. However, this site is closer to the river and at significantly lower elevation, which may explain the shallow depth to groundwater.

3.5 Subsurface Conditions and Estimated Percolation Rates

3.5.1 Ash Mountain

The subsurface conditions encountered at the Ash Mountain site generally consist of loose to compact Fill at the existing ground surface to a depth of approximately 2 to 14 feet-bgs that is underlain by primarily compact to very dense residual soil. The residual soil below a depth of approximately 10 feet-bgs is mostly very dense. According to the USCS, both the Fill and residual soil predominantly classify as clayey sand (SC). Based on the conditions encountered, it appears the Fill is thickest on the west side of the site (approximately 14 feet) and thins out to the east (approximately 2 feet), which provides an indication of the depth to native, residual soil across the site.

Groundwater was not encountered during drilling in any of the test borings at the site.

One soil sample from the site was tested for corrosivity potential. The tested parameters (electrical resistivity, pH, Chlorides and Sulfates) are within the typical range of non-corrosive values. The site soils likely have a low corrosive potential, but additional testing should be performed if construction of the proposed subsurface disposal system is sensitive to corrosion of buried concrete or metal.

As noted in Section 3.2, Table 204 of the LAMP (2018) can be used to estimate the application and percolation rates of the soils encountered within the proposed disposal depth (approximately 1 to 15 feet-bgs) at the Ash Mountain site based on the USDA soil texture. On average, the clayey sand encountered from 1 to 15 feet-bgs across the site consists of approximately 75 percent sand, 25 percent clay and/or silt and a negligible amount of gravel and, therefore, classifies as a sandy clay loam USDA soil texture. This corresponds to a maximum application rate of 0.2 gallons per day per square foot according to Table 204 of the LAMP (2018). Table 203 of the LAMP (2018) can be used to estimate a corresponding soil percolation rate of 60 minutes per inch. However, as discussed in Section 4.2, these values likely overestimate the amount of percolation that is achievable at the Ash Mountain site and, therefore, they should not be used unless verified through actual field percolation testing.

3.5.2 Buckeye Housing Lined Pond

The subsurface conditions encountered at the Buckeye Housing Lined Pond site generally consist of compact to dense Fill at the existing ground surface to a depth of 4 to 7 feet-bgs that is underlain by dense to very dense residual soil. According to the USCS, the Fill and residual soil classify as clayey sand (SC). Based on the conditions encountered and our observation of the site, it appears the Fill is most likely thickest on the south side of the site (approximately 7 feet at BE-B-1) and thins out to the north (approximately 4 feet at BE-B-1A). Due to the limited number and fairly close spacing of the test borings, the thickness, and limits of Fill across the site are not fully understood, although it is likely that the fill on the east side of the pond is limited as the natural ground surface in the area of the pond slopes down from east to west. Additionally, the two percolation test holes at the bottom of the lined pond indicate a 3- to 4-inch-thick layer of Fill between the geomembrane liner and the native, residual soil.

Groundwater was not encountered during drilling in any of the test borings or percolation holes at the site.

One soil sample from the site was tested for corrosivity potential. The tested parameters (electrical resistivity, pH, Chlorides and Sulfates) are within the typical range of non-corrosive values. The site soils likely have a low corrosive potential, but additional testing should be performed if construction of the proposed subsurface disposal system is sensitive to corrosion of buried concrete or metal.

The percolation test results indicate a range of possible percolation rates from 50 minutes per inch to no measurable percolation. The variation in percolation rates is likely due to local differences in the subsurface conditions (e.g., changes in the sizes and shapes of pores in the soil). There is a possibility that the inclement weather (i.e., rainfall) could have been a factor, but as discussed in Section 4.1, this is not considered to have had a large effect on the test results.

3.5.3 Buckeye Housing Old Unlined Pond

The subsurface conditions encountered at the Buckeye Housing Unlined Pond site generally consist of presumably compact Fill (no SPT blow counts available) at the existing ground surface up to a depth of approximately 5 feet-bgs that is underlain by mostly very dense residual soil. According to USCS, the Fill and residual soil classify as clayey sand (SC). Due to the single test boring, the thickness and limits of Fill across the site are not fully understood, although it is noted that the three percolation test holes did not encounter fill.

Groundwater was not encountered during drilling in any of the test borings or percolation holes at the site.

One soil sample from the site was tested for corrosivity potential. The tested parameters (electrical resistivity, pH, Chlorides and Sulfates) are within the typical range of non-corrosive values. The site soils likely have a low corrosive potential, but additional testing should be performed if construction of the proposed subsurface disposal system is sensitive to corrosion of buried concrete or metal.

The percolation test results for this site generally indicated percolation rates from 250 minutes per inch to no measurable percolation. The observed lack of percolation is likely due to the significant fines content of the soils and the dense nature of the subsurface materials. There is a possibility that the inclement weather (i.e., rainfall) could have also been a factor, but as discussed in Section 4.1, this is not considered to have had a large effect on the test results.

4.0 GEOTECHNICAL CONSIDERATIONS

4.1 Potential Rainfall and Bedrock Effects on Percolation Tests

As stated in Section 3.2.1, percolation tests were performed despite scattered rain showers during the week of our exploration. Golder does not have enough information to fully understand the extent of the effects of rainfall on the percolation tests. However, given the low measured percolation rates in the borings, Golder considers it likely that the rainfall had a largely insignificant effect on the measured percolation rates. Additional percolation testing would be required to verify this assertion.

Additionally, based on our understanding of the site geology and the conditions encountered during our exploration, we suspect bedrock could underlie the residual soils at relatively shallow depths. The drilling methods used for our exploration did not allow us to verify whether or not bedrock was encountered at the sampler or auger refusal depths. Furthermore, our current scope of work and exploration did not include evaluating the depth to competent, impermeable bedrock at any of the sites. However, auger refusal (which occurred at one test boring, BE-B-2 at the Buckeye Housing Old Unlined Pond) is typically a strong indication that either a large boulder or competent bedrock was encountered. We do not have enough information to verify or delineate the depths of competent bedrock across the sites, but it is conceivable that the percolation rates within the proposed disposal depths could be affected by the presence of shallow bedrock under certain portions of the sites.

4.2 Overall Suitability for Subsurface Wastewater Disposal System

Based on our current understanding of the site and the information obtained from our geotechnical exploration, it is Golder's opinion that none of the three sites provide ground conditions that are favorable for a subsurface wastewater disposal system such as a leach field or seepage pit. Despite the potential effects that inclement weather (i.e., rainfall) may have had on the percolation testing, the proposed disposal depths at the sites generally consist of residual soils that classify as clayey sand (SC) according to the USCS. Clayey sands typically do not percolate septic effluent well, especially when the clayey sands are very dense, as is the case for a large portion of the Ash Mountain and Buckeye Housing sites. Furthermore, the LAMP (2018) states the following in Section 401.3, "The average of all percolation tests in the leaching area shall not exceed two hundred (200) minutes per inch (mi./inch). No single percolation test shall exceed two hundred-forty (240) mi./inch". Based on the percolation data, the site does not meet these criteria as the average of the six percolation rates exceeds 200 mi./inch, and five of the six percolation tests exceeded 240 mi./inch.

Since we did not perform any percolation testing at the Ash Mountain site, it is possible but unlikely that the soils at this site percolate better than those at the Buckeye Housing site. There is no indication from the results of the test borings that the soils at Ash Mountain would have significantly faster percolation rates than those at the Buckeye Housing site. Hence, the Ash Mountain site should be considered to have the same percolation rates as the Buckeye Housing sites unless additional percolation testing is performed at the Ash Mountain site.

Additionally, there are existing noteworthy slopes on the south sides of the three sites which could present issues from an operational and/or slope stability standpoint if not addressed in the design of the disposal system. We do not have topographic survey data for the sites to verify the slope heights or lengths but based on our observation of the sites the slopes at the Buckeye Housing sites appear to be approximately 10 to 20 feet in height, and the slope at Ash Mountain appears to be at least 50 feet in height. If pursued, the proposed subsurface disposal system should be setback from the crest of the nearest slope to guard against effluent daylighting at the slope face and/or causing instability in the existing slope. Golder considers minimum setback distances of 25 and 50 feet for the Buckeye Housing and Ash Mountain sites, respectively, to be appropriate based on our current understanding of the project. These setback distances should be verified once the project's layout is refined. The proposed disposal system at the Ash Mountain site should also not be installed within 100 feet of the landslide deposit shown in Figure 2.

Based on the results of the exploration, it appears that groundwater is sufficiently deep at the sites such that the minimum required separation of 5 feet between the bottom of the disposal system and the seasonal high groundwater can be maintained if the depth of the disposal system does not exceed 15 feet-bgs.

5.0 ADDITIONAL GEOTECHNICAL EXPLORATION

After Golder's initial scope of work for this project was completed and our draft report was submitted, NPS and HECO identified two additional locations to evaluate for potential subsurface wastewater disposal system sites. Under a separate, follow-on scope of work, an additional geotechnical exploration was completed between November 16 and November 19, 2020. The report of its findings, titled "Additional Geotechnical Exploration - Rehabilitate Ash Mountain Wastewater Systems, Sequoia National Park, California", dated March 2021 (Golder 2021), is included as Appendix D to this report. As described in Golder's report in Appendix D, ground conditions that may be suitable for a subsurface wastewater disposal system were identified at the additional November 2020 exploration locations at the Buckeye Housing site.

6.0 CLOSING

Golder would like to thank HECO for the opportunity to provide support on the Rehabilitate Ash Mountain Wastewater Systems Project. If you have any questions or require any clarifications regarding the information presented in this report, please contact the undersigned.

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Ryan Hillman, PE
Senior Consultant

RPCE/RH/kkm

https://golderassociates.sharepoint.com/sites/114648/project files/6 deliverables/report - final/19129554_r_rev 0_heco_geotech exploration ash and buckey mtn_030321.docx

7.0 USE OF THIS REPORT

This report has been prepared exclusively for the use of HECO/NPS and their consultants and contractors for specific application to the Rehabilitate Ash Mountain Wastewater Systems Project in Tulare County, California. Appendix E contains important information regarding the proper use and interpretation of this report. If the project objectives and remediation concepts vary, or are changed, from that assumed in this report, Golder should be provided an opportunity to review the revised documents or information and, if necessary, complete additional explorations and/or modify our recommendations, as may be appropriate.

We encourage review of this report by bidders and/or contractors as it relates to factual data only (laboratory test results, conclusions, etc.). The conclusions presented in this report are based on the explorations and observations completed for this study and are not intended, nor should they be construed to represent, a warranty regarding the conditions, but are forwarded to assist with the planning and/or design process.

Engineering judgment has been applied in interpreting and presenting the results. We recommend that, if construction activities are pursued, HECO/NPS retain Golder to provide construction observation to confirm the soil conditions, provide supplementary recommendations as needed, and help assure compliance with the conclusions contained in this report. It is possible, and common, for variations in the subsurface conditions between the test borings, as well as variations over time, and actual conditions encountered during construction may be different from those interpreted herein.

The site exploration was completed in general accordance with the locally accepted standard of care for geotechnical engineering practice that existed at the time of the exploration, subject to the time limits and financial and physical constraints applicable to the services for this project, to provide information for the areas explored.

The conclusions contained in this report do not include an assessment of the presence or implication(s) of possible surface and/or subsurface contamination resulting from previous site activities and/or resulting from the introduction of materials from offsite sources.

8.0 REFERENCES

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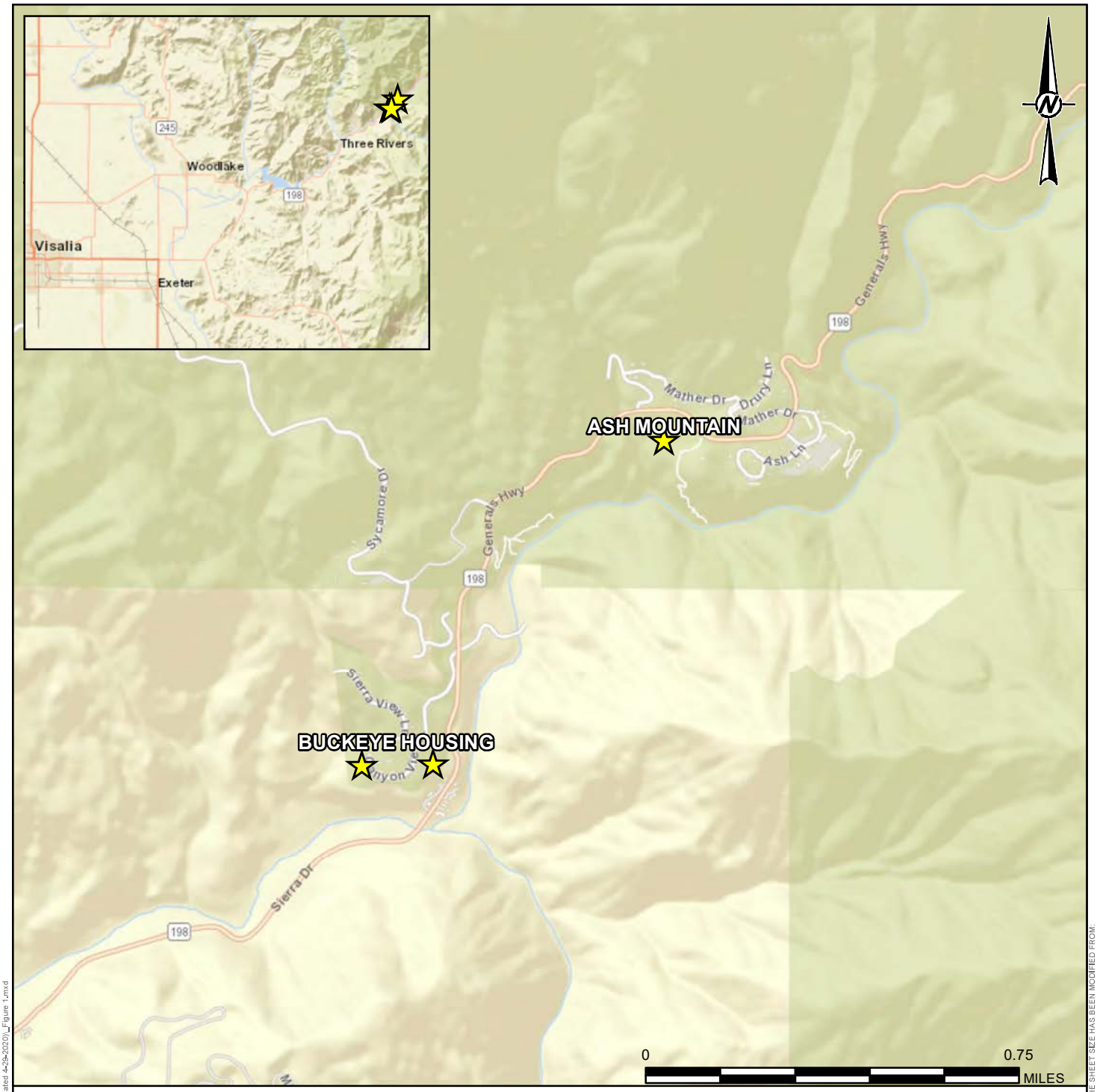
USDA. United States Department of Agriculture. 1996. *Overview of the Prehistory of the Stanislaus National Forest*. May.

USGS. United States Geological Survey. 2013. Sisson, Thomas W., and James G. Moore. Prepared in cooperation with the National Park Service. *Geologic Map of Southwestern Sequoia National Park, Tulare County, California*. Open-File Report 2013-1096.

Figures



LEGEND

★ PROJECT LOCATIONS

REFERENCE

1. BASEMAP OBTAINED FROM ESRI BASEMAP WEB SERVICE.
2. KEY MAP OBTAINED FROM ESRI BASEMAP WEB SERVICE.

CLIENT
HECO ENGINEERS
32 N MAIN STREET PO BOX 235
PAYETTE, ID 83661

PROJECT
GEOTECHNICAL EXPLORATION
REHABILITATE ASH MOUNTAIN WASTEWATER SYSTEMS

TITLE
SITE VICINITY MAP

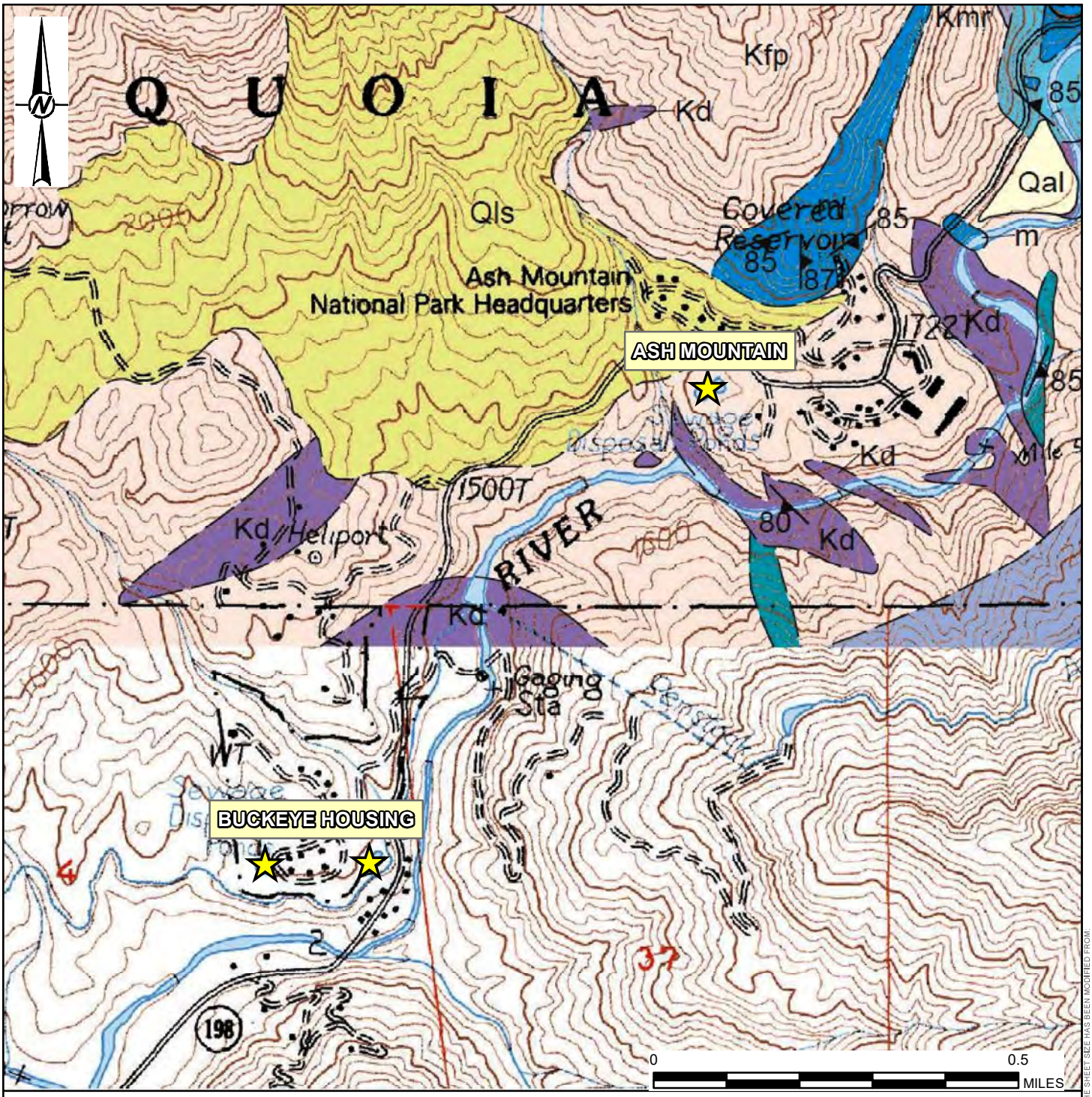
CONSULTANT
GOLDER

YYYY-MM-DD	2020-04-02
PREPARED	JHC
DESIGN	JHC
REVIEW	RPCE
APPROVED	RH

PROJECT 19129554 | Rev. 0 | FIGURE 1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 1 in

Path: C:\Users\HSGill\Golder Associates\19129554 HECO SE\Ash Mtn and Buckeye - Figures\GIS Files (updated 4-29-2020)_Figure 1.mxd



LEGEND

Qls	**Landslide deposits (Holocene and Pleistocene)** - Bouldery and hummocky landslide and debris deposits
Kd	**Diorite (Cretaceous)** - Small intrusions of fine- and medium-grained hornblende diorite and quartz diorite
Kfp	**Granite of Frys Point (Early Cretaceous)** - Medium- and coarse-grained biotite granite that lacks mafic inclusions but is locally cut by diorite and granodiorite dikes
qb	**Quartz-biotite schist and hornfels (Mesozoic)** - Encompasses quartzofeldspathic micaceous schist, phyllite, slate, and hornfels
slp	**Slate and phyllite (Mesozoic)** - Fissile slate, phyllite, and dark-colored argillaceous hornfels derived from mudstone

NOTE(S)

1. GEOLOGIC MAP AND UNIT DESCRIPTIONS OBTAINED FROM: UNITED STATES GEOLOGICAL SURVEY (USGS). 2013. GEOLOGIC MAP OF SOUTHWESTERN SEQUOIA NATIONAL PARK, TULARE COUNTY, CALIFORNIA. OPEN-FILE REPORT 2013-1096.
2. GEOLOGY FOR THE BUCKEYE HOUSING AREA NOT SHOWN ON USGS (2013).

CLIENT
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32 N MAIN STREET PO BOX 235
PAYETTE, ID 83661

PROJECT
GEOTECHNICAL EXPLORATION
REHABILITATE ASH MOUNTAIN WASTEWATER SYSTEMS

TITLE
LOCAL GEOLOGIC MAP

CONSULTANT
GOLDER

YYYY-MM-DD	2020-04-02
PREPARED	JHC
DESIGN	JHC
REVIEW	RPCE
APPROVED	RH

PROJECT 19129554 | Rev. 0 | FIGURE **2**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 1 in 0

Path: C:\Users\HSGill\Golder Associates\19129554 HECO SE\Ash Mtn and Buckeye - Figures\GIS Files (updated 4-29-2020)_Figure 2.mxd

LEGEND

TEST BORING

REFERENCE

1. DATE OF IMAGERY: MAY 2014.

CLIENT
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32 N MAIN STREET PO BOX 235
PAYETTE, ID 83661

PROJECT
GEOTECHNICAL EXPLORATION
REHABILITATE ASH MOUNTAIN WASTEWATER SYSTEMS

TITLE
ASH MOUNTAIN SITE PLAN

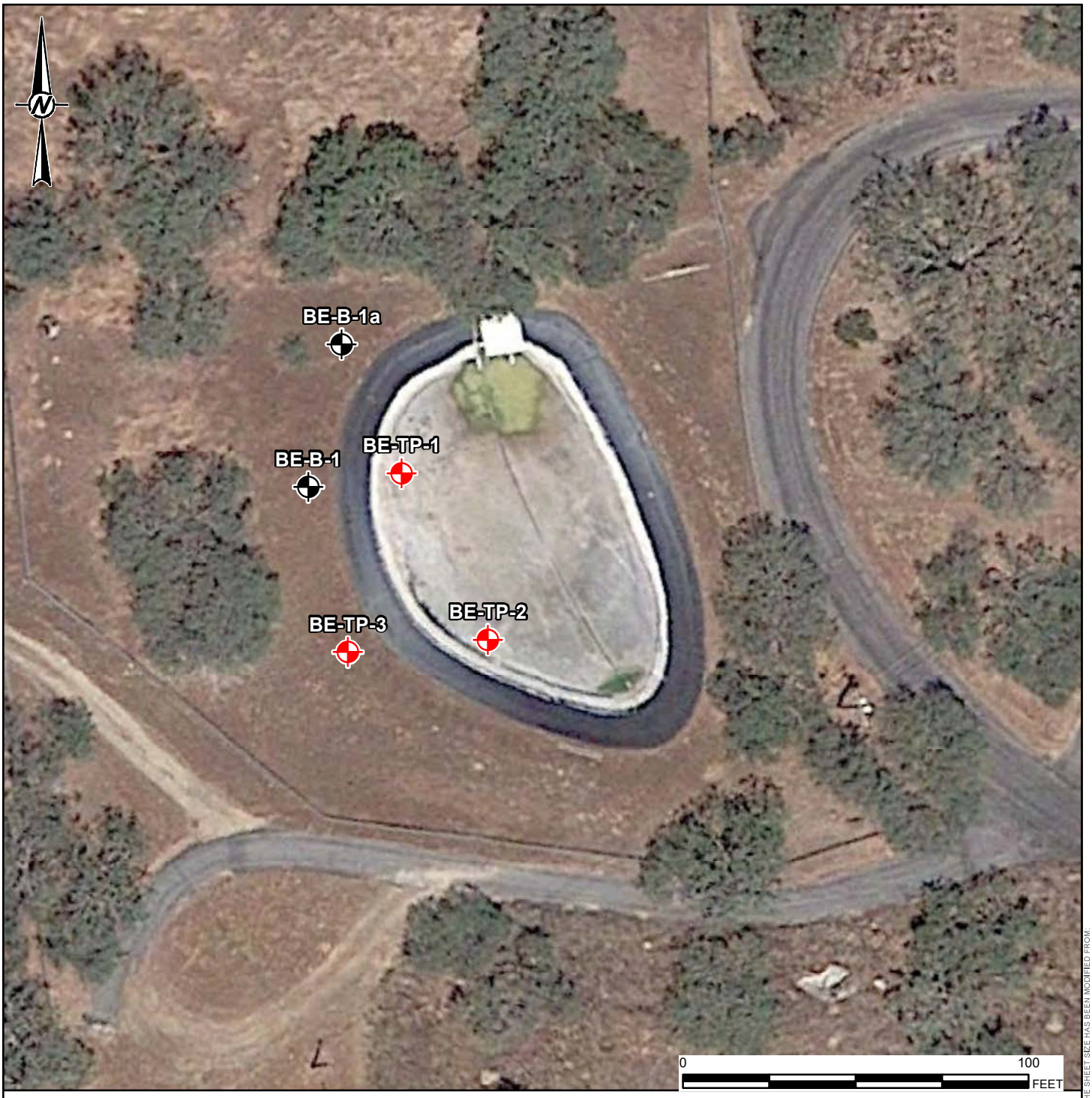
CONSULTANT
GOLDER

YYYY-MM-DD	2020-04-02
PREPARED	JHC
DESIGN	JHC
REVIEW	RPCE
APPROVED	RH

PROJECT 19129554 | Rev. 0 | FIGURE **3**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:
1 in
0

Path: C:\Users\HSGill\Golder Associates\19129554_HECO SEKI Ash Mtn and Buckeye - Figures\GIS Files (updated 4-29-2020)_Figure 3.mxd



LEGEND

- TEST BORING
- PERCOLATION BORING

REFERENCE

1. DATE OF IMAGERY: MAY 2014.

CLIENT
HECO ENGINEERS
32 N MAIN STREET PO BOX 235
PAYETTE, ID 83661

PROJECT
GEOTECHNICAL EXPLORATION
REHABILITATE ASH MOUNTAIN WASTEWATER SYSTEMS

TITLE
BUCKEYE HOUSING LINED POND SITE PLAN

CONSULTANT
GOLDER

YYYY-MM-DD	2020-04-02
PREPARED	JHC
DESIGN	JHC
REVIEW	RPCE
APPROVED	RH

PROJECT 19129554 | Rev. 0 | FIGURE **4**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 1 in 0

Path: C:\Users\HSGill\Golder Associates\19129554 HECO SE\3 Ash Mtn and Buckeye - Figures\GIS Files (updated 4-29-2020)_Figure 4.mxd

LEGEND

- TEST BORING
- PERCOLATION BORING
- NPS MONITORING WELL

REFERENCE

1. DATE OF IMAGERY: MAY 2014.

CLIENT
HECO ENGINEERS
32 N MAIN STREET PO BOX 235
PAYETTE, ID 83661

PROJECT
GEOTECHNICAL EXPLORATION
REHABILITATE ASH MOUNTAIN WASTEWATER SYSTEMS

TITLE
BUCKEYE HOUSING OLD UNLINED POND SITE PLAN

CONSULTANT
GOLDER

YYYY-MM-DD	2020-04-02
PREPARED	JHC
DESIGN	JHC
REVIEW	RPCE
APPROVED	RH

PROJECT	Rev.	FIGURE
19129554	0	5

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 1 in

Path: C:\Users\HSGill\Golder Associates\19129554 HECO SE\3 Ash Mtn and Buckeye - Figures\GIS Files (updated 4-29-2020)_Figure 5.mxd

APPENDIX A

Logs of Test Borings and Percolation Holes

RECORD OF BOREHOLE LEGEND

PROJECT: Sequoia National Park
PROJECT NO.: 19129554
LOCATION: Three Rivers, CA

DRILLING START: 2020 March 25 00:00
DRILLING END: 2020 March 25 00:00
COORDINATES: ,

SHEET: 1 of 1
GS ELEV.:
TOC ELEV.: na
DATUM: WGS84

DEPTH (ft)	BORING METHOD	SOIL PROFILE: Depth	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	SAMPLES: SAMPLE TYPE & NUMBER	SAMPLES: BLOWS per 6 in (ASTM D1586 140 lb hammer 30 inch drop)	SAMPLES: REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft; WATER CONTENT (%)	NOTES WATER LEVELS LABORATORY DATA	ADDITIONAL LAB TESTING
0	SOLID STEM AUGER	0.0	(GP); **Graphic Log:** Standard symbols for soil types **USCS:** Unified Soil Classification System per ASTM D2487 **MATERIAL DESCRIPTION FOR SOIL:** Soil classifications are based on the Unified Soil Classification System per ASTM D2487								
5											
10			**Sampler Types:** Standard Penetration Test (SPT) - 2-inch outside diameter, 1.4-inch inside diameter split-spoon sampler	GP		DO	5-10-15 **(25)**	17/18	25		
			Shelby Tube Sample - 3-inch outside diameter thin-walled tube sampler pushed into the bottom of the borehole			DS		10/10			
			Auger Cuttings Sample			AS		10/10			
15			Grab Sample			GB		8/8			
		17.0	(SP); Inferred material contact (dashed line) - actual material contact may be gradual								
20			**Laboratory Test Abbreviations:** LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index	SP							
			Other Abbreviations: REC/ATT = length of sample recovered/length of sample attempted								
25		25.0									
			Bottom of borehole at 25.0 ft.								
30											

DRILLING CO.: Taber Drilling
DRILLER:
DRILL RIG:

LOGGED: JHC
CHECKED:
REVIEWED:

GOLDER

LEGEND

RECORD OF BOREHOLE AM-B-1

PROJECT: Sequoia National Park
PROJECT NO.: 19129554
LOCATION: Three Rivers, CA

DRILLING START: 2020 March 24 14:40
DRILLING END: 2020 March 24 15:17
COORDINATES: 36.490154,-118.830572

SHEET: 1 of 1
GS ELEV.: 1605.0
TOC ELEV.: na
DATUM: WGS84

DEPTH (ft)	BORING METHOD	SOIL PROFILE: Depth	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: Elev	USCS	GRAPHIC LOG	SAMPLES: SAMPLE TYPE & NUMBER	SAMPLES: BLOWS per 6 in (ASTM D1586 140 lb hammer 30 inch drop Automatic)	SAMPLES: REC / ATT (in)	PENETRATION RESISTANCE BLOWS / ft; WATER CONTENT (%)	NOTES WATER LEVELS LABORATORY DATA	ADDITIONAL LAB TESTING
0	SOLID STEM AUGER	0.0	FILL, (SC), clayey sand, dark brown; non-cohesive, dry to moist	1605.0	SC		AS		30/30			
5			Weak cementation; Increase in gravel content, decrease in fines content. Becomes compact				DO	7-9-16 **(25)**	14/18	25	5 - 6.5: Sieve: Gravel = 5%, Sand = 65%, Fines = 30%.	
		7.0	(SC) Clayey sand, orange-brown gray, moderate cementation; non-cohesive, compact, dry	1598.0			DO	17-13-13 **(26)**	12/18	26		
10			Becomes very dense		SC		DO	23-35-48 **(83)**	13/18	>>		
							DO	45-41-50/3" **(91/9")**	14/15	>>	12.5 - 14: Sieve: Gravel = 0%, Sand = 74%, Fines = 26%. Atterberg: LL = 29, PL = 16, PI = 13. Moisture: 5.2%.	
15		15.4	Bottom of borehole at 15.4 ft. Groundwater was not encountered drilling. Backfilled with cement grout.	1589.6			DO	50/5" **(50/5")**	3/5	>>		
20												
25												
30												

DRILLING CO.: Taber Drilling
DRILLER: Octavio Baldazo
DRILL RIG: CME 55

LOGGED: JHC
CHECKED: RPCE
REVIEWED: RH

GOLDER

AM-B-1
1 of 1

RECORD OF BOREHOLE AM-B-1a

PROJECT: Sequoia National Park
PROJECT NO.: 19129554
LOCATION: Three Rivers, CA

DRILLING START: 2020 March 24 15:27
DRILLING END: 2020 March 24 16:03
COORDINATES: 36.490298,-118.830842

SHEET: 1 of 1
GS ELEV.: 1594.0
TOC ELEV.: na
DATUM: WGS84

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLES SAMPLE TYPE & NUMBER	BLOWS per 6 in ASTM D1586 140 lb hammer 30 inch drop Automatic	REC ATT (in)	PENETRATION RESISTANCE BLOWS / ft	NOTES WATER LEVELS LABORATORY DATA	ADDITIONAL LAB TESTING
0	4-INCH DIAMETER SOLID STEM AUGER	0.0	FILL, (SC), clayey sand, dark brown; non-cohesive, dry to moist	1594.0	SC		AS		30/30			
5			No cementation; Decrease in fines content. Becomes loose				DO	6-3-4 (7)	13/18	7		
10			Becomes compact				DO	7-8-10 (18)	15/18	18	10 - 11.5: Sieve: Gravel = 2%, Sand = 69%, Fines = 29%.	
		14.0	(SC)	1580.0								
15			Clayey sand, orange-brown gray, weak cementation; non-cohesive, loose, dry		SC		DO	5-3-5 (8)	11/18	8		
20			Becomes very dense				DO	50/1" (50/1")	0/1	>>		
25		25.1		1568.9			DO	50/1" (50/1")	0/1	>>		
			Sampler refusal. Bottom of borehole at 25.1 ft. Groundwater was not encountered drilling. Backfilled with cement grout.									
30												

WATER CONTENT (%): W_p — W — W_l (20 40 60 80)

DRILLING CO.: Taber Drilling
DRILLER: Octavio Baldazo
DRILL RIG: CME 55

LOGGED: JHC
CHECKED: RPCE
REVIEWED: RH

GOLDER

AM-B-1a
1 of 1

01 - GOLDER - BOREHOLE RECORD - DF STD US LAB E-M.GDT - 20/12/21 12:22
C:\USERS\JCONSOLI\GOLDER ASSOCIATES\19129554, HECO SEKI ASH MTN AND BUCKEYE - PROJECT FILES\5 TECHNICAL WORK\GINT\HECO SEKI GINT 20201221.GPJ

RECORD OF BOREHOLE AM-B-2

PROJECT: Sequoia National Park
PROJECT NO.: 19129554
LOCATION: Three Rivers, CA

DRILLING START: 2020 March 25 07:20
DRILLING END: 2020 March 25 08:00
COORDINATES: 36.490256,-118.830374

SHEET: 1 of 1
GS ELEV.: 1611.0
TOC ELEV.: na
DATUM: WGS84

DEPTH (ft)	BORING METHOD	SOIL PROFILE: Depth	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: Elev	USCS	GRAPHIC LOG	SAMPLES: SAMPLE TYPE & NUMBER	SAMPLES: BLOWS per 6 in (ASTM D1586, 140 lb hammer, 30 inch drop, Automatic)	SAMPLES: REC / ATT (in)	PENETRATION RESISTANCE BLOWS / ft; WATER CONTENT (%)	NOTES, WATER LEVELS, LABORATORY DATA	ADDITIONAL LAB TESTING
0	4-INCH DIAMETER SOLID STEM AUGER	0.0	FILL, (SC), clayey sand, dark brown; non-cohesive, dry to moist	1611.0			AS		30/30		0 - 2.5: Corrosion: pH = 6.60, Minimum Resistivity = 21170 ohm-cm, Chloride = 1.0 ppm, Sulfate = 0.4 ppm.	
			No cementation; Increase in gravel content, decrease in fines content. Becomes brown, compact		SC		DO	15-14-16 **(30)**	14/18	30		
5							DO	11-11-10 **(21)**	11/18	21		
		7.0		1604.0								
			(SM) Silty sand, orange-brown gray, weak cementation; non-cohesive, compact, dry				DO	14-12-15 **(27)**	9/18	27		
10			Decrease in fines content. Becomes very dense		SM		DO	11-26-28 **(54)**	9/18	NP >>	10 - 11.5: Sieve: Gravel = 0%, Sand = 80%, Fines = 20%. Atterberg: LL = NV, PL = NP, PI = NP. Moisture: 4.0%.	
							DO	28-41-50 **(91)**	13/18	>>		
15		15.9		1595.1			DO	48-50/5" **(50/5")**	10/11	>>		
			Bottom of borehole at 15.9 ft. Groundwater was not encountered drilling. Backfilled with cement grout.									
20												
25												
30												

DRILLING CO.: Taber Drilling
DRILLER: Octavio Baldazo
DRILL RIG: CME 55

LOGGED: JHC
CHECKED: RPCE
REVIEWED: RH

GOLDER

AM-B-2
1 of 1

RECORD OF BOREHOLE AM-B-3

PROJECT: Sequoia National Park
PROJECT NO.: 19129554
LOCATION: Three Rivers, CA

DRILLING START: 2020 March 25 08:30
DRILLING END: 2020 March 25 08:58
COORDINATES: 36.49052,-118.829957

SHEET: 1 of 1
GS ELEV.: 1613.0
TOC ELEV.: na
DATUM: WGS84

DEPTH (ft)	BORING METHOD	SOIL PROFILE: Depth	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: Elev	USCS	GRAPHIC LOG	SAMPLES: SAMPLE TYPE & NUMBER	SAMPLES: BLOWS per 6 in (ASTM D1586, 140 lb hammer, 30 inch drop, Automatic)	SAMPLES: REC / ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS LABORATORY DATA	ADDITIONAL LAB TESTING
0	4-INCH DIAMETER SOLID STEM AUGER	0.0	FILL, (SC), clayey sand, gray; non-cohesive, dry to moist, mostly fine grained sand	1613.0	SC		AS		30/30			
		2.0	(SC) Clayey sand, orange-brown gray, weak cementation; non-cohesive, very dense, dry	1611.0			DO	36-50 (50/")	11/12	>>		
5			Becomes weakly to moderately cemented		SC		DO	50 (50/")	2/6	>>		
		7.9		1605.1			DO	50/5" (50/5")	3/5	>>		
			Sampler refusal. Bottom of borehole at 7.9 ft. Groundwater was not encountered drilling. Backfilled with cuttings.									
10												
15												
20												
25												
30												

DRILLING CO.: Taber Drilling
DRILLER: Octavio Baldazo
DRILL RIG: CME 55

LOGGED: JHC
CHECKED: RPCE
REVIEWED: RH

GOLDER

AM-B-3
1 of 1

01 - GOLDER - BOREHOLE RECORD - DF STD US LAB E-M.GDT - 20/12/21 12:22
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RECORD OF BOREHOLE AM-B-4

PROJECT: Sequoia National Park
PROJECT NO.: 19129554
LOCATION: Three Rivers, CA

DRILLING START: 2020 March 25 09:10
DRILLING END: 2020 March 25 09:47
COORDINATES: 36.490648,-118.83021

SHEET: 1 of 1
GS ELEV.: 1610.0
TOC ELEV.: na
DATUM: WGS84

DEPTH (ft)	BORING METHOD	SOIL PROFILE: Depth	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: Elev	USCS	GRAPHIC LOG	SAMPLES: SAMPLE TYPE & NUMBER	SAMPLES: BLOWS per 6 in (ASTM D1586 140 lb hammer 30 inch drop Automatic)	SAMPLES: REC / ATT (in)	PENETRATION RESISTANCE BLOWS / ft; WATER CONTENT (%)	NOTES WATER LEVELS LABORATORY DATA	ADDITIONAL LAB TESTING
0	4-INCH DIAMETER SOLID STEM AUGER	0.0	FILL, (SC), clayey sand, brown; non-cohesive, dry to moist, mostly fine grained sand	1610.0	SC		AS		30/30			
		2.0	(SC) Clayey sand, orange-brown gray, moderate to strong cementation; non-cohesive, very dense, dry	1608.0			DO	23-37-44 (81)	14/18	>>		
5			Decrease in gravel content. Becomes dense				DO	18-11-20 (31)	11/18	31		
			Moderate cementation		SC		DO	20-22-25 (47)	14/18	47		
10			Becomes weakly cemented, very dense				DO	50/4" (50/4")	3/4	>>	10 - 11.5: Sieve: Gravel = 6%, Sand = 78%, Fines = 16%.	
		12.6	Sampler refusal. Bottom of borehole at 12.6 ft. Groundwater was not encountered drilling. Backfilled with cement grout.	1597.4			DO	50/1" (50/1")	0/1	>>		
15												
20												
25												
30												

DRILLING CO.: Taber Drilling
DRILLER: Octavio Baldazo
DRILL RIG: CME 55

LOGGED: JHC
CHECKED: RPCE
REVIEWED: RH

GOLDER

AM-B-4
1 of 1

01 - GOLDER - BOREHOLE RECORD - DF STD US LAB E-M.GDT - 20/12/21 12:22
C:\USERS\JCONSOLI\GOLDER ASSOCIATES\19129554, HECO SEKI ASH MTN AND BUCKEYE - PROJECT FILES\5 TECHNICAL WORK\GINT\HECO SEKI GINT 20201221.GPJ

RECORD OF BOREHOLE AM-B-5

PROJECT: Sequoia National Park
PROJECT NO.: 19129554
LOCATION: Three Rivers, CA

DRILLING START: 2020 March 25 10:00
DRILLING END: 2020 March 25 10:26
COORDINATES: 36.490542,-118.830633

SHEET: 1 of 1
GS ELEV.: 1606.0
TOC ELEV.: na
DATUM: WGS84

DEPTH (ft)	BORING METHOD	SOIL PROFILE: Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLES: SAMPLE TYPE & NUMBER	BLOWS per 6 in (ASTM D1586 140 lb hammer 30 inch drop Automatic)	REC / ATT (in)	PENETRATION RESISTANCE BLOWS / ft; WATER CONTENT (%)	NOTES WATER LEVELS LABORATORY DATA	ADDITIONAL LAB TESTING
0	4-INCH DIAMETER SOLID STEM AUGER	0.0	FILL, (SC) Clayey sand, brown; non-cohesive, dry to moist, mostly fine to medium grained sand	1606.0	SC		AS		30/30			
		2.0	(CL), sandy clay, red-brown, moderate to strong cementation; cohesive, very stiff, w < PL	1604.0			DO	5-8-11 **(19)**	15/18	19		
5					CL							
			Becomes brown, hard, strong cementation				DO	26-44-50/3" **(94/9")**	14/15	>>	5 - 6.5: Sieve: Gravel = 1%, Sand = 38%, Fines = 61%. Atterberg: LL = 42, PL = 19, PI = 23. Moisture: 12.5%.	
		7.0	(SC), clayey sand, orange-brown gray; non-cohesive, very dense, dry	1599.0			DO	50/1" **(50/1")**	0/1	>>		
10					SC							
		10.3	Sampler refusal. Bottom of borehole at 10.3 ft. Groundwater was not encountered drilling. Backfilled with cuttings.	1595.7			DO	50/3" **(50/3")**	1/3	>>		
15												
20												
25												
30												

DRILLING CO.: Taber Drilling
DRILLER: Octavio Baldazo
DRILL RIG: CME 55

LOGGED: JHC
CHECKED: RPCE
REVIEWED: RH

GOLDER

AM-B-5
1 of 1

01 - GOLDER - BOREHOLE RECORD - DF STD US LAB E-M.GDT - 20/12/21 12:22
C:\USERS\JCONSOLI\GOLDER ASSOCIATES\19129554, HECO SEKI ASH MTN AND BUCKEYE - PROJECT FILES\5 TECHNICAL WORK\GINT\HECO SEKI GINT 20201221.GPJ

RECORD OF BOREHOLE AM-B-6

PROJECT: Sequoia National Park
PROJECT NO.: 19129554
LOCATION: Three Rivers, CA

DRILLING START: 2020 March 25 10:40
DRILLING END: 2020 March 25 11:01
COORDINATES: 36.49027,-118.830053

SHEET: 1 of 1
GS ELEV.: 1619.0
TOC ELEV.: na
DATUM: WGS84

DEPTH (ft)	BORING METHOD	SOIL PROFILE: Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLES: SAMPLE TYPE & NUMBER	BLOWS per 6 in (ASTM D1586, 140 lb hammer, 30 inch drop, Automatic)	REC / ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS LABORATORY DATA	ADDITIONAL LAB TESTING
0	4-INCH DIAMETER SOLID STEM AUGER	0.0	FILL, (SC), clayey sand, light brown; non-cohesive, dry	1619.0	SC		AS		30/30			
		2.0	(SC) Clayey sand, orange-brown gray, no cementation; non-cohesive, very dense, dry	1617.0			DO	50/5" (50/5")	4/5	>>		
5					SC		DO	50/2" (50/2")	2/2	>>		
		7.8	Sampler refusal Bottom of borehole at 7.8 ft. Groundwater was not encountered drilling. Backfilled with cuttings.	1611.2			DO	50/3" (50/3")	2/3	>>		
10												
15												
20												
25												
30												

DRILLING CO.: Taber Drilling
DRILLER: Octavio Baldazo
DRILL RIG: CME 55

LOGGED: JHC
CHECKED: RPCE
REVIEWED: RH

GOLDER

AM-B-6
1 of 1

01 - GOLDER - BOREHOLE RECORD - DF STD US LAB E-M.GDT - 20/12/21 12:22
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RECORD OF BOREHOLE BE-B-1

PROJECT: Sequoia National Park
PROJECT NO.: 19129554
LOCATION: Three Rivers, CA

DRILLING START: 2020 March 24 08:20
DRILLING END: 2020 March 24 09:13
COORDINATES: 36.480944,-118.841653

SHEET: 1 of 1
GS ELEV.: 1390.0
TOC ELEV.: na
DATUM: WGS84

DEPTH (ft)	BORING METHOD	SOIL PROFILE: Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLES: SAMPLE TYPE & NUMBER	BLOWS per 6 in (ASTM D1586 140 lb hammer 30 inch drop Automatic)	REC / ATT (in)	PENETRATION RESISTANCE BLOWS / ft; WATER CONTENT (%)	NOTES WATER LEVELS LABORATORY DATA	ADDITIONAL LAB TESTING
0	4-INCH DIAMETER SOLID STEM AUGER	0.0	FILL, (SC), clayey sand, brown; non-cohesive, dry to moist	1390.0			AS		30/30			
			Increase in gravel content		SC		DO	9-8-11 (19)	14/18	19		
5			Becomes dense				DO	13-22-20 (42)	10/18	42		
		7.0		1383.0								
			(SC), clayey sand, orange-brown, weak cementation; non-cohesive, dense, dry to moist				DO	13-16-19 (35)	11/18	35		
10			Becomes moderately cemented		SC		DO	18-19-21 (40)	14/18	40	10 - 11.5: Sieve: Gravel = 1%, Sand = 56%, Fines = 43%.	
			Becomes dry, very dense				DO	50/3" (50/3")	3/3	>>		
15		15.4		1374.6			DO	50/5" (50/5")	5/5	>>		
			Sampler refusal. Bottom of borehole at 15.4 ft. Groundwater was not encountered drilling. Backfilled with cement grout.									
20												
25												
30												

DRILLING CO.: Taber Drilling
DRILLER: Octavio Baldazo
DRILL RIG: CME 55

LOGGED: JHC
CHECKED: RPCE
REVIEWED: RH

GOLDER

BE-B-1
1 of 1

RECORD OF BOREHOLE BE-B-1a

PROJECT: Sequoia National Park
PROJECT NO.: 19129554
LOCATION: Three Rivers, CA

DRILLING START: 2020 March 24 09:25
DRILLING END: 2020 March 24 10:05
COORDINATES: 36.481059,-118.841618

SHEET: 1 of 1
GS ELEV.: 1391.0
TOC ELEV.: na
DATUM: WGS84

DEPTH (ft)	BORING METHOD	SOIL PROFILE: Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLES: SAMPLE TYPE & NUMBER	BLOWS per 6 in (ASTM D1586, 140 lb hammer, 30 inch drop, Automatic)	REC / ATT (in)	PENETRATION RESISTANCE BLOWS / ft; WATER CONTENT (%)	NOTES WATER LEVELS LABORATORY DATA	ADDITIONAL LAB TESTING
0	4-INCH DIAMETER SOLID STEM AUGER	0.0	FILL, (SC), clayey sand, brown; non-cohesive, dry to moist	1391.0	SC		AS		30/30			
		4.0	(SC), clayey sand, orange-brown, weak cementation; non-cohesive, dense, dry	1387.0								
5							DO	8-16-28 **(44)**	15/18	44		
10			Becomes moderately cemented, very dense		SC		DO	36-50 **(50/")**	5/12	>>		
15		15.8	Decrease in fines and gravel content, becomes gray-brown	1375.2			DO	43-50/4" **(50/4")**	9/10	>>		
			Sampler refusal. Bottom of borehole at 15.8 ft. Groundwater was not encountered drilling. Backfilled with cement grout.									
20												
25												
30												

DRILLING CO.: Taber Drilling
DRILLER: Octavio Baldazo
DRILL RIG: CME 55

LOGGED: JHC
CHECKED: RPCE
REVIEWED: RH

GOLDER

BE-B-1a
1 of 1

01 - GOLDER - BOREHOLE RECORD - DF STD US LAB E-M.GDT - 20/12/21 12:22
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RECORD OF BOREHOLE BE-B-2

PROJECT: Sequoia National Park
PROJECT NO.: 19129554
LOCATION: Three Rivers, CA

DRILLING START: 2020 March 24 12:15
DRILLING END: 2020 March 24 13:05
COORDINATES: 36.480758,-118.83899

SHEET: 1 of 1
GS ELEV.: 1382.0
TOC ELEV.: na
DATUM: WGS84

DEPTH (ft)	BORING METHOD	SOIL PROFILE: Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLES: SAMPLE TYPE & NUMBER	BLOWS per 6 in (ASTM D1586 140 lb hammer 30 inch drop Automatic)	REC / ATT (in)	PENETRATION RESISTANCE BLOWS / ft; WATER CONTENT (%)	NOTES WATER LEVELS LABORATORY DATA	ADDITIONAL LAB TESTING
0	4-INCH DIAMETER SOLID STEM AUGER	0.0	FILL, (SC), clayey sand, brown; non-cohesive, dry	1382.0	SC		AS		30/30			
5		5.0	(SC) Clayey sand, orange-brown, weak cementation; non-cohesive, compact, dry to moist	1377.0			DO	8-10-9 **(19)**	10/18	19		
			Becomes very dense				DO	37-50/3" **(50/3")**	8/9	>>		
10			Decrease in gravel content. Becomes dark orange-brown, moderately to well cemented, dry		SC		DO	25-29-27 **(56)**	16/18	>>	10 - 11.5: Sieve: Gravel = 7%, Sand = 65%, Fines = 28%.	
			Sand mostly fine to medium grained				DO	37-50/4" **(50/4")**	8/10	>>		
15		15.2		1366.8			DO	50/2" **(50/2")**	0/2	>>		
			Auger refusal. Bottom of borehole at 15.2 ft. Groundwater was not encountered drilling. Backfilled with cement grout.									
20												
25												
30												

DRILLING CO.: Taber Drilling
DRILLER: Octavio Baldazo
DRILL RIG: CME 55

LOGGED: JHC
CHECKED: RPCE
REVIEWED: RH

GOLDER

BE-B-2
1 of 1

01 - GOLDER - BOREHOLE RECORD - DF STD US LAB E-M.GDT - 20/12/21 12:22
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RECORD OF BOREHOLE BE-TP-1

PROJECT: Sequoia National Park
PROJECT NO.: 19129554
LOCATION: Three Rivers, CA

DRILLING START: 2020 March 25 00:00
DRILLING END: 2020 March 25 00:00
COORDINATES: 36.480954,-118.84155

SHEET: 1 of 1
GS ELEV.: 1393.0
TOC ELEV.: na
DATUM: WGS84

DEPTH (ft)	BORING METHOD	SOIL PROFILE: Depth	DESCRIPTION	SOIL PROFILE: Elev	USCS	GRAPHIC LOG	SAMPLES: SAMPLE TYPE & NUMBER	SAMPLES: BLOWS per 6 in (ASTM D1586 140 lb hammer 30 inch drop)	SAMPLES: REC / ATT (in)	PENETRATION RESISTANCE BLOWS / ft; WATER CONTENT (%)	NOTES WATER LEVELS LABORATORY DATA	ADDITIONAL LAB TESTING
0		0.0		1393.0								
	6-INCH DIAM. SSA	0.3	FILL, (SC), clayey sand with gravel, gray-brown; non-cohesive, moist to wet	1392.7	SC		AS		4/4		0.5 - 4: Sieve: Gravel = 2%, Sand = 74%, Fines = 24%. Atterberg: LL = 25, PL = 16, PI = 9. Moisture: 9.6%.	
			(SC), clayey sand, orange-brown; non-cohesive, dry to moist Becomes harder with depth		SC		AS		42/42			
		4.2		1388.8								
5			Bottom of borehole at 4.2 ft. Groundwater was not encountered drilling. Backfilled with cuttings.									
10												
15												
20												
25												
30												

PENETRATION RESISTANCE BLOWS / ft: 10 20 30 40
WATER CONTENT (%): W_p W W_l 20 40 60 80

DRILLING CO.: Taber Drilling
DRILLER: Octavio Baldazo
DRILL RIG: CME 55

LOGGED: JHC
CHECKED: RPCE
REVIEWED: RH

GOLDER

BE-TP-1
1 of 1

01 - GOLDER - BOREHOLE RECORD - DF STD US LAB E-M.GDT - 20/12/21 12:22
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RECORD OF BOREHOLE BE-TP-2

PROJECT: Sequoia National Park
PROJECT NO.: 19129554
LOCATION: Three Rivers, CA

DRILLING START: 2020 March 25 00:00
DRILLING END: 2020 March 25 00:00
COORDINATES: 36.48083,-118.84147

SHEET: 1 of 1
GS ELEV.: 1392.0
TOC ELEV.: na
DATUM: WGS84

DEPTH (ft)	BORING METHOD	SOIL PROFILE: Depth	DESCRIPTION	SOIL PROFILE: Elev	USCS	GRAPHIC LOG	SAMPLES: SAMPLE TYPE & NUMBER	SAMPLES: BLOWS per 6 in (ASTM D1586 140 lb hammer 30 inch drop)	SAMPLES: REC / ATT (in)	PENETRATION RESISTANCE BLOWS / ft; WATER CONTENT (%)	NOTES WATER LEVELS LABORATORY DATA	ADDITIONAL LAB TESTING
0		0.0		1392.0						10 20 30 40; W_p W W_l 20 40 60 80		
	6-INCH DIAM. SSA	0.3	FILL, (SC), clayey sand with gravel, gray-brown; non-cohesive, moist to wet	1391.7	SC						0 - 4: Corrosion: pH = 6.45, Minimum Resistivity = 17.42 ohm-cm (x1000), Chloride = 1.3 ppm, Sulfate = 14.5 ppm.	
			(SC), clayey sand, orange-brown; non-cohesive, dry to moist Becomes harder with depth		SC		AS		48/48			
		4.3		1387.7								
5			Bottom of borehole at 4.3 ft. Groundwater was not encountered drilling. Backfilled with cuttings.									
10												
15												
20												
25												
30												

DRILLING CO.: Taber Drilling
DRILLER: Octavio Baldazo
DRILL RIG: CME 55

LOGGED: JHC
CHECKED: RPCE
REVIEWED: RH

GOLDER

BE-TP-2
1 of 1

RECORD OF BOREHOLE BE-TP-3

PROJECT: Sequoia National Park
PROJECT NO.: 19129554
LOCATION: Three Rivers, CA

DRILLING START: 2020 March 25 00:00
DRILLING END: 2020 March 25 00:00
COORDINATES: 36.480812,-118.841601

SHEET: 1 of 1
GS ELEV.: 1389.0
TOC ELEV.: na
DATUM: WGS84

DEPTH (ft)	BORING METHOD	SOIL PROFILE: Depth	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: Elev	USCS	GRAPHIC LOG	SAMPLES: SAMPLE TYPE & NUMBER	SAMPLES: BLOWS per 6 in (ASTM D1586 140 lb hammer 30 inch drop)	SAMPLES: REC / ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40)	WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS LABORATORY DATA	ADDITIONAL LAB TESTING
0	9-INCH DIAM. SSA	0.0	FILL, (SC), clayey sand, brown; non-cohesive, dry to moist	1389.0	SC		AS		48/48				
		4.3	Bottom of borehole at 4.3 ft. Groundwater was not encountered drilling. Backfilled with cuttings.	1384.7									
5													
10													
15													
20													
25													
30													

DRILLING CO.: Doulos Environmental
DRILLER: Hal Hansen
DRILL RIG: Mini-Excavator

LOGGED: JHC
CHECKED: RPCE
REVIEWED: RH

GOLDER

BE-TP-3
1 of 1

RECORD OF BOREHOLE BE-TP-4

PROJECT: Sequoia National Park
PROJECT NO.: 19129554
LOCATION: Three Rivers, CA

DRILLING START: 2020 March 25 00:00
DRILLING END: 2020 March 25 00:00
COORDINATES: 36.480897,-118.838884

SHEET: 1 of 1
GS ELEV.: 1379.0
TOC ELEV.: na
DATUM: WGS84

DEPTH (ft)	BORING METHOD	SOIL PROFILE: Depth	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: Elev	USCS	GRAPHIC LOG	SAMPLES: SAMPLE TYPE & NUMBER	SAMPLES: BLOWS per 6 in (ASTM D1586 140 lb hammer 30 inch drop)	SAMPLES: REC / ATT (in)	PENETRATION RESISTANCE BLOWS / ft; WATER CONTENT (%)	NOTES WATER LEVELS LABORATORY DATA	ADDITIONAL LAB TESTING
0		0.0		1379.0								
	9-INCH DIAM. SSA	0.2	2" dark brown to black topsoil with grass and organics	1378.8								
			(SC); clayey sand with gravel, light brown to brown; non-cohesive, dry to moist, boulders up to 12" in diameter		SC		AS		24/24		0 - 2: Sieve: Gravel = 20%, Sand = 48%, Fines = 32%.	
			Becomes orange-brown, dry									
			Becomes harder with depth				AS		12/12		2 - 3: Sieve: Gravel = 28%, Sand = 50%, Fines = 22%.	
		4.2		1374.8								
5			Bottom of borehole at 4.2 ft. Groundwater was not encountered drilling. Backfilled with cuttings.									
10												
15												
20												
25												
30												

DRILLING CO.: Doulos Environmental
DRILLER: Hal Hansen
DRILL RIG: Mini-Excavator

LOGGED: JHC
CHECKED: RPCE
REVIEWED: RH

GOLDER

BE-TP-4
1 of 1

RECORD OF BOREHOLE BE-TP-5

PROJECT: Sequoia National Park
PROJECT NO.: 19129554
LOCATION: Three Rivers, CA

DRILLING START: 2020 March 25 00:00
DRILLING END: 2020 March 25 00:00
COORDINATES: 36.481007,-118.838707

SHEET: 1 of 1
GS ELEV.: 1376.0
TOC ELEV.: na
DATUM: WGS84

DEPTH (ft)	BORING METHOD	SOIL PROFILE: Depth	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: Elev	USCS	GRAPHIC LOG	SAMPLES: SAMPLE TYPE & NUMBER	SAMPLES: BLOWS per 6 in (ASTM D1586 140 lb hammer 30 inch drop)	SAMPLES: REC / ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40)	WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS LABORATORY DATA	ADDITIONAL LAB TESTING
0		0.0		1376.0									
	9-INCH DIAM. SSA	0.2	2" dark brown to black topsoil with grass and organics	1375.8									
			(SC), clayey sand with gravel, light brown to brown; non-cohesive, dry to moist, boulders up to 12" in diameter Becomes orange-brown, dry Becomes harder with depth		SC		AS		48/48			0 - 4: Corrosion: pH = 6.07, Minimum Resistivity = 3750 ohm-cm, Chloride = 8.8 ppm, Sulfate = 37.2 ppm.	
		4.3		1371.8									
5			Bottom of borehole at 4.3 ft. Groundwater was not encountered drilling. Backfilled with cuttings.										
10													
15													
20													
25													
30													

DRILLING CO.: Doulos Environmental
DRILLER: Hal Hansen
DRILL RIG: Mini-Excavator

LOGGED: JHC
CHECKED: RPCE
REVIEWED: RH

GOLDER

BE-TP-5
1 of 1

RECORD OF BOREHOLE BE-TP-6

PROJECT: Sequoia National Park
PROJECT NO.: 19129554
LOCATION: Three Rivers, CA

DRILLING START: 2020 March 25 00:00
DRILLING END: 2020 March 25 00:00
COORDINATES: 36.481121,-118.838502

SHEET: 1 of 1
GS ELEV.: 1368.0
TOC ELEV.: na
DATUM: WGS84

DEPTH (ft)	BORING METHOD	SOIL PROFILE: Depth	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: Elev	USCS	GRAPHIC LOG	SAMPLES: SAMPLE TYPE & NUMBER	SAMPLES: BLOWS per 6 in (ASTM D1586 140 lb hammer 30 inch drop)	SAMPLES: REC / ATT (in)	PENETRATION RESISTANCE BLOWS / ft; WATER CONTENT (%)	NOTES WATER LEVELS LABORATORY DATA	ADDITIONAL LAB TESTING
0		0.0		1368.0						10 20 30 40; W_p W W_l 20 40 60 80		
	9-INCH DIAM. SSA	0.2	2" dark brown to black topsoil with grass and organics	1367.8								
			(SC), clayey sand with gravel, light brown to brown; non-cohesive, dry to moist, boulders up to 12" in diameter Becomes orange-brown, dry Becomes harder with depth		SC		AS		48/48		0 - 4: Sieve: Gravel = 3%, Sand = 64%, Fines = 33%. Atterberg: LL = 30, PL = 16, PI = 14. Moisture: 19.2%.	
		4.4		1363.7								
5			Bottom of borehole at 4.4 ft. Groundwater was not encountered drilling. Backfilled with cuttings.									
10												
15												
20												
25												
30												

DRILLING CO.: Doulos Environmental
DRILLER: Hal Hansen
DRILL RIG: Mini-Excavator

LOGGED: JHC
CHECKED: RPCE
REVIEWED: RH

GOLDER

BE-TP-6
1 of 1

APPENDIX B

Percolation Test Data

Percolation Boring Test Data Sheet

Project Name: HECO SEKI
Project Number: 19129554
Date: 3/26/2020
Location: Buckeye Housing Lined Pond
Boring ID: BE-TP-1

Test hole dimensions	
Boring Depth (feet)*:	4.22
Boring Diameter (inches):	6
Total Pipe Length (feet):	5.0
Pipe Diameter (inches):	1

*measured at time of test

Miscellaneous Test Details	
Liquid Description:	Clean water
Measurement Method:	Water level sounder
Depth to Water Table:	Unknown, not encountered
Water Remaining In Boring:	Yes
Tested By:	J. Consoli
Checked By:	RP Erickson

Pre-Soak/Pre-Test

Reading No.	Date	Start Time	Stop Time	Time Interval (min)	Initial Depth to Water (feet)	Final Depth to Water (feet)	Total Change in Water Level (feet)	Comments
Pre-Test	3/25/2020	15:44	16:34	50.0	2.81	3.34	0.53	No water in hole
Pre-Test	3/26/2020	9:25			4.55			

Percolation Test Data

Reading No.	Start Time	Stop Time	Time Interval, Δt (min)	Initial Depth to Water, D_o (feet)	Final Depth to Water, D_f (feet)	Change in Water Level, ΔD (inches)	% Change from Prior Reading	Percolation Rate (in/hr)	Percolation Rate (min/in)
1	9:50	10:20	30.0	3.22	3.46	2.88		5.8	10.4
2	10:20	10:50	30.0	3.46	3.59	1.56	46%	3.1	19.2
3	10:50	11:20	30.0	3.59	3.66	0.84	46%	1.7	35.7
4	11:20	11:50	30.0	3.66	3.71	0.60	29%	1.2	50.0
5	11:50	12:20	30.0	3.71	3.76	0.60	0%	1.2	50.0
6	12:20	12:50	30.0	3.07	3.24	2.04	240%	4.1	14.7
7	12:50	13:20	30.0	3.24	3.36	1.44	29%	2.9	20.8
8	13:20	13:50	30.0	3.36	3.46	1.20	17%	2.4	25.0

Percolation Test Results

Percolation Rate (minutes/inch): 50.00

Percolation Boring Test Data Sheet

Project Name: HECO SEKI
Project Number: 19129554
Date: 3/26/2020
Location: Buckeye Housing Lined Pond
Boring ID: BE-TP-2

Test hole dimensions	
Boring Depth (feet)*:	4.32
Boring Diameter (inches):	6
Total Pipe Length (feet):	5.0
Pipe Diameter (inches):	1

*measured at time of test

Miscellaneous Test Details	
Liquid Description:	Clean water
Measurement Method:	Water level sounder
Depth to Water Table:	Unknown, not encountered
Water Remaining In Boring:	Yes
Tested By:	J. Consoli
Checked By:	RP Erickson

Pre-Soak/Pre-Test

Reading No.	Date	Start Time	Stop Time	Time Interval (min)	Initial Depth to Water (feet)	Final Depth to Water (feet)	Total Change in Water Level (feet)	Comments
Pre-Test	3/25/2020	15:48	16:37	49.0	0.87	2.28	1.41	Hole almost full with water
Pre-Test	3/26/2020	9:29			2.73			

Percolation Test Data

Reading No.	Start Time	Stop Time	Time Interval, Δt (min)	Initial Depth to Water, D_o (feet)	Final Depth to Water, D_f (feet)	Change in Water Level, ΔD (inches)	% Change from Prior Reading	Percolation Rate (in/hr)	Percolation Rate (min/in)
1	9:52	10:22	30.0	2.73	2.76	0.36		0.7	83.3
2	10:22	10:52	30.0	2.76	2.79	0.36	0%	0.7	83.3
3	10:52	11:22	30.0	2.76	2.80	0.48	33%	1.0	62.5
4	11:22	11:52	30.0	2.80	2.80	0.00	100%	0.0	Cannot Calculate
5	11:52	12:22	30.0	2.80	2.80	0.00	0%	0.0	Cannot Calculate
6	12:22	12:52	30.0	2.80	2.80	0.00	0%	0.0	Cannot Calculate
7	12:52	13:22	30.0	2.80	2.80	0.00	0%	0.0	Cannot Calculate
8	13:22	13:52	30.0	2.80	2.80	0.00	0%	0.0	Cannot Calculate

Percolation Test Results

Percolation Rate (minutes/inch): Cannot Calculate

Percolation Boring Test Data Sheet

Project Name: HECO SEKI
Project Number: 19129554
Date: 3/26/2020
Location: Buckeye Housing Lined Pond
Boring ID: BE-TP-3

Test hole dimensions	
Boring Depth (feet)*:	4.28
Boring Diameter (inches):	9
Total Pipe Length (feet):	5.0
Pipe Diameter (inches):	1

*measured at time of test

Miscellaneous Test Details	
Liquid Description:	Clean water
Measurement Method:	Water level sounder
Depth to Water Table:	Unknown, not encountered
Water Remaining In Boring:	Yes
Tested By:	J. Consoli
Checked By:	RP Erickson

Pre-Soak/Pre-Test

Reading No.	Date	Start Time	Stop Time	Time Interval (min)	Initial Depth to Water (feet)	Final Depth to Water (feet)	Total Change in Water Level (feet)	Comments
Pre-Test	3/25/2020	15:40	16:39	59.0	2.86	3.01	0.15	No water in hole
Pre-Test	3/26/2020	9:35			3.09			

Percolation Test Data

Reading No.	Start Time	Stop Time	Time Interval, Δt (min)	Initial Depth to Water, D_o (feet)	Final Depth to Water, D_f (feet)	Change in Water Level, ΔD (inches)	% Change from Prior Reading	Percolation Rate (in/hr)	Percolation Rate (min/in)
1	9:54	10:24	30	3.09	3.20	1.32		2.6	22.7
2	10:24	10:54	30	3.20	3.20	0.00	100%	0.0	Cannot Calculate
3	10:54	11:24	30	3.20	3.20	0.00	0%	0.0	Cannot Calculate
4	11:24	11:54	30	3.20	3.20	0.00	0%	0.0	Cannot Calculate
5	11:54	12:24	30	3.20	3.21	0.12	Cannot Calculate	0.2	250.0
6	12:24	12:54	30	3.21	3.21	0.00	100%	0.0	Cannot Calculate
7	12:54	13:25	31	3.02	3.02	0.00	0%	0.0	Cannot Calculate
8	13:25	13:55	30	3.02	3.03	0.12	Cannot Calculate	0.2	250.0

Percolation Test Results

Percolation Rate (minutes/inch): Cannot Calculate

Percolation Boring Test Data Sheet

Project Name: HECO SEKI
Project Number: 19129554
Date: 3/26/2020
Location: Buckeye Housing Unlined Pond
Boring ID: BE-TP-4

Test hole dimensions	
Boring Depth (feet)*:	4.20
Boring Diameter (inches):	9
Total Pipe Length (feet):	5.0
Pipe Diameter (inches):	1

*measured at time of test

Miscellaneous Test Details	
Liquid Description:	Clean water
Measurement Method:	Water level sounder
Depth to Water Table:	Unknown, not encountered
Water Remaining In Boring:	Yes
Tested By:	J. Consoli
Checked By:	RP Erickson

Pre-Soak/Pre-Test

Reading No.	Date	Start Time	Stop Time	Time Interval (min)	Initial Depth to Water (feet)	Final Depth to Water (feet)	Total Change in Water Level (feet)	Comments
Pre-Test	3/25/2020	15:18	16:06	48	3.26	3.18	-0.08	No water in hole
Pre-Test	3/26/2020	8:52			3.28			

Percolation Test Data

Reading No.	Start Time	Stop Time	Time Interval, Δt (min)	Initial Depth to Water, D_o (feet)	Final Depth to Water, D_f (feet)	Change in Water Level, ΔD (inches)	% Change from Prior Reading	Percolation Rate (in/hr)	Percolation Rate (min/in)
1	10:00	10:30	30	3.28	3.29	0.12		0.2	250.0
2	10:30	11:00	30	3.29	3.29	0.00	100%	0.0	Cannot Calculate
3	11:00	11:30	30	3.29	3.29	0.00	0%	0.0	Cannot Calculate
4	11:30	12:00	30	3.29	3.29	0.00	0%	0.0	Cannot Calculate
5	12:00	12:30	30	3.29	3.29	0.00	0%	0.0	Cannot Calculate
6	12:30	13:00	30	3.29	3.29	0.00	0%	0.0	Cannot Calculate
7	13:00	13:30	30	3.29	3.29	0.00	0%	0.0	Cannot Calculate
8	13:33	14:03	30	2.48	2.48	0.00	0%	0.0	Cannot Calculate

Percolation Test Results

Percolation Rate (minutes/inch): Cannot Calculate

Percolation Boring Test Data Sheet

Project Name: HECO SEKI
Project Number: 19129554
Date: 3/26/2020
Location: Buckeye Housing Unlined Pond
Boring ID: BE-TP-5

Test hole dimensions	
Boring Depth (feet)*:	4.25
Boring Diameter (inches):	9
Total Pipe Length (feet):	5.0
Pipe Diameter (inches):	1

*measured at time of test

Miscellaneous Test Details	
Liquid Description:	Clean water
Measurement Method:	Water level sounder
Depth to Water Table:	Unknown, not encountered
Water Remaining In Boring:	Yes
Tested By:	J. Consoli
Checked By:	RP Erickson

Pre-Soak/Pre-Test

Reading No.	Date	Start Time	Stop Time	Time Interval (min)	Initial Depth to Water (feet)	Final Depth to Water (feet)	Total Change in Water Level (feet)	Comments
Pre-Test	3/25/2020	15:11	16:10	59	2.36	2.36	0	Some water in hole
Pre-Test	3/26/2020	8:47			1.50			

Percolation Test Data

Reading No.	Start Time	Stop Time	Time Interval, Δt (min)	Initial Depth to Water, D_o (feet)	Final Depth to Water, D_f (feet)	Change in Water Level, ΔD (inches)	% Change from Prior Reading	Percolation Rate (in/hr)	Percolation Rate (min/in)
1	10:02	10:32	30	1.51	1.52	0.12		0.2	250.0
2	10:32	11:02	30	1.52	1.53	0.12	0%	0.2	250.0
3	11:02	11:32	30	1.53	1.54	0.12	0%	0.2	250.0
4	11:32	12:02	30	1.54	1.54	0.00	100%	0.0	Cannot Calculate
5	12:02	12:32	30	1.54	1.54	0.00	0%	0.0	Cannot Calculate
6	12:32	13:02	30	1.54	1.54	0.00	0%	0.0	Cannot Calculate
7	13:02	13:36	34	1.54	1.54	0.00	0%	0.0	Cannot Calculate
8	13:36	14:06	30	1.54	1.54	0.00	0%	0.0	Cannot Calculate

Percolation Test Results

Percolation Rate (minutes/inch): 250.00

Percolation Boring Test Data Sheet

Project Name: HECO SEKI
Project Number: 19129554
Date: 3/26/2020
Location: Buckeye Housing Unlined Pond
Boring ID: BE-TP-6

Test hole dimensions	
Boring Depth (feet)*:	4.35
Boring Diameter (inches):	9
Total Pipe Length (feet):	5.0
Pipe Diameter (inches):	1

*measured at time of test

Miscellaneous Test Details	
Liquid Description:	Clean water
Measurement Method:	Water level sounder
Depth to Water Table:	Unknown, not encountered
Water Remaining In Boring:	Yes
Tested By:	J. Consoli
Checked By:	RP Erickson

Pre-Soak/Pre-Test

Reading No.	Date	Start Time	Stop Time	Time Interval (min)	Initial Depth to Water (feet)	Final Depth to Water (feet)	Total Change in Water Level (feet)	Comments
Pre-Test	3/25/2020	15:07	16:14	67	1.58	1.75	0.17	Some water in hole
Pre-Test	3/26/2020	8:37			1.67			

Percolation Test Data

Reading No.	Start Time	Stop Time	Time Interval, Δt (min)	Initial Depth to Water, D_o (feet)	Final Depth to Water, D_f (feet)	Change in Water Level, ΔD (inches)	% Change from Prior Reading	Percolation Rate (in/hr)	Percolation Rate (min/in)
1	10:04	10:34	30	1.68	1.68	0.00		0.0	Cannot Calculate
2	10:34	11:04	30	1.68	1.68	0.00	0%	0.0	Cannot Calculate
3	11:04	11:34	30	1.68	1.68	0.00	0%	0.0	Cannot Calculate
4	11:34	12:04	30	1.68	1.68	0.00	0%	0.0	Cannot Calculate
5	12:04	12:34	30	1.68	1.68	0.00	0%	0.0	Cannot Calculate
6	12:34	13:04	30	1.68	1.68	0.00	0%	0.0	Cannot Calculate
7	13:12	13:39	27	1.14	1.44	3.60	Cannot Calculate	8.0	7.5
8	13:39	14:09	30	1.44	1.51	0.84	77%	1.7	35.7

Percolation Test Results

Percolation Rate (minutes/inch): Cannot Calculate

APPENDIX C

Geotechnical Laboratory Testing Results

MOISTURE CONTENT TEST RESULTS

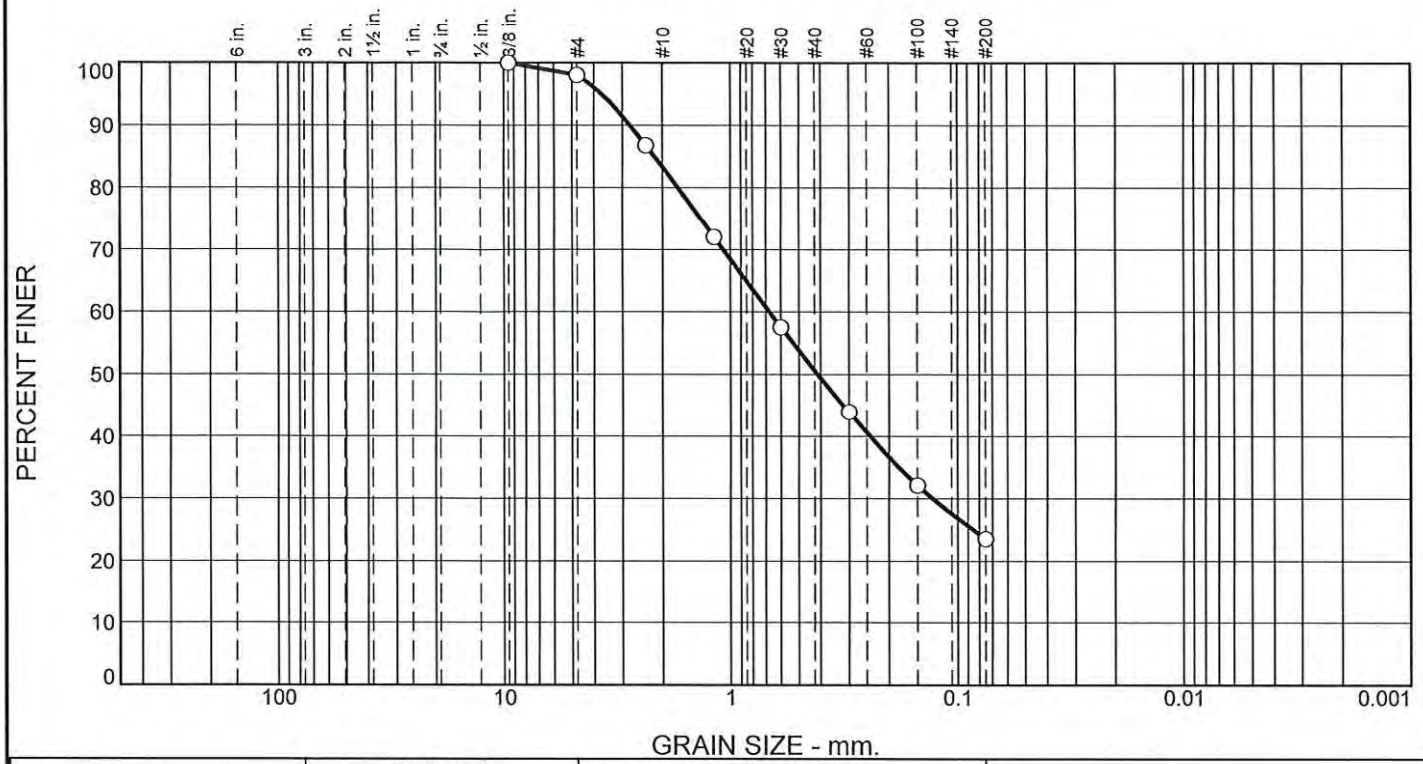
Sample Identification	Depth, ft.	Moisture Content, %
BE-TP-1	0.5'-4'	9.6
BE-TP-6	0'-4'	19.2
AM-B-1	12.5'-14'	5.2
AM-B-2	10'-11.5'	4.0
AM-B-5	5'-6.5'	12.5

Test Method: ASTM D2216

PROJECT NUMBER:	20-141	April 6, 2020	HECO SEKI

GULF SHORE EXPLORATION AND TESTING
3362 Fitzgerald Road
Rancho Cordova, CA 95742
Phone: (916) 939-4117
FAX: (916) 635-4315

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
0	0	2	15	32	27	24

Test Results (ASTM D6913 & ASTM D1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3/8 Inch	100		
#4	98		
#8	87		
#16	72		
#30	58		
#50	44		
#100	32		
#200	24		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= 16 LL= 25 PI= 9

Classification

USCS (D 2487)= SC AASHTO (M 145)= A-2-4(0)

Coefficients

D_{90}= 2.7758 D_{85}= 2.1638 D_{60}= 0.6748
D_{50}= 0.4119 D_{30}= 0.1285 D_{15}=
D_{10}= C_u= C_c=

Remarks

F.M.=2.10

Date Received: 4/1/20 **Date Tested:** 4/3/20

Tested By: RC

Checked By: JML

Title: PM

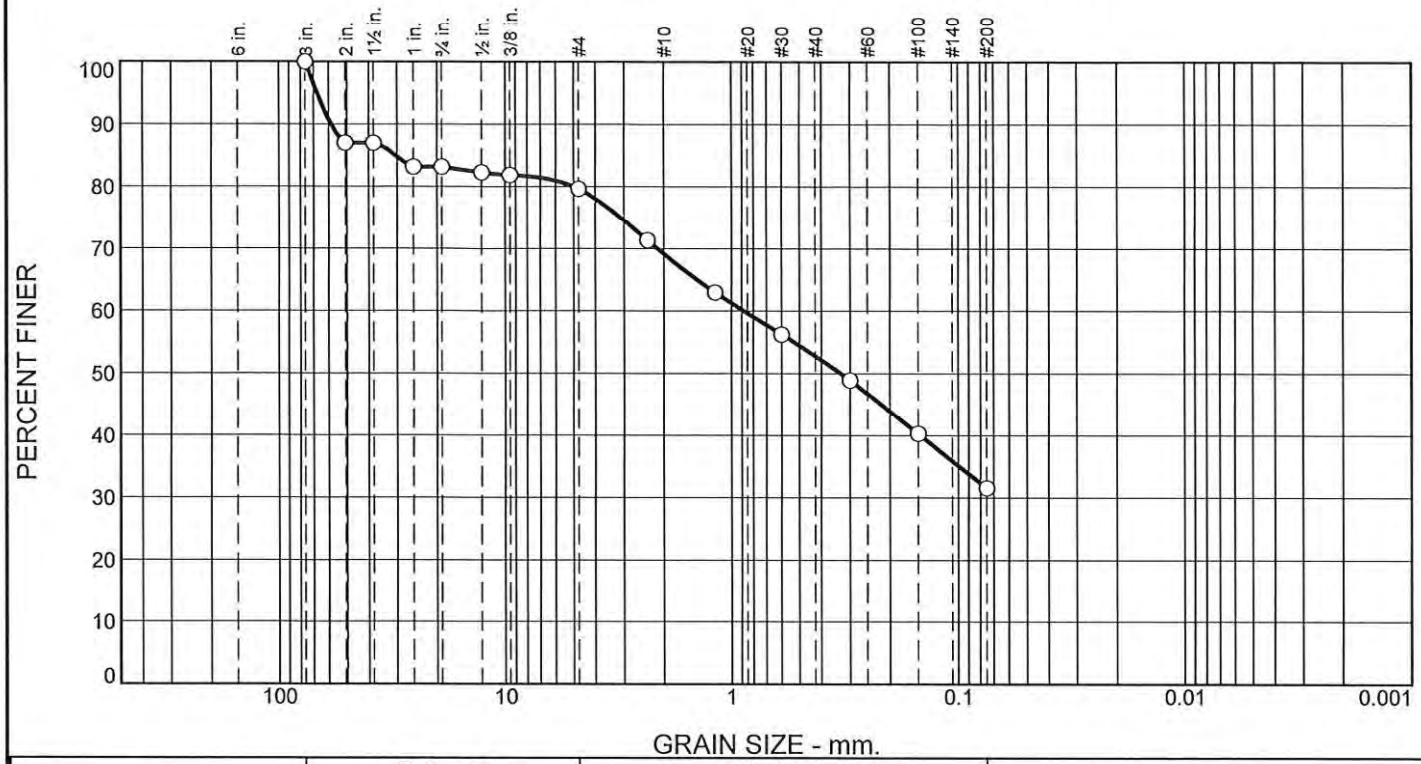
Location: BE-TP-1 **Date Sampled:** -
Sample Number: 50636 **Depth:** 0.5'-4'

GULF SHORE EXPLORATION AND TESTING

Client: Golder Associates
Project: HECO SEKI

Project No: 20-141 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
0	17	3	11	16	21	32

Test Results (ASTM D6913 & ASTM D1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3 Inch	100		
2 Inch	87		
1 1/2 Inch	87		
1 Inch	83		
3/4 Inch	83		
1/2 Inch	82		
3/8 Inch	82		
#4	80		
#8	71		
#16	63		
#30	56		
#50	49		
#100	40		
#200	32		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS (D 2487)= AASHTO (M 145)=

Coefficients

D_{90}= 58.7506 D_{85}= 30.4266 D_{60}= 0.8813
D_{50}= 0.3291 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

F.M.=2.89

Date Received: 4/1/20 **Date Tested:** 4/3/20

Tested By: RC

Checked By: JML

Title: PM

Location: BE-TP-4
Sample Number: 50637 **Depth:** 0'-2'

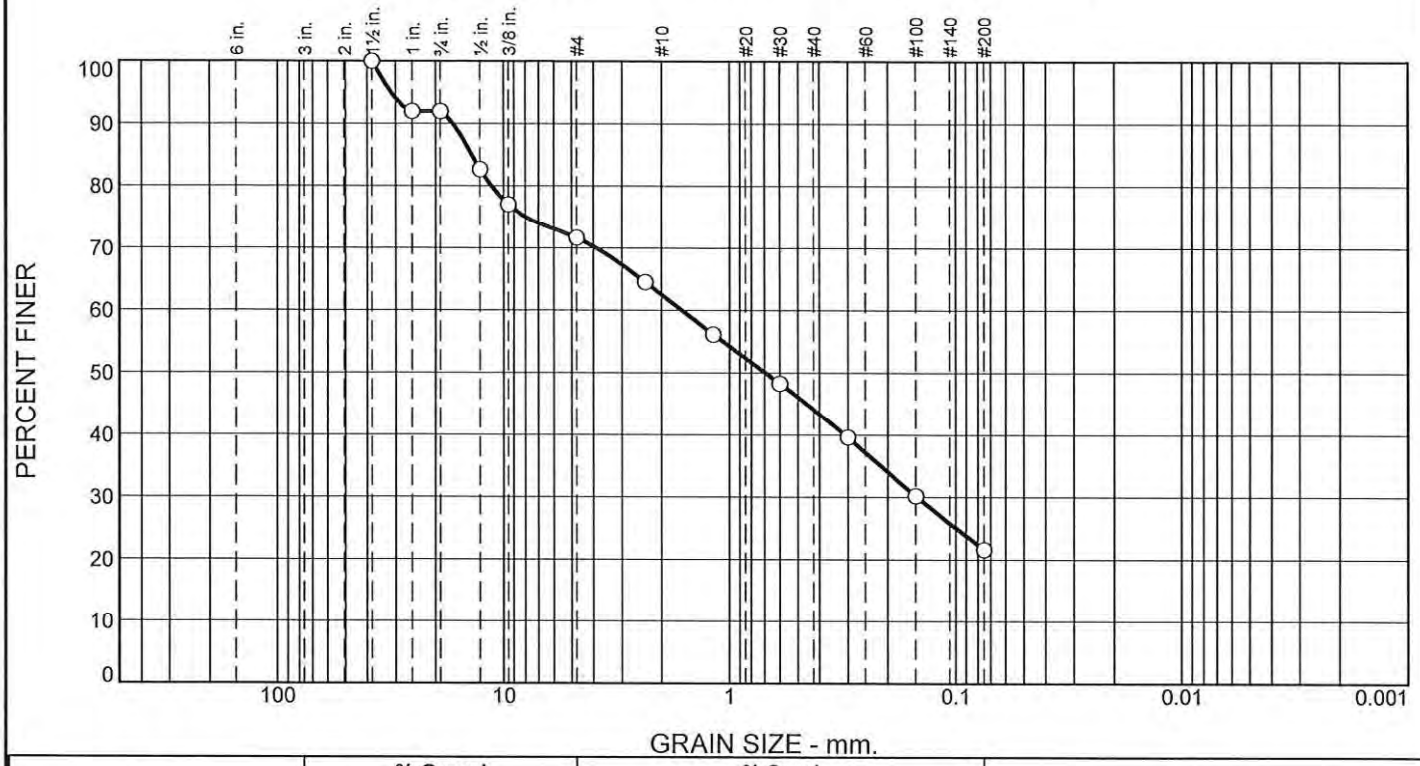
Date Sampled: -

GULF SHORE EXPLORATION AND TESTING

Client: Golder Associates
Project: HECO SEKI

Project No: 20-141 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
0	8	20	9	19	22	22

Test Results (ASTM D6913 & ASTM D1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1 1/2 Inch	100		
1 Inch	92		
3/4 Inch	92		
1/2 Inch	83		
3/8 Inch	77		
#4	72		
#8	65		
#16	56		
#30	48		
#50	40		
#100	30		
#200	22		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS (D 2487)= AASHTO (M 145)=

Coefficients

D_{90}= 16.7647 D_{85}= 13.8554 D_{60}= 1.6245
D_{50}= 0.6939 D_{30}= 0.1478 D_{15}=
D_{10}= C_u= C_c=

Remarks

F.M.=3.21

Date Received: 4/1/20 **Date Tested:** 4/8/20

Tested By: JB

Checked By: JML

Title: PM

Location: BE-TP-4
Sample Number: 50638 **Depth:** 2'-3'

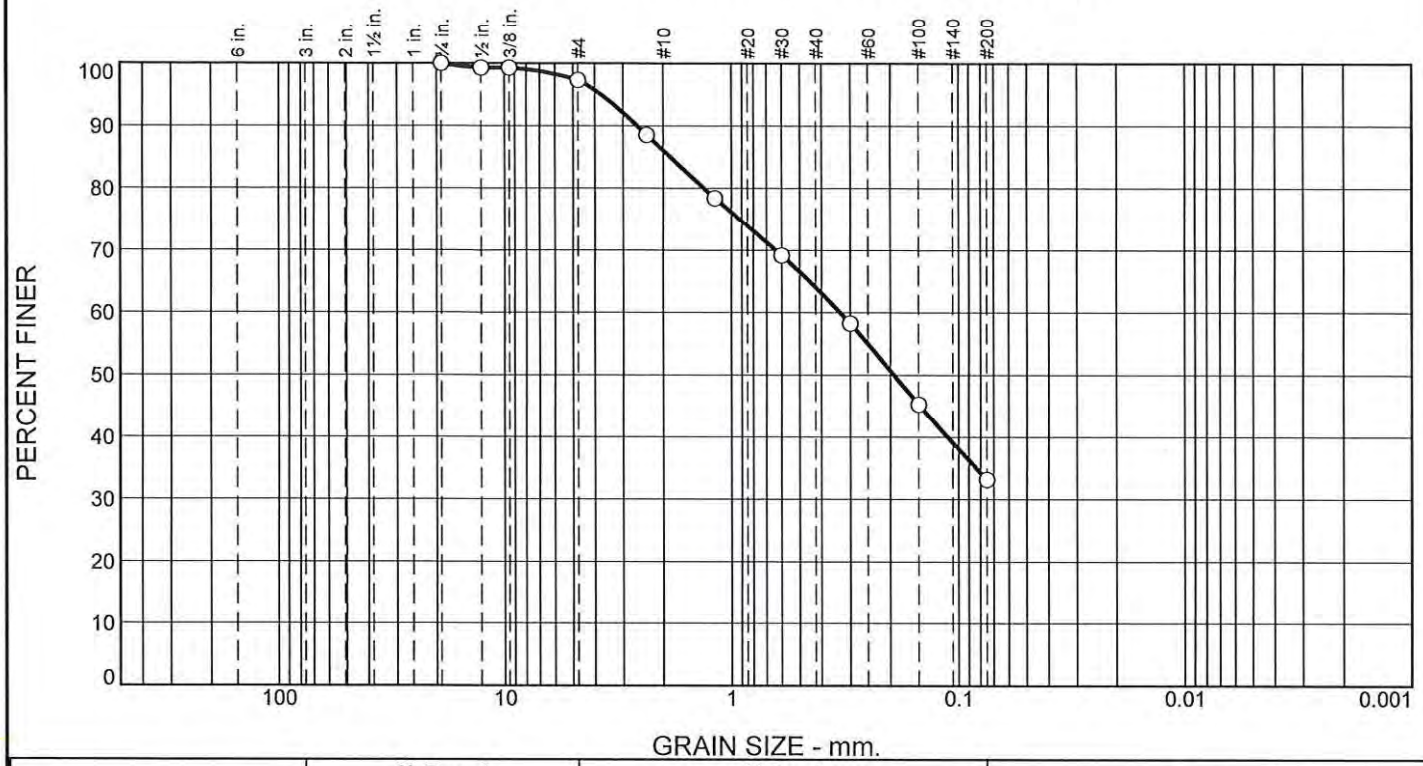
Date Sampled: -

GULF SHORE EXPLORATION AND TESTING

Client: Golder Associates
Project: HECO SEKI

Project No: 20-141 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
0	0	3	11	22	31	33

Test Results (ASTM D6913 & ASTM D1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3/4 Inch	100		
1/2 Inch	99		
3/8 Inch	99		
#4	97		
#8	89		
#16	78		
#30	69		
#50	58		
#100	45		
#200	33		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= 16 LL= 30 PI= 14

Classification

USCS (D 2487)= SC AASHTO (M 145)= A-2-6(1)

Coefficients

D_{90}= 2.5992 D_{85}= 1.8586 D_{60}= 0.3312
D_{50}= 0.1922 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

F.M.=1.64

Date Received: 4/1/20 **Date Tested:** 4/3/20

Tested By: RC

Checked By: JML

Title: PM

Location: BE-TP-6
Sample Number: 50639 **Depth:** 0'-4'

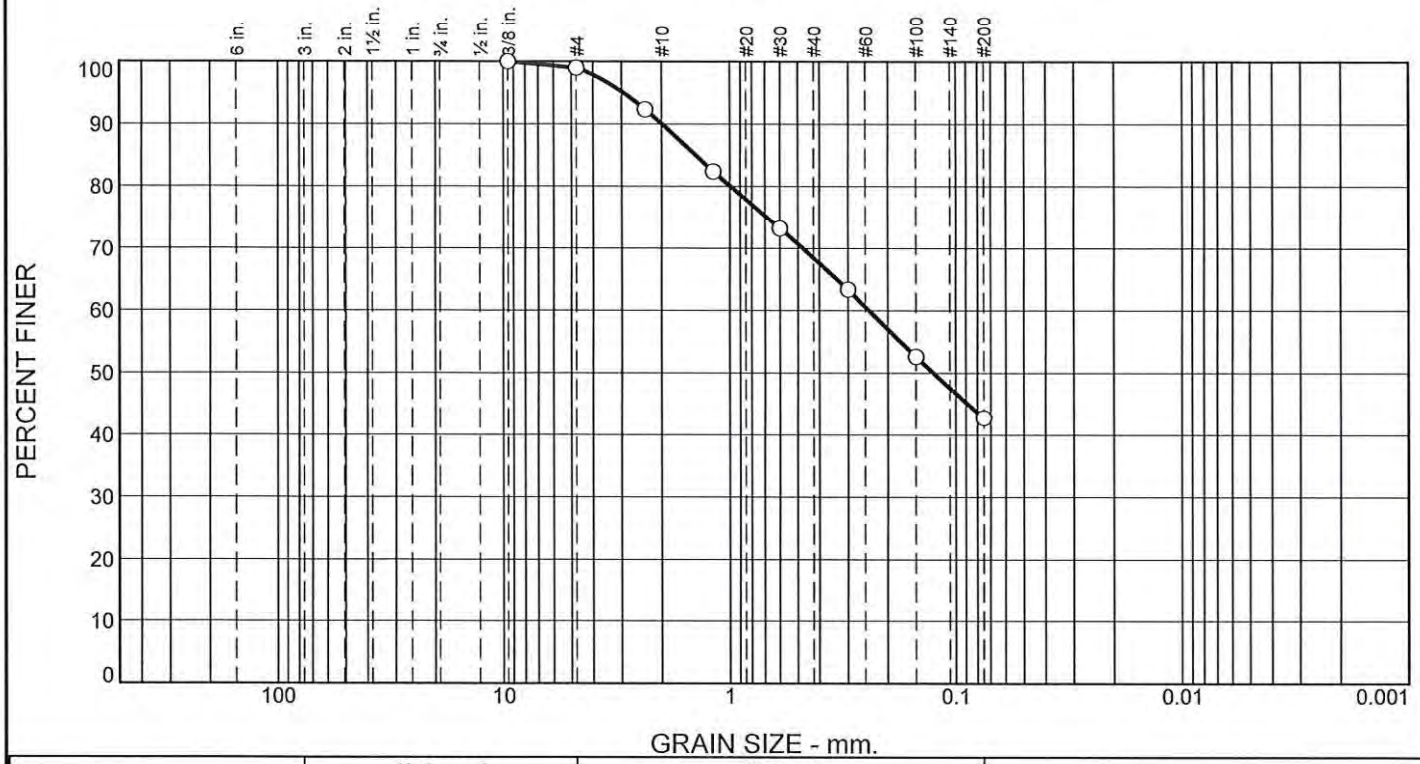
Date Sampled: -

GULF SHORE EXPLORATION AND TESTING

Client: Golder Associates
Project: HECO SEKI

Project No: 20-141 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
0	0	1	9	22	25	43

Test Results (ASTM D6913 & ASTM D1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3/8 Inch	100		
#4	99		
#8	92		
#16	82		
#30	73		
#50	63		
#100	53		
#200	43		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS (D 2487)= AASHTO (M 145)=

Coefficients

D_{90}= 1.9898 D_{85}= 1.4106 D_{60}= 0.2411
D_{50}= 0.1255 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

F.M.=1.37

Date Received: 4/1/20 **Date Tested:** 4/8/20

Tested By: JB

Checked By: JML

Title: PM

Location: BE-B-1
Sample Number: 50640 **Depth:** 10'-11.5'

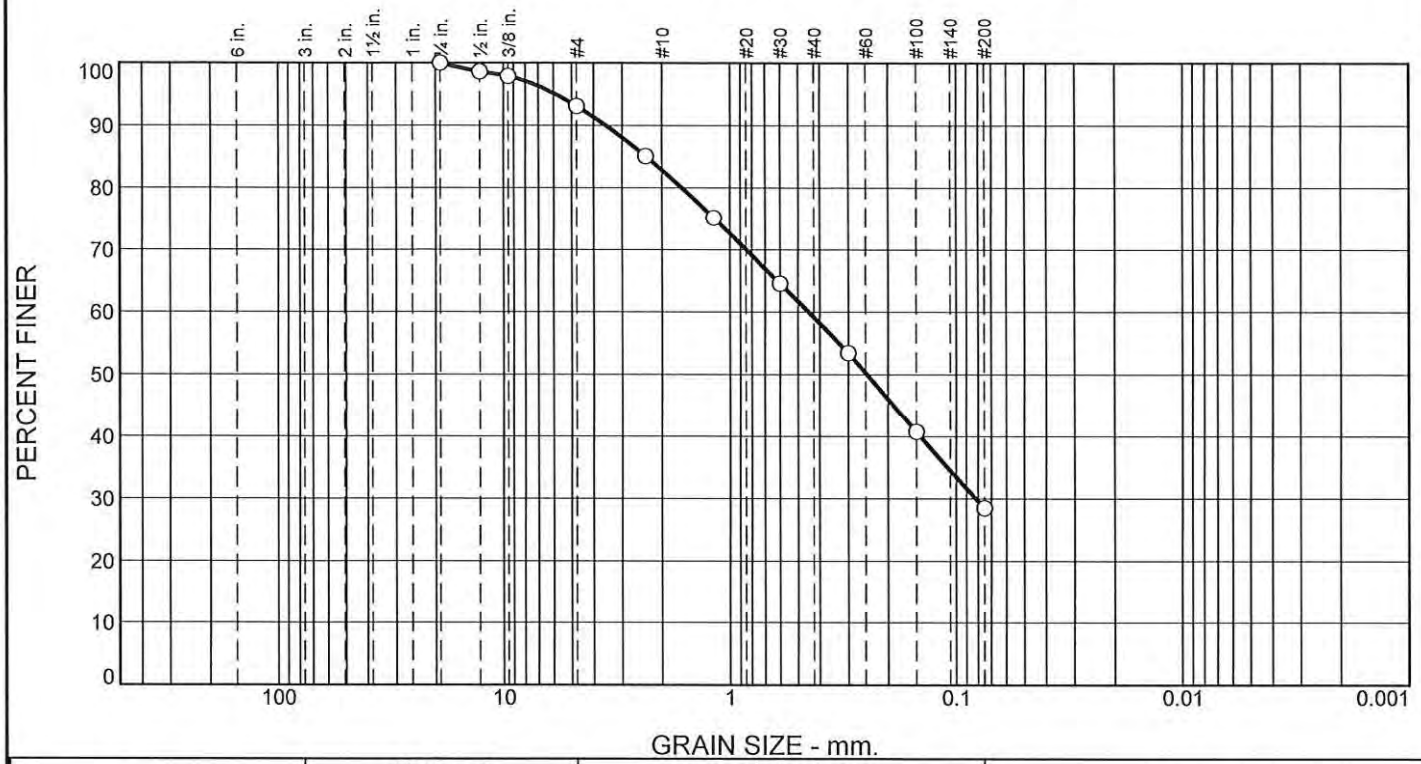
Date Sampled: -

GULF SHORE EXPLORATION AND TESTING

Client: Golder Associates
Project: HECO SEKI

Project No: 20-141 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
0	0	7	10	24	31	28

Test Results (ASTM D6913 & ASTM D1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3/4 Inch	100		
1/2 Inch	99		
3/8 Inch	98		
#4	93		
#8	85		
#16	75		
#30	65		
#50	53		
#100	41		
#200	28		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS (D 2487)= AASHTO (M 145)=

Coefficients

D_{90}= 3.5378 D_{85}= 2.3459 D_{60}= 0.4478
D_{50}= 0.2468 D_{30}= 0.0818 D_{15}=
D_{10}= C_u= C_c=

Remarks

F.M.=1.90

Date Received: 4/1/20 **Date Tested:** 4/8/20

Tested By: JB

Checked By: JML

Title: PM

Location: BE-B-2
Sample Number: 50641 **Depth:** 10'-11.5'

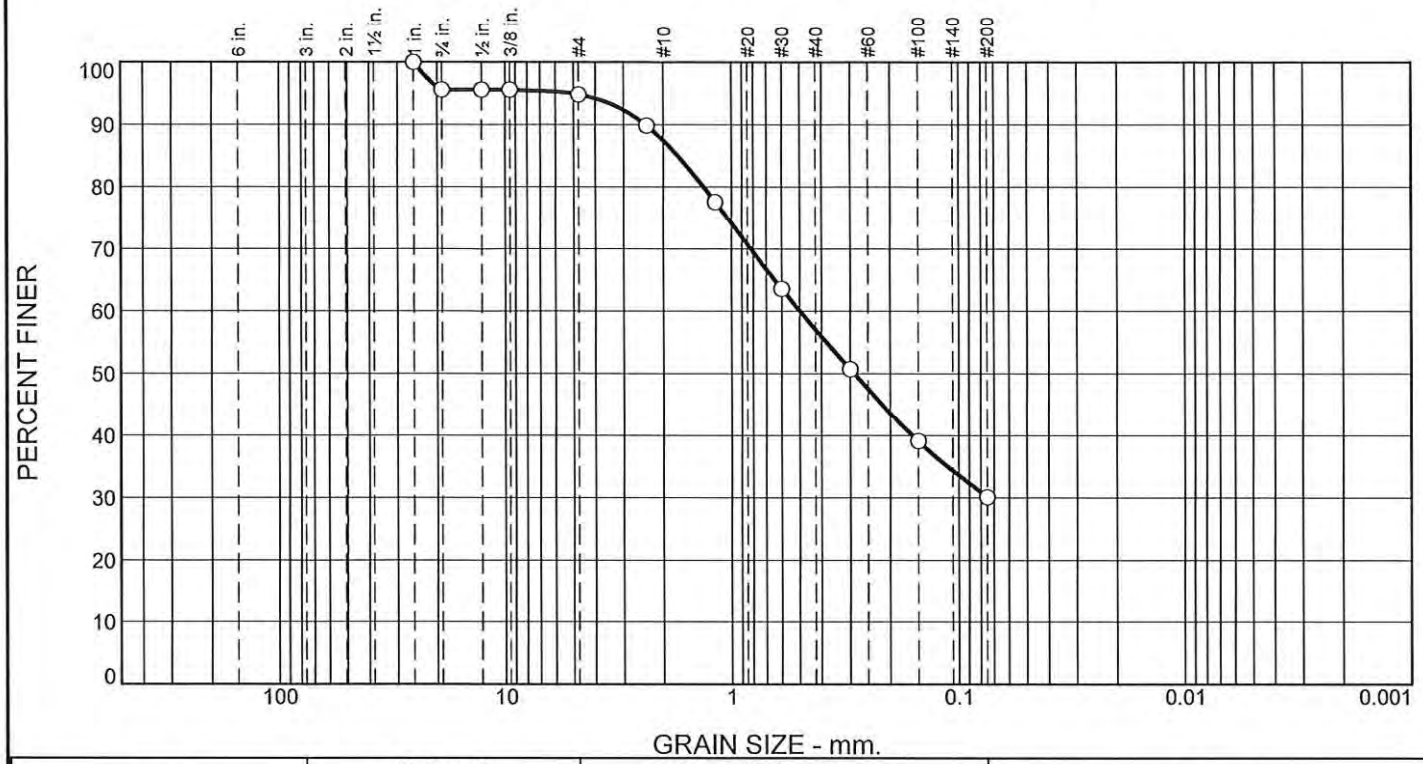
Date Sampled: -

GULF SHORE EXPLORATION AND TESTING

Client: Golder Associates
Project: HECO SEKI

Project No: 20-141 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
0	4	1	8	30	27	30

Test Results (ASTM D6913 & ASTM D1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1 Inch	100		
3/4 Inch	96		
1/2 Inch	96		
3/8 Inch	96		
#4	95		
#8	90		
#16	78		
#30	64		
#50	51		
#100	39		
#200	30		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS (D 2487)= AASHTO (M 145)=

Coefficients

D_{90}= 2.3930 D_{85}= 1.7259 D_{60}= 0.4986
D_{50}= 0.2876 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

F.M.=1.93

Date Received: 4/1/20 **Date Tested:** 4/6/20

Tested By: JB

Checked By: JML

Title: PM

Location: AM-B-1
Sample Number: 50644 **Depth:** 5'-6.5'

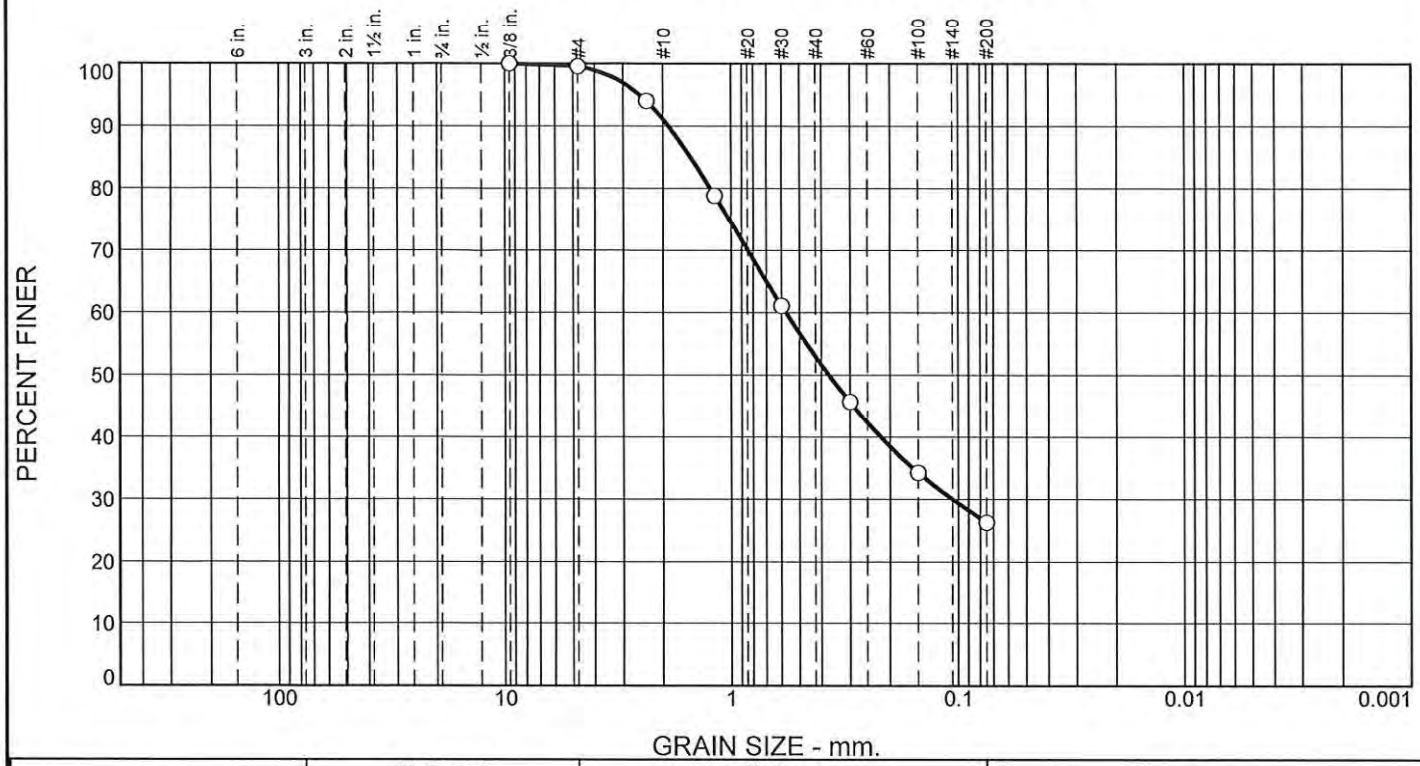
Date Sampled: -

GULF SHORE EXPLORATION AND TESTING

Client: Golder Associates
Project: HECO SEKI

Project No: 20-141 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
0	0	0	9	38	27	26

Test Results (ASTM D6913 & ASTM D1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3/8 Inch	100		
#4	100		
#8	94		
#16	79		
#30	61		
#50	46		
#100	34		
#200	26		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= 16 LL= 29 PI= 13

Classification

USCS (D 2487)= SC AASHTO (M 145)= A-2-6(0)

Coefficients

D_{90}= 1.8876 D_{85}= 1.5074 D_{60}= 0.5733
D_{50}= 0.3707 D_{30}= 0.1058 D_{15}=
D_{10}= C_u= C_c=

Remarks

F.M.=1.86

Date Received: 4/1/20 **Date Tested:** 4/6/20

Tested By: JB

Checked By: JML

Title: PM

Location: AM-B-1 **Date Sampled:** -

Sample Number: 50645 **Depth:** 12.5'-14'

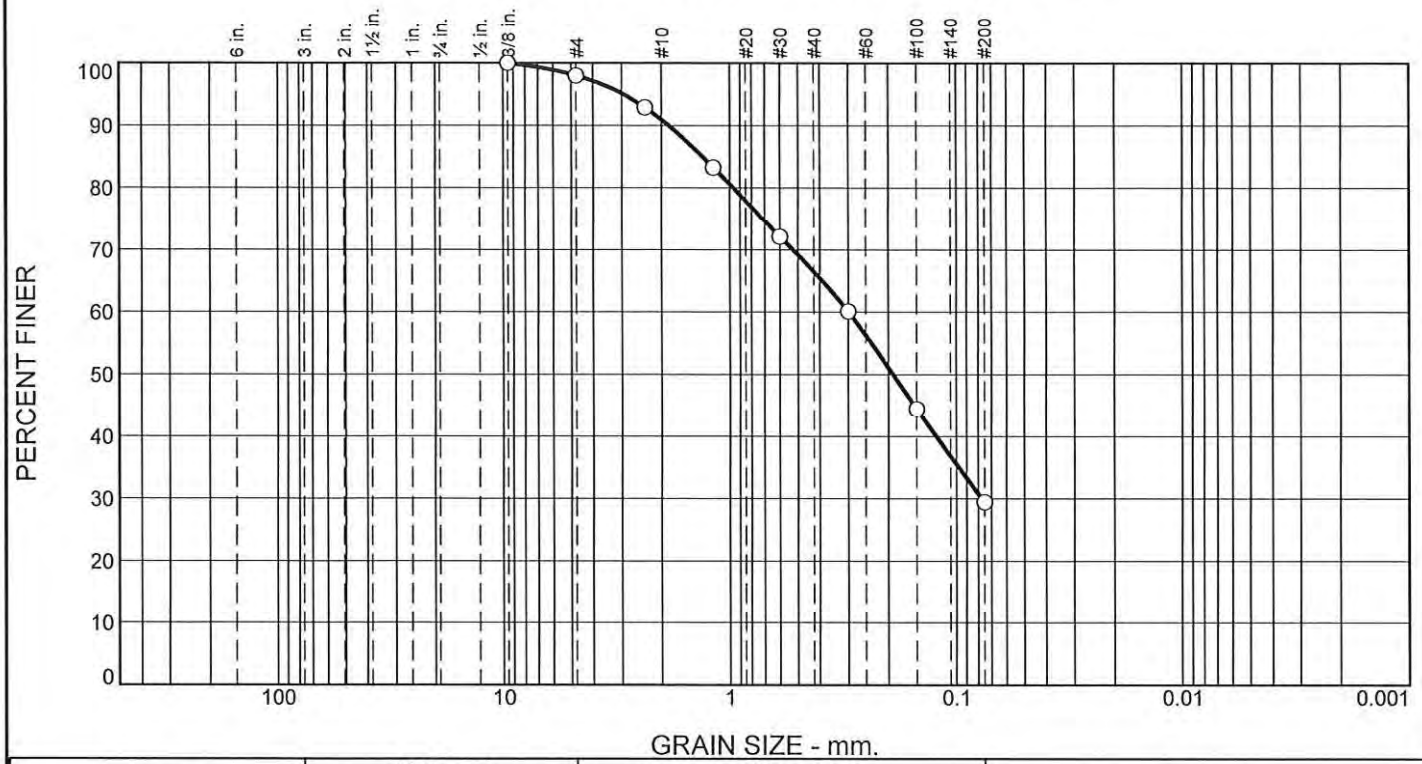
GULF SHORE EXPLORATION AND TESTING

Client: Golder Associates

Project: HECO SEKI

Project No: 20-141 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
0	0	2	7	25	37	29

Test Results (ASTM D6913 & ASTM D1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3/8 Inch	100		
#4	98		
#8	93		
#16	83		
#30	72		
#50	60		
#100	44		
#200	29		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS (D 2487)= AASHTO (M 145)=

Coefficients

D_{90}= 1.8569 D_{85}= 1.3148 D_{60}= 0.2980
D_{50}= 0.1902 D_{30}= 0.0771 D_{15}=
D_{10}= C_u= C_c=

Remarks

F.M.=1.49

Date Received: 4/1/20 **Date Tested:** 4/8/20

Tested By: JB

Checked By: JML

Title: PM

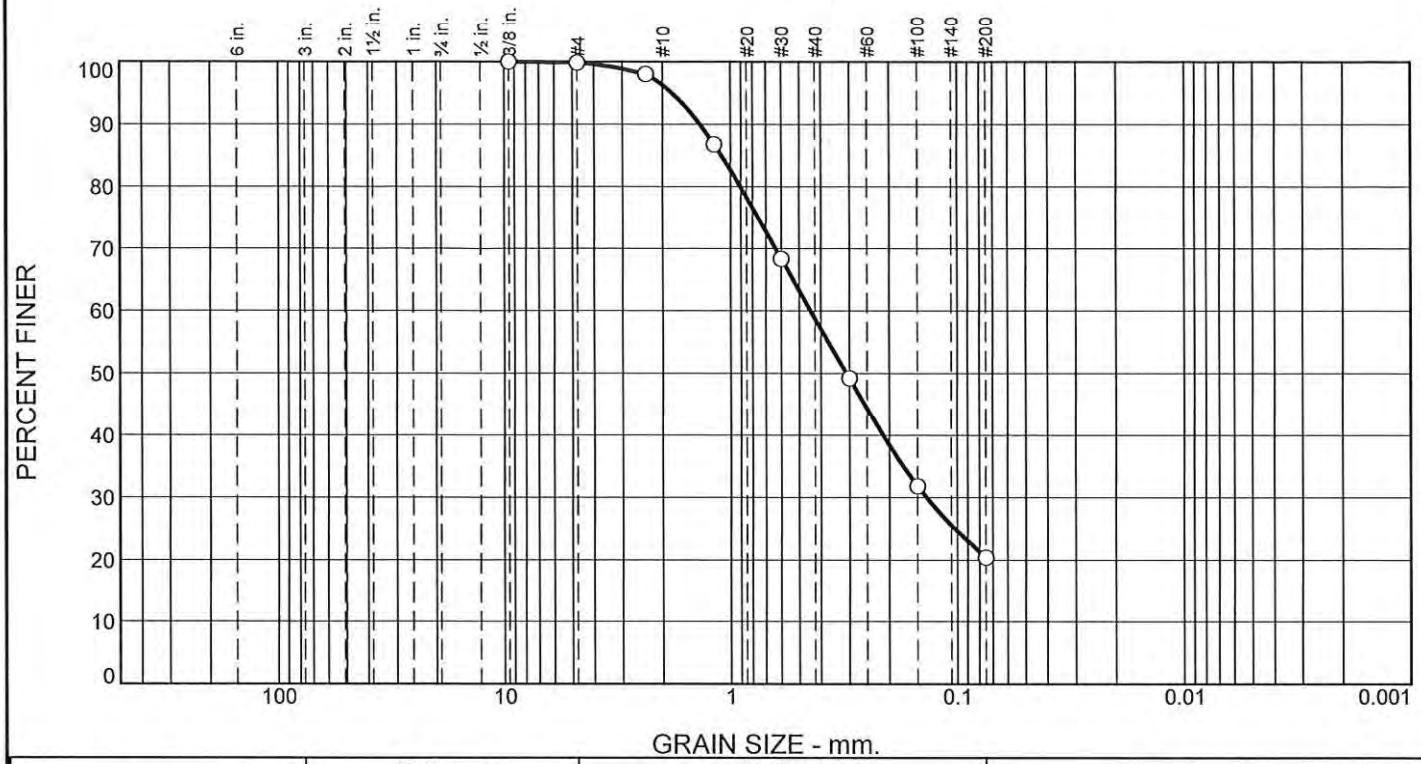
Location: AM-B-1A **Date Sampled:** -
Sample Number: 50646 **Depth:** 10'-11.5'

GULF SHORE EXPLORATION AND TESTING

Client: Golder Associates
Project: HECO SEKI

Project No: 20-141 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
0	0	0	4	37	39	20

Test Results (ASTM D6913 & ASTM D1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3/8 Inch	100		
#4	100		
#8	98		
#16	87		
#30	68		
#50	49		
#100	32		
#200	20		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SM AASHTO (M 145)= A-2-4(0)

Coefficients

D_{90}= 1.3657 D_{85}= 1.0962 D_{60}= 0.4452
D_{50}= 0.3088 D_{30}= 0.1368 D_{15}=
D_{10}= C_u= C_c=

Remarks

F.M.=1.66

Date Received: 4/1/20 **Date Tested:** 4/6/20

Tested By: JB

Checked By: JML

Title: PM

Location: AM-B-2
Sample Number: 50647 **Depth:** 10'-11.5'

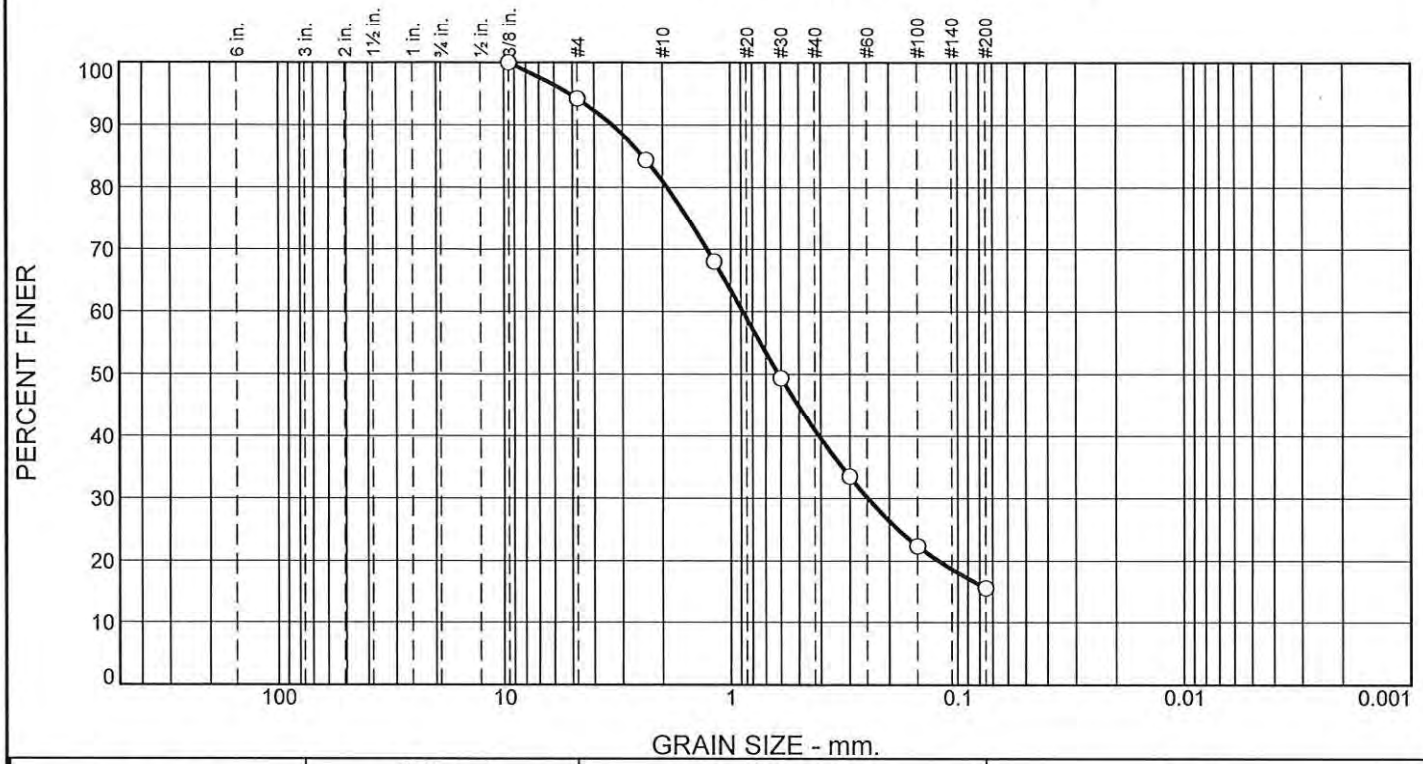
Date Sampled: -

GULF SHORE EXPLORATION AND TESTING

Client: Golder Associates
Project: HECO SEKI

Project No: 20-141 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
0	0	6	13	40	25	16

Test Results (ASTM D6913 & ASTM D1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3/8 Inch	100		
#4	94		
#8	84		
#16	68		
#30	49		
#50	34		
#100	22		
#200	16		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS (D 2487)= AASHTO (M 145)=

Coefficients

D_{90}= 3.3333 D_{85}= 2.4375 D_{60}= 0.8834
D_{50}= 0.6140 D_{30}= 0.2482 D_{15}=
D_{10}= C_u= C_c=

Remarks

F.M.=2.48

Date Received: 4/1/20 **Date Tested:** 4/6/20

Tested By: JB

Checked By: JML

Title: PM

Location: AM-B-4
Sample Number: 50648 **Depth:** 10'-11.5'

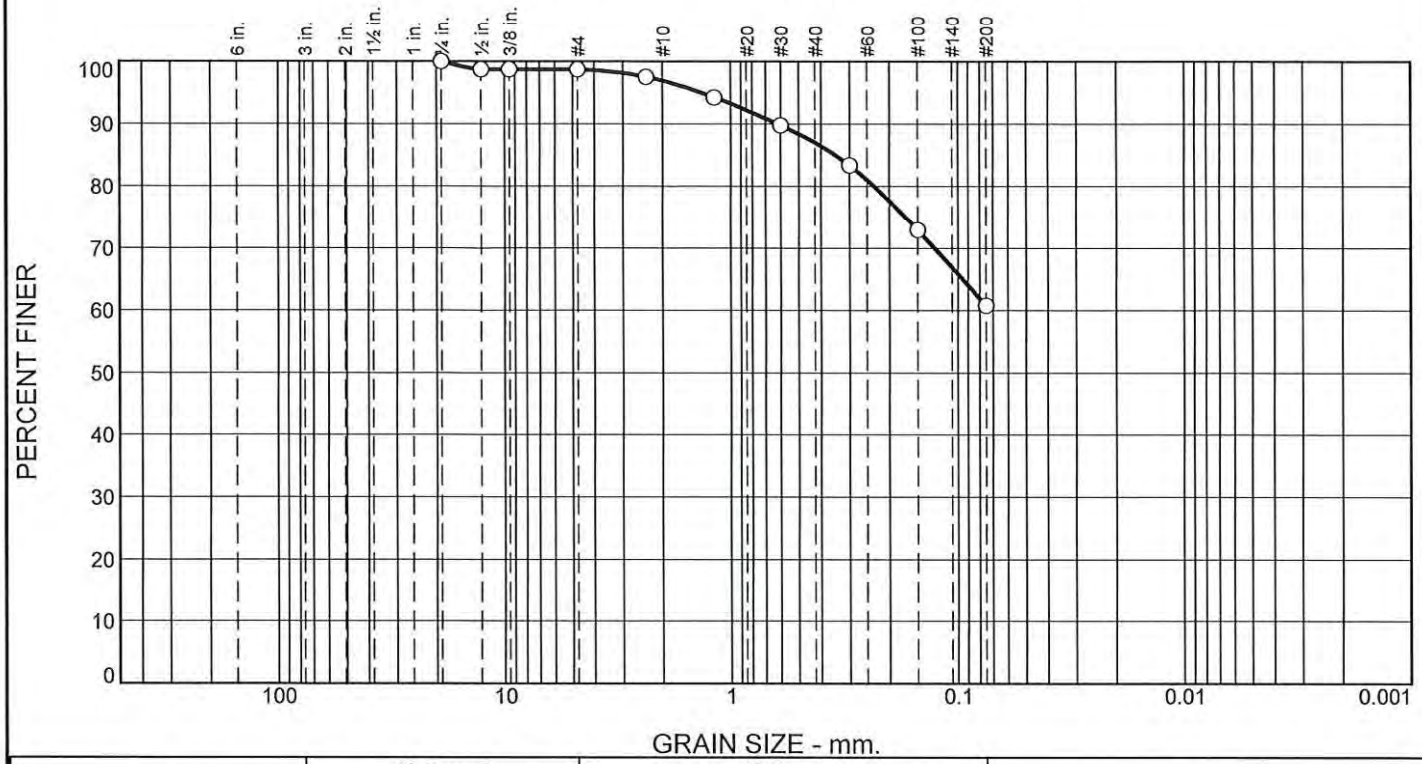
Date Sampled: -

GULF SHORE EXPLORATION AND TESTING

Client: Golder Associates
Project: HECO SEKI

Project No: 20-141 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
0	0	1	2	10	26	61

Test Results (ASTM D6913 & ASTM D1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3/4 Inch	100		
1/2 Inch	99		
3/8 Inch	99		
#4	99		
#8	98		
#16	94		
#30	90		
#50	83		
#100	73		
#200	61		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= 19 LL= 42 PI= 23

Classification

USCS (D 2487)= CL AASHTO (M 145)= A-7-6(11)

Coefficients

D_{90}= 0.6194 D_{85}= 0.3457 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

F.M.=0.65

Date Received: 4/1/20 **Date Tested:** 4/6/20

Tested By: JB

Checked By: JML

Title: PM

Location: AM-B-5
Sample Number: 50649 **Depth:** 5'-6.5'

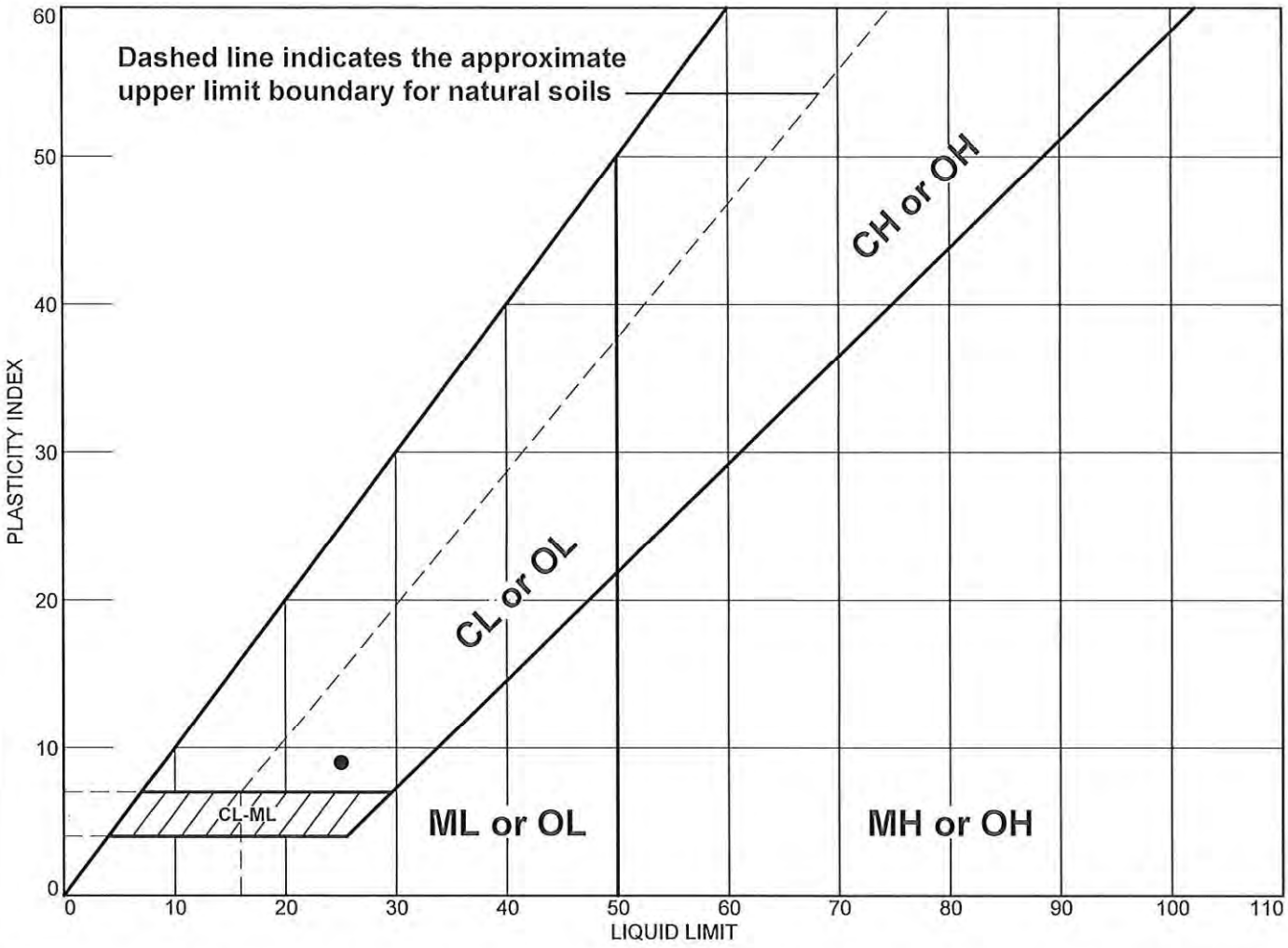
Date Sampled: -

GULF SHORE EXPLORATION AND TESTING

Client: Golder Associates
Project: HECO SEKI

Project No: 20-141 **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		25	16	9	51	24	SC

Project No. 20-141 **Client:** Golder Associates

Project: HECO SEKI

● **Location:** BE-TP-1 **Depth:** 0.5'-4' **Sample Number:** 50636

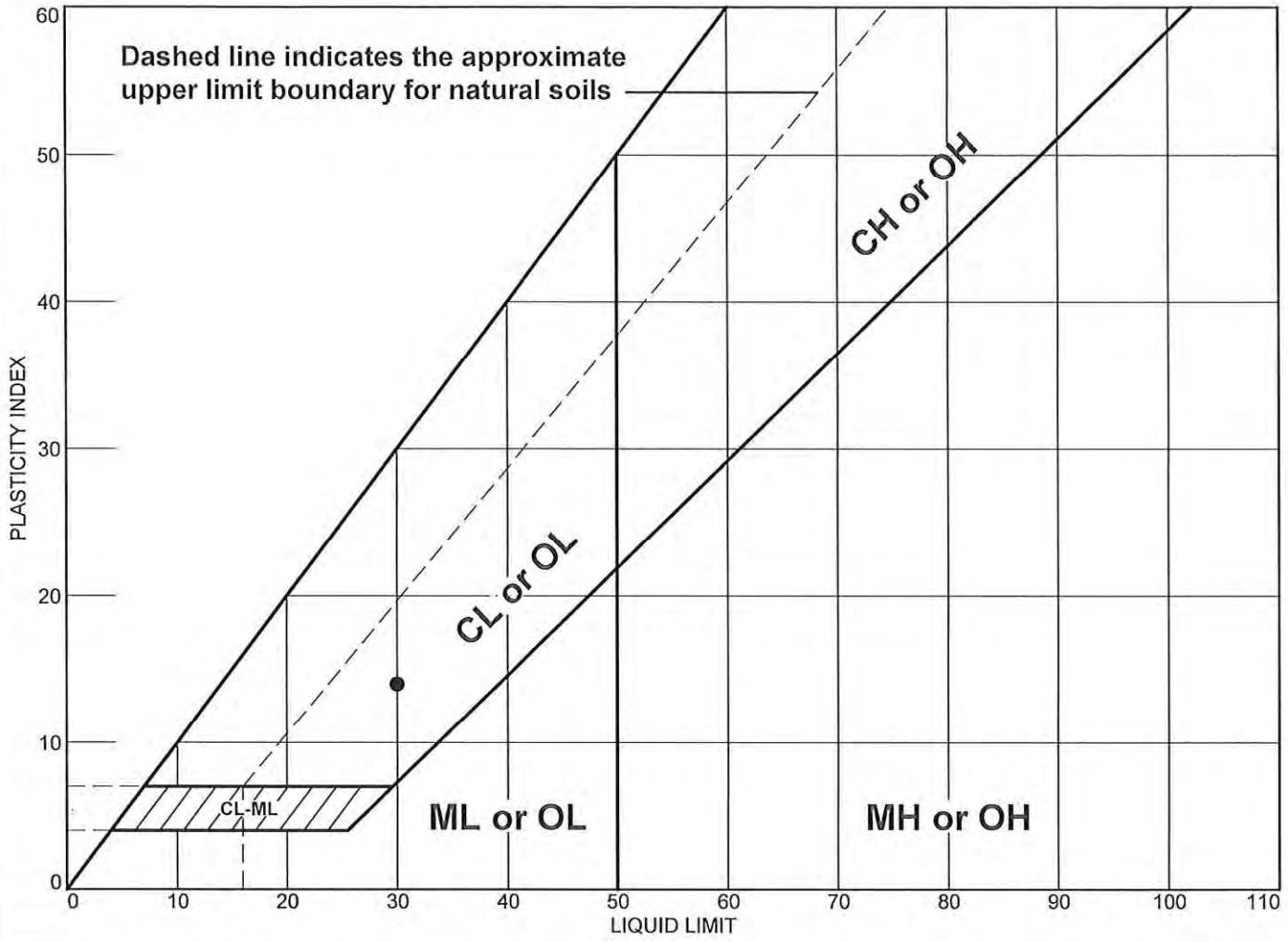
Remarks:

GULF SHORE EXPLORATION AND TESTING

Figure

Tested By: RC **Checked By:** JML

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		30	16	14	64	33	SC

Project No. 20-141 **Client:** Golder Associates

Project: HECO SEKI

● **Location:** BE-TP-6 **Depth:** 0'-4' **Sample Number:** 50639

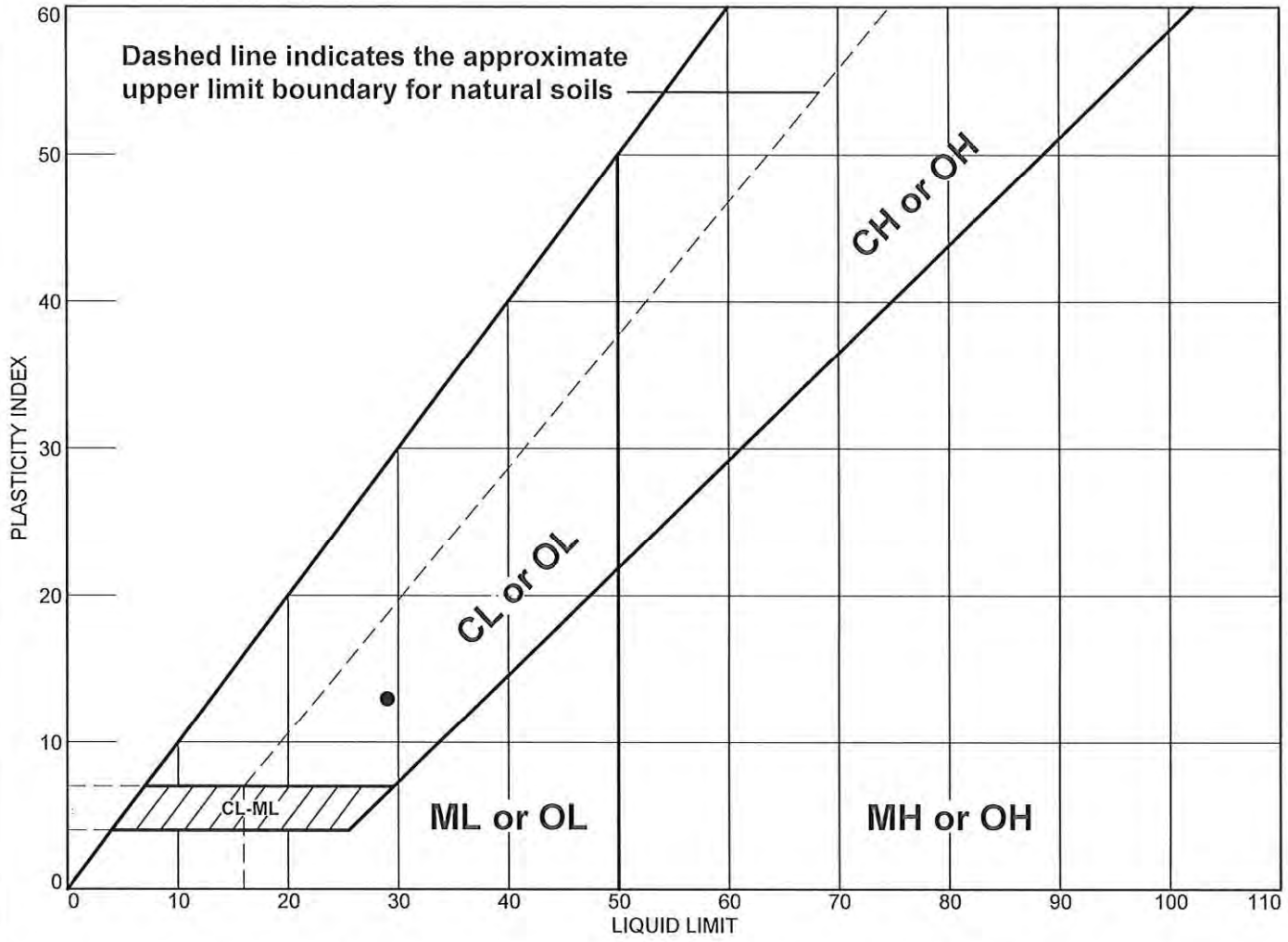
Remarks:

GULF SHORE EXPLORATION AND TESTING

Figure

Tested By: RC **Checked By:** JML

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		29	16	13	53	26	SC

Project No. 20-141 **Client:** Golder Associates

Project: HECO SEKI

● **Location:** AM-B-1 **Depth:** 12.5'-14' **Sample Number:** 50645

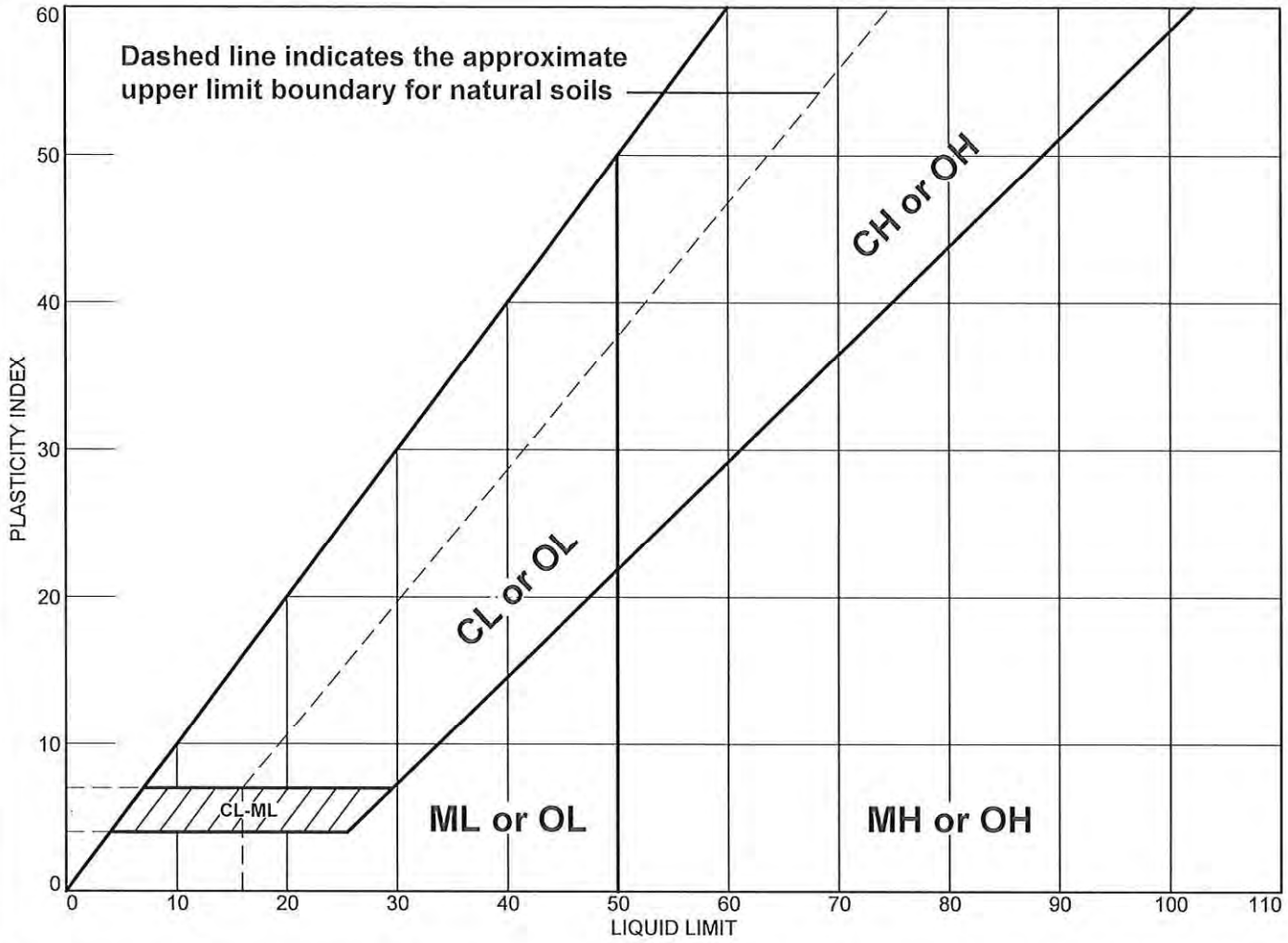
Remarks:

GULF SHORE EXPLORATION AND TESTING

Figure

Tested By: RC **Checked By:** JML

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		NV	NP	NP	59	20	SM

Project No. 20-141 **Client:** Golder Associates

Project: HECO SEKI

● **Location:** AM-B-2 **Depth:** 10'-11.5' **Sample Number:** 50647

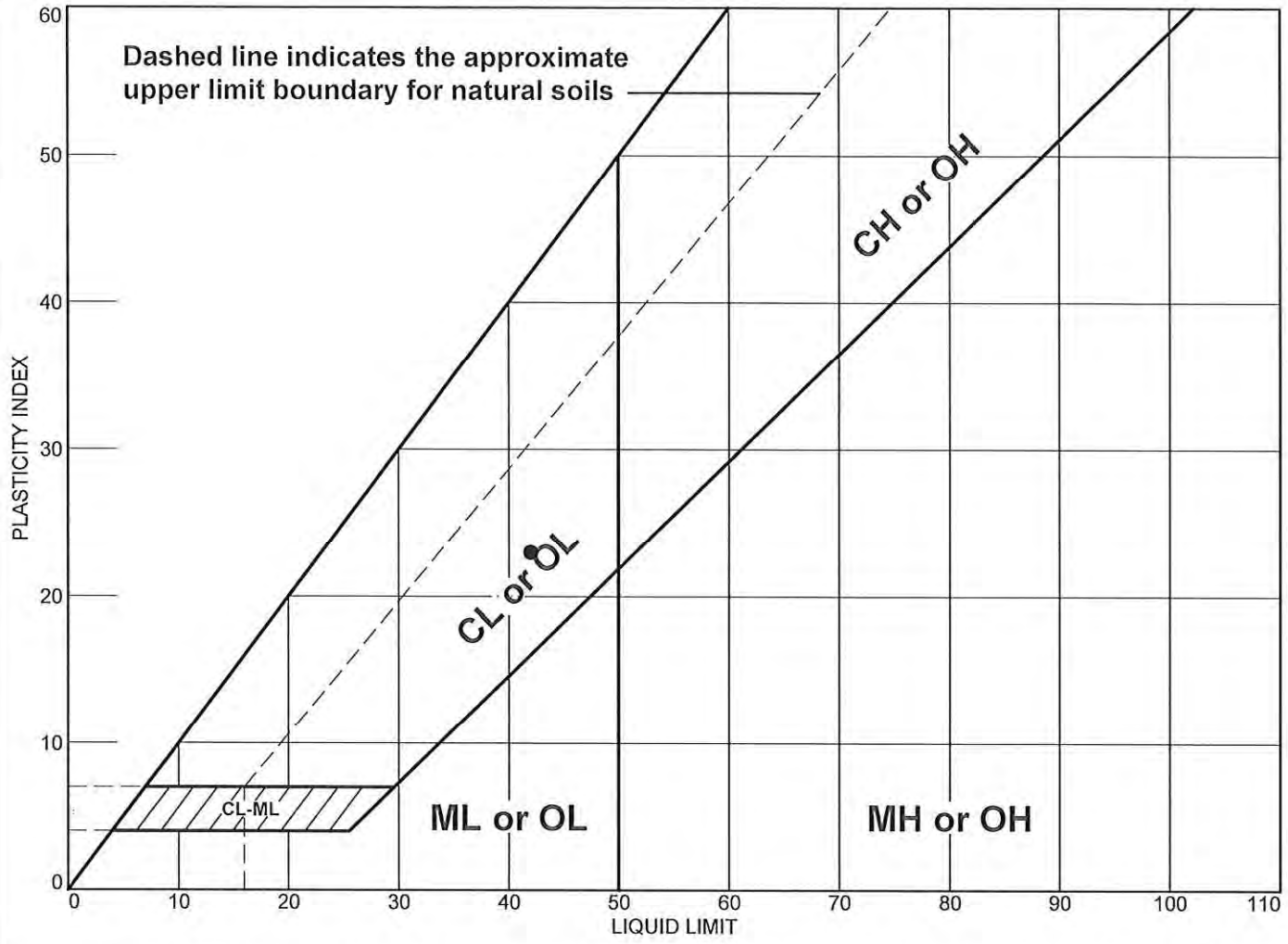
Remarks:

GULF SHORE EXPLORATION AND TESTING

Figure

Tested By: JM **Checked By:** JML

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		42	19	23	87	61	CL

Project No. 20-141 **Client:** Golder Associates

Project: HECO SEKI

● **Location:** AM-B-5 **Depth:** 5'-6.5' **Sample Number:** 50649

Remarks:

GULF SHORE EXPLORATION AND TESTING

Figure

Tested By: RC **Checked By:** JML

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 04/08/2020
Date Submitted 04/02/2020

To: Joe Llamas
Gulf Shore Construction Services
3362 Fitzgerald Rd
Rancho Cordova, CA 95742

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 20-141 HECO SEKI Site ID : AM-B-2@0-2.5FT.
Thank you for your business.

* For future reference to this analysis please use SUN # 81843-170995.

EVALUATION FOR SOIL CORROSION

Soil pH	6.60		
Minimum Resistivity	21.17 ohm-cm (x1000)		
Chloride	1.0 ppm	00.00010	%
Sulfate	0.4ppm	00.00004	%

METHODS
pH and Min.Resistivity CA DOT Test #643 Mod.(Sm.Cell)
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Reprint of Report
Dated_____

Date Reported 04/08/2020
Date Submitted 04/02/2020

To: Joe Llamas
Gulf Shore Construction Services
3362 Fitzgerald Rd
Rancho Cordova, CA 95742

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 20-141 HECO SEKI Site ID : BE-TP-2@0-4FT.
Thank you for your business.

* For future reference to this analysis please use SUN # 81843-170993.

EVALUATION FOR SOIL CORROSION

Soil pH	6.45	
Minimum Resistivity	17.42 ohm-cm (x1000)	
Chloride	1.3 ppm	00.00013 %
Sulfate	14.5ppm	00.00145 %

METHODS
pH and Min.Resistivity CA DOT Test #643 Mod.(Sm.Cell)
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Reprint of Report
Dated_____

Date Reported 04/08/2020
Date Submitted 04/02/2020

To: Joe Llamas
Gulf Shore Construction Services
3362 Fitzgerald Rd
Rancho Cordova, CA 95742

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 20-141 HECO SEKI Site ID : BE-TP-5@0-4FT.
Thank you for your business.

* For future reference to this analysis please use SUN # 81843-170994.

EVALUATION FOR SOIL CORROSION

Soil pH	6.07	
Minimum Resistivity	3.75 ohm-cm (x1000)	
Chloride	8.8 ppm	00.00088 %
Sulfate	37.2ppm	00.00372 %

METHODS
pH and Min.Resistivity CA DOT Test #643 Mod.(Sm.Cell)
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m

APPENDIX D

Additional Geotechnical Exploration Report

REPORT

Additional Geotechnical Exploration

Rehabilitate Ash Mountain Wastewater Systems, Sequoia National Park, California

Submitted to:

HECO Engineers

32 N. Main Street
PO Box 235
Payette, ID 83661

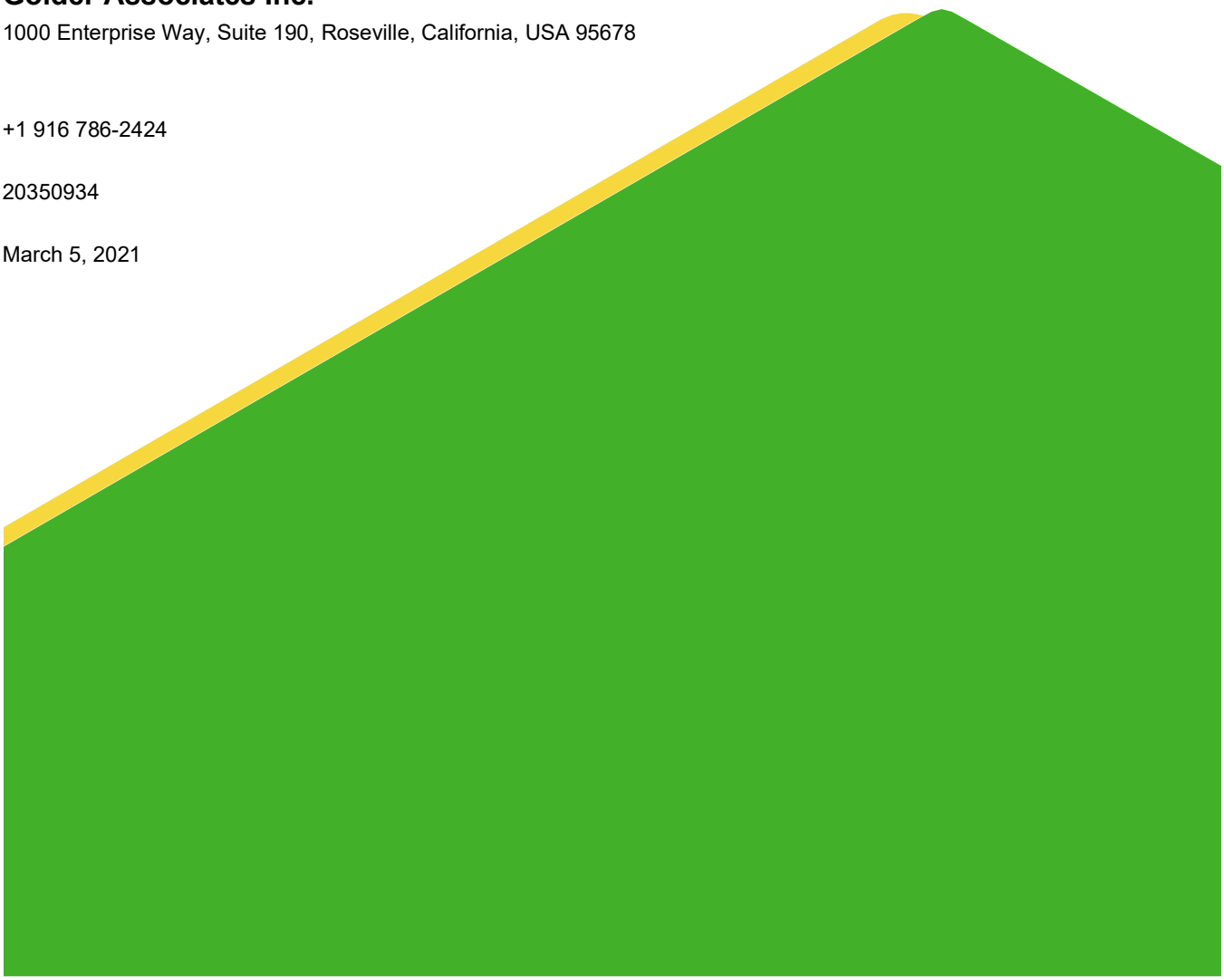
Submitted by:

Golder Associates Inc.
1000 Enterprise Way, Suite 190, Roseville, California, USA 95678

+1 916 786-2424

20350934

March 5, 2021



Distribution List

Bart Brooke, PE (HECO)

Kent Gingrich, PE (HECO)

George Murgel, PE, Ph.D. (HECO)

Rick McKee (HECO)

Julián H. Consoli (Golder)

Josh Hanson (Golder)

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APPENDICES

1.0 INTRODUCTION

Golder Associates Inc. (Golder) is pleased to submit this report to HECO Engineers (HECO) which presents the findings of our additional geotechnical exploration of the proposed subsurface wastewater disposal locations related to the Rehabilitate Ash Mountain Wastewater Systems Project within the Ash Mountain developed areas of Sequoia National Park, located in Tulare County, California. Sequoia National Park, and subsequently the sites of our exploration, is within the jurisdiction of the National Park Service (NPS). Our exploration was performed at two nearby, but separate, sites within the areas of Ash Mountain NPS headquarters and Buckeye Housing community. The site locations are shown in Figure 1.

This report has been prepared in accordance with Golder's approved and agreed upon scope presented in our proposal number P20350934 dated July 31, 2020, and per NPS Contract No. 140P8519D0001, Task Order No. 140P8620F0008/P00002, Rehabilitate Ash Mountain Wastewater Systems – PMIS 184085, 246176 and 181622.

This report has been prepared as Appendix D to Golder's report titled "Geotechnical Exploration Rehabilitate Ash Mountain Wastewater Systems, Sequoia National Park, California", dated March 2021 (Golder 2021).

1.1 Project Understanding and Background

It is Golder's understanding that the existing critical components at the Ash Mountain and Buckeye Housing wastewater treatment facilities and system are at the end of their life cycle and need to be replaced to reduce the risk of a shutdown of visitor and administrative services in the Ash Mountain developed areas, as well as to protect natural resources by preventing an inadvertent discharge of untreated wastewater. We understand that the subsurface conditions and percolation rates of the existing soils at the existing wastewater disposal sites needed to be investigated to assess their suitability to accommodate an underground disposal field to receive discharged effluent.

Golder previously conducted geotechnical explorations at a proposed disposal location at the Ash Mountain wastewater treatment facility and two (2) proposed locations at the Buckeye Housing wastewater treatment facility from March 23 through March 26, 2020 (Golder 2021). Because the results of these previous explorations indicated the originally proposed locations were not favorable for subsurface wastewater effluent disposal, NPS and HECO identified two additional locations to evaluate and consider.

Golder was asked to conduct geotechnical explorations at the two additional proposed locations: one proposed location at the Buckeye Housing site and one at the Ash Mountain site. We understand that the subsurface conditions and percolation rates of the soils at the proposed disposal locations and elevations must be evaluated to assess their suitability for use as an underground disposal field for lower quality effluent. Based on our correspondence with HECO, we understand that the approximate design depths of the proposed subsurface disposal systems at these additional locations are within 4 feet of the existing ground surface. Additionally, we understand that it is proposed to fill the existing lined ponds at the existing Ash Mountain wastewater treatment facility location that was previously explored (Golder 2021) to accommodate the installation of a 100,000-gallon water tank founded on a reinforced concrete slab on grade. HECO requested that Golder provide recommendations for fill placement to support the pond infilling and tank loading, and to analyze slope stability of the existing southwestern slope to estimate the minimum offset distance of the proposed tank from the slope crest. Providing geotechnical recommendations related to the design of the reinforced concrete slab on grade foundation was not part of our scope.

1.2 Scope of Work

Golder's scope of work for the additional geotechnical exploration consisted of:

- Preparing a site-specific Health and Safety Environmental Plan to identify and mitigate hazards related to work conducted in the field.
- Performing a site reconnaissance with NPS personnel to delineate the project limits and observe the existing site conditions.
- Performing a geotechnical exploration to evaluate the site-specific subsurface conditions, which included:
  - Advancing two vertical test borings, each to approximately 35.1 feet below the existing ground surface (feet-bgs).
  - Excavating eight shallow test pits and advancing associated percolation boreholes to approximately 4 feet-bgs and performing subsequent percolation tests in each of the percolation boreholes.
  - Conducting geotechnical laboratory testing on selected representative soil samples.
- Preparing this report that includes the following:
  - A site plan that shows test boring and percolation test locations.
  - A summary of the geotechnical exploration and subsurface conditions encountered.
  - Test boring and percolation test hole logs.
  - Laboratory testing results.
  - Percolation testing results.
  - Geotechnical considerations for the proposed subsurface wastewater disposal systems at the sites.
  - Recommendations for fill materials.
  - Slope stability analyses to estimate minimum tank offset distance from the existing slope crest.

2.0 GEOLOGIC SETTING

Both the Ash Mountain site and Buckeye Housing site are located in the Sierra Nevada geomorphic province. The Sierra is a tilted fault block that is nearly 400 miles long. The rocks are mainly igneous and metamorphic units of diverse composition and age, including volcanic and metasedimentary interlayered rocks. In the central and southern Sierra, plutonic igneous rocks, mostly silicic (granitic), form the multiple intrusions of the Sierra Nevada batholith and are believed to constitute approximately 60 percent of the exposed rock. Sedimentary and volcanic rocks that overlie the basement are most prominent in the central and northern Sierra.

Formation of the Sierra Nevada mountain range began during the Paleozoic Era approximately 475 million years ago with sea floor deposition of sediments originating from the ancestral North American continent which was drifting west. Toward the end of the Paleozoic, these seafloor sediments became folded as the Pacific plate collided with the North American plate. Paleozoic deposits are exposed on the western edge of the forest in the upper foothills zone. These Paleozoic strata include metasedimentary and metavolcanic rocks such as slate, phyllite, greenstone, hornfels, gneiss, graywacke, crystalline limestone, and chert. During the subsequent

Mesozoic Era, which began approximately 225 million years ago, these seafloor sediments were increasingly folded, tilted, and fed into the subduction zone formed between the Pacific and North American plates. Rocks on the subducting Pacific plate melted, forming magma. Some of this molten rock was expelled from volcanoes. The rest cooled in place, forming the Sierra Nevada batholith. As time progressed, many of the seafloor volcanic and sedimentary rocks became metamorphosed. Crustal uplifting began, forming a folded mountain range, which is the Sierra Nevada mountain range (USDA 1996).

2.1 Local Geology

Rocks within the vicinity of the sites are primarily Cretaceous granites and granodiorites of the Sierra Nevada batholith that intruded masses of Mesozoic metasedimentary and metavolcanics rocks. Quaternary till and talus are the main surficial deposits in the area (USGS 2013).

The geologic unit underlying the Ash Mountain site is mapped as Quaternary landslide deposits (Holocene and Pleistocene) (Qls) which consists of bouldery and hummocky landslide and debris deposits (USGS 2013). According to the USGS (2013), this landslide deposit consists of a surficial bouldery mantle on the steep south slope of Ash Peaks Ridge. Furthermore, the USGS (2013) indicates that this landslide deposit is not recent and that it may have been generated by high rainfall during the Pleistocene. The area surrounding the Ash Mountain site largely is mapped as Granite of Frys Point (Early Cretaceous) (Kfp), a medium- and coarse-grained biotite granite that lacks mafic inclusions but is locally cut by diorite and granodiorite dikes in some areas. Small intrusions of fine- and medium-grained hornblende diorite and quartz diorite (Kd) of Cretaceous age are mapped in areas to the south of the site.

The Buckeye Housing site's geology is unmapped on the USGS (2013) map but, based on outcrops observed by Golder during our fieldwork as well as residual soil encountered during drilling, the geology consists of an intrusive igneous rock (either granite or diorite). Based on the USGS (2013) map, the Buckeye Housing site is likely within the Granite of Frys Point (Kfp) or Diorite (Kd) units described above. A less-detailed, smaller-scaled map (CGS 2010) generally maps the area at and around the Buckeye Housing site as granitic rocks (granite, quartz monzonite, granodiorite, and quartz diorite) and metamorphic rocks.

A map of the local geology is shown in Figure 2.

3.0 GEOTECHNICAL EXPLORATION

Golder conducted a geotechnical field exploration to characterize the subsurface conditions at the two proposed subsurface disposal locations from November 16 through November 19, 2020. The exploration consisted of advancing geotechnical test borings, excavating test pits, augering shallow percolation test holes adjacent to each test pit, performing percolation tests in the shallow augered holes, and geotechnical laboratory testing on selected representative samples of soil. The following test borings and percolation tests were completed:

- Ash Mountain: four test pits and associated percolation test holes (AM2-TP-1 through AM2-TP-4).
- Buckeye Housing: two test borings (BE2-B-1 and BE2-B-2) and four test pits and associated percolation test holes (BE2-TP-1 through BE2-TP-4).

The locations of the test borings and test pits/percolation test holes for the Ash Mountain site and Buckeye Housing site are shown in Figures 3 and 4, respectively.

The only feasible access found to the Ash Mountain site consisted of traversing a steep slope. Golder's drilling and excavating subcontractor (Gulf Shore Construction Services) was able to mobilize their mini-excavator up the slope, however, it was their judgment that their track-mounted rig could not safely traverse up the slope without the risk of slipping, sliding, or rolling over. As such, we were not able to advance test borings at the Ash Mountain site.

Prior to the commencement of the field work, the proposed exploration locations were cleared of existing underground utilities by Underground Service Alert (USA) as required by California state law. HECO also contracted a private utility locator to locate and mark existing underground utilities at the sites prior to the exploration activities. Additionally, since the geotechnical exploration was conducted on federally owned property, it was not required to obtain drilling, encroachment, or similar permits from Tulare County. A NPS representative was on-site during test pitting to monitor for potential archaeological disturbance. NPS required all work at the Buckeye Housing locations to be completed between 8:00 am and 5:00 pm each day due to the proximity of this site to residences.

The following sections describe each component of the geotechnical exploration program in detail.

3.1 Geotechnical Drilling, Test Pitting, and Sampling

Geotechnical drilling, test pitting, and soil sampling were conducted on November 17 and November 18, 2020 and consisted of excavating four test pits at Ash Mountain (Figure 3) and excavating four test pits and advancing two test borings at the Buckeye Housing site (Figure 4). No test borings were advanced at the Ash Mountain site as described in Section 3.0. Test borings and test pits were advanced by Gulf Shore Construction Services (Gulf Shore), under subcontract to Golder, using a track-mounted LANDA 55 hollow stem auger drill rig and a Takeuchi TB240 mini-excavator, respectively. The two test borings at the Buckeye Housing site were advanced to approximately 35.1 feet-bgs. All test pits were excavated to approximately 4 feet-bgs.

During drilling, representative soil samples were recovered at approximately 2.5- to 5-foot vertical intervals to characterize the subsurface conditions. Samples were obtained using a 1.5-inch inside diameter (ID) and 2-inch outside diameter (OD) split-spoon sampler following standard penetration test (SPT) procedures according to ASTM D1586, "Standard Method for Penetration Test and Split Barrel Sampling of Soils." This sampling method consists of driving the split-spoon sampler to a depth of up to 18 inches into the undisturbed soil at the bottom of the boring at each sampling interval. The sampler was driven with a 140-pound, hydraulic wire-line automatic hammer falling 30-inches per drop. The number of hammer blows required to drive the sampler the final 12 inches is known as the standard penetration resistance (N) value, which provides an index of the relative density of granular soils and the consistency of fine-grained soils. All recovered samples were stored in air-tight plastic bags to prevent moisture loss.

During test pitting, bulk samples were collected to characterize the subsurface conditions. Samples were obtained by collecting soil from the excavator bucket during test pitting. All recovered samples were stored in air-tight plastic bags to prevent moisture loss.

Drilling and test pitting were observed by a Golder geologist who logged the soil and groundwater conditions encountered, recorded the N-values during drilling, and obtained soil samples for further classification and laboratory testing. Soil samples were classified in the field in accordance with Golder's technical procedures and the Unified Soil Classification System (USCS) (ASTM D2487). At the completion of drilling, each test boring was backfilled with neat cement grout. Test pits were backfilled with the excavated soils. The coordinates of each test boring and test pit were collected using a handheld Global Positioning System (GPS) device. The coordinates

were used to estimate the ground surface elevation at each location on Google Earth and are, therefore, approximate as the locations were not surveyed.

Summary logs of the test borings and test pits are provided in Appendix A.

3.2 Percolation Tests

3.2.1 Percolation Test Holes

A percolation test hole was advanced to approximately 4 feet-bgs adjacent to each test pit by Gulf Shore using an 8-inch diameter auger attachment on the excavator. Percolation test holes were constructed in general accordance with the Tulare County Local Agency Management Program's (LAMP) Onsite Wastewater Treatment Systems percolation testing guidance document (LAMP 2018). Accordingly, percolation test holes were constructed by placing approximately 2-inches of pea gravel at the bottom of the hole, followed by placing a slotted 1-inch polyvinyl chloride (PVC) casing inside the hole and adding pea gravel in the annular space around the PVC casing to keep the hole from collapsing. The location of the test pits and corresponding percolation test holes are shown in Figures 3 and 4.

3.2.2 Presoaking Activities

Once the PVC casing and pea gravel were installed in each percolation test hole, clean water was poured down the casing to begin the pre-soaking process. The water levels in the borings were recorded by using an electronic water level indicator to measure the depth to water relative to the top of the PVC casing. NPS provided an on-site water hose to facilitate pre-soaking and percolation testing activities.

Pre-soaking activities were conducted on the afternoon of November 17, 2020 for both sites and consisted of filling each percolation boring with 1 to 2 feet of clean water. Water was added periodically until the beginning of the percolation tests and allowed to soak for approximately 24 hours at the Ash Mountain site and approximately 40 hours at the Buckeye Housing site.

3.2.3 Percolation Testing

Percolation testing was conducted at the Ash Mountain site on November 18, 2020 and at the Buckeye Housing site on November 19, 2020. After pre-soaking, the percolation test holes were filled with water to approximately 0.5- to 1.5-feet above the bottom of the hole. The depth to water was then measured in each percolation test hole at 30-minute intervals until completion of the test. Section 401.4, subsection 2, paragraph c of the LAMP (2018) specifies percolation test measurement requirements. Part iii of paragraph c provides instruction, as follows, for collecting readings and computing the corresponding percolation rate:

> *Readings shall be taken at 30-minute intervals. Refill as necessary to maintain 6 inches of water over the pea gravel bottom at each interval. Readings shall be taken until two consecutive readings do not vary by more than ten percent per reading, with a minimum of 3 readings. The last 30-minute interval is used to compute the percolation rate. If 4 inches or more of water seeps from the hole during the 30-minute interval, readings may be taken at 10 minute intervals. Readings shall be taken until 2 consecutive readings do not vary by more than ten percent per reading with a minimum of 3 readings. The last 10-minute interval is used to compute the percolation rate.*

Readings are considered as the change in water level over one 30- or 10-minute interval.

None of the percolation holes met the criteria for the 10-minute interval readings, so the depth to water was measured at each percolation test hole approximately every 30 minutes for four hours. Water was added intermittently to the percolation test holes to keep the water level at least 6 inches above the bottom of the percolation hole as required by the LAMP (2018).

Following the completion of percolation testing, the PVC casings were removed from the borings, and the borings were backfilled with native soil cuttings and restored to the original ground level.

Percolation rates were calculated in accordance with Section 401.4.2.c.iii of the LAMP (2018) and are summarized in Tables 1 and 2 for the Ash Mountain and Buckeye Housing sites, respectively. Detailed percolation test data sheets are provided in Appendix B.

Table 1: Summary of Percolation Testing at Ash Mountain

Percolation Test Hole	Measured Percolation Rate (minutes per inch)[1]
AM2-TP-1	125[2]
AM2-TP-2	250
AM2-TP-3	250
AM2-TP-4	250

Notes:
[1] – Indicates the raw, measured percolation rate and does not include a factor of safety.
[2] – After four hours, no two consecutive readings varied by less than 10 percent, therefore the last reading was used to calculate the percolation rate.

Table 2: Summary of Percolation Testing at Buckeye Housing

Percolation Test Hole	Measured Percolation Rate (minutes per inch)[1]
BE2-TP-1	31
BE2-TP-2	42
BE2-TP-3	50
BE2-TP-4	250

Notes:
[1] – Indicates the raw, measured percolation rate and does not include a factor of safety

3.3 Geotechnical Laboratory Testing

Representative soil samples from the geotechnical test borings and test pits were selected and transported to Gulf Shore Construction Services Inc. in Rancho Cordova, California for the following geotechnical laboratory tests:

- Particle size analysis (ASTM D6913)
- Atterberg limits (ASTM D4318)
- Moisture content (ASTM D2216)

- Soil chemistry for corrosion potential (California Test Methods 643, 417, and 422)

The results of the geotechnical laboratory testing are summarized on the test boring and test pit logs and presented in detail in Appendix C.

3.4 Subsurface Conditions and Estimated Percolation Rates

3.4.1 Ash Mountain

The subsurface conditions encountered at the Ash Mountain site generally consist of up to 1 inch of organic-rich topsoil underlain by residual soil/completely weathered rock to a depth of approximately 1.5- to 2.5-feet-bgs. Completely to highly weathered rock was encountered in each test pit below 1.5- to 2.5-feet-bgs, and the test pits were very difficult to excavate after that depth. According to the USCS, the material encountered in each test pit predominantly classified as clayey sand (SC) or silty, clayey sand (SC-SM). Groundwater was not encountered in any of the test pits.

One soil sample from the site was tested for corrosivity potential. The tested parameters (electrical resistivity, pH, Chlorides and Sulfates) are within the typical range of non-corrosive values. The site soils likely have a low corrosive potential, but additional testing should be performed if construction of the proposed subsurface disposal system is sensitive to corrosion of buried concrete or metal.

The percolation test results for this site indicate a range of possible percolation rates from 125 minutes per inch (mi./inch) to 250 mi./inch. The variation in percolation rates is likely due to local differences in the subsurface conditions (e.g., changes in the sizes and shapes of pores in the soil, depth to competent rock, etc.).

3.4.2 Buckeye Housing

The subsurface conditions encountered at the Buckeye Housing site generally consist of up to 6 inches of organic-rich topsoil underlain by residual soil/completely weathered rock to a depth of approximately 1.5- to 3.5-feet-bgs. Completely to highly weathered rock was encountered in each boring and test pit after 1.5- to 3.5-feet-bgs, and the test pits were very difficult to excavate after that depth, except for BE2-TP-1 which was easily excavated to 4 feet bgs and only appeared to contain residual soil. During drilling at test boring BE2-B-1, the soil was very dense beginning at approximately 2.5 feet-bgs, and sampler refusal was encountered as shallow as 5 feet-bgs. At test boring BE2-B-2, the soil was dense beginning at approximately 5 feet-bgs, and sampler refusal was encountered at 10 feet-bgs. According to the USCS, the material encountered in each test pit and test boring predominantly classified as clayey sand (SC) or silty, clayey sand (SC-SM). Groundwater was not encountered in any of the test borings or test pits.

One soil sample from the site was tested for corrosivity potential. The tested parameters (electrical resistivity, pH, Chlorides and Sulfates) are within the typical range of non-corrosive values. The site soils likely have a low corrosive potential, but additional testing should be performed if construction of the proposed subsurface disposal system is sensitive to corrosion of buried concrete or metal.

The percolation test results for this site indicate a range of possible percolation rates from 31 mi./inch to 250 mi./inch. The variation in percolation rates is likely due to local differences in the subsurface conditions (e.g., changes in the sizes and shapes of pores in the soil, depth to competent rock, etc.).

4.0 GEOTECHNICAL CONSIDERATIONS

4.1 Overall Suitability for Subsurface Wastewater Disposal System

4.1.1 Ash Mountain

Based on our current understanding of the site and the information obtained from our geotechnical exploration, it is Golder's opinion that the Ash Mountain site does not provide ground conditions that are favorable for a subsurface wastewater disposal system such as a leach field or seepage pit. The percolation testing showed very low percolation rates in the four augered borings adjacent to the test pits. The proposed disposal depths at the site generally consist of residual soils and highly weathered rock that classify as clayey sand (SC) according to the USCS. Clayey sands typically do not percolate septic effluent well, especially when the clayey sands are very dense, as is the case for the Ash Mountain site. Furthermore, the LAMP states the following in Section 401.3, "The average of all percolation tests in the leaching area shall not exceed two hundred (200) minutes per inch (mi./inch). No single percolation test shall exceed two hundred-forty (240) mi./inch". Based on the percolation data, the site does not meet these criteria as the average of the four percolation rates exceeded 200 mi./inch, and three of the four percolation tests exceeded 240 mi./inch.

4.1.2 Buckeye Housing

Based on our current understanding of the site and the information obtained from our geotechnical exploration, it is Golder's opinion that the Buckeye Housing site provides ground conditions that may be suitable for a subsurface wastewater disposal system such as a leach field or seepage pit. Per the criteria defined in the LAMP, the average of all percolation tests in the leaching area shall not exceed 200 mi./inch and no single percolation test shall exceed 240 mi./inch. The measured percolation rate at BE2-TP-4 was 250 mi./inch; however, use of the site for a subsurface disposal system may be considered if the limits of the disposal system avoid the area around BE2-TP-4. If BE2-TP-4 is avoided, and its data excluded, the average percolation rate for the site based on the other three percolation tests (BE2-TP-1 through BE2-TP-3) is approximately 41 mi./inch, which meets the LAMP's site-average criteria of 200 mi./inch. Of these three percolation tests, the slowest measured percolation rate was 50 mi./inch. Based on Table 203 of the LAMP, a percolation rate of 50 mi./inch corresponds to an application rate of 0.311 gallons per day per square foot, which may be suitable depending on the footprint of the disposal system and anticipated loading.

Based on the results of the exploration, it appears that groundwater is sufficiently deep at this site such that the minimum required separation of 5 feet between the bottom of the proposed disposal system and the seasonal high groundwater can be maintained if the depth of the disposal system does not exceed 15 feet-bgs.

4.2 Recommendations for Fill Placement

It is Golder's understanding that NPS is proposing to decommission the current Ash Mountain wastewater treatment facility by demolishing the structure elements of the facility, infilling the two lined ponds, and installing a water tank with a nominal 100,000-gallon storage capacity that is founded on a reinforced concrete slab on grade within the limits of the infilled pond(s). At the time this report was prepared, we were not informed whether on-site, local cut-to-fill soils or imported soils would be used as engineered fill to infill the ponds. The following paragraphs provide general guidance for the proposed earthwork activities, and the following subsections provide recommendations for subgrade and foundation preparation and fill materials that are applicable to the proposed pond infilling and tank installation.

Careful earthwork planning and subgrade protection by the contractor and implementation of the recommendations presented herein will help minimize unanticipated costs. We recommend that any earthwork and excavation on the site be sequenced to limit the amount of exposed subgrade, particularly if construction starts during the rainy season.

Site preparation and earthwork operations should be performed in accordance with all applicable codes and standards. All compaction requirements presented in this report are relative to ASTM D1557 (modified Proctor compaction test). Relative compaction refers to the percentage of the in-place measured soil dry density divided by the same soil's maximum dry density as determined by the ASTM D1557 laboratory test procedure. Optimum moisture content is the corresponding moisture content of the same soil at its maximum dry density.

4.2.1 Surface Drainage

Proper surface drainage is critical to the satisfactory performance of the project. Uncontrolled infiltration of stormwater runon/runoff, irrigation excess, and/or water from other sources into the soils can adversely affect the performance of the planned improvements. Saturation (or near saturation) of soil can cause it to lose internal shear strength, thereby increasing its compressibility and resulting in a detrimental and undesirable change in its engineering properties. Proper positive surface drainage should be maintained at all times both during and after the construction of the proposed development. During construction, the contractor(s) will be responsible for controlling surface drainage at the site. The contractor(s) should prepare the site in an acceptable manner prior to anticipated storm events such that surface water is not allowed to pond within the project's footprint, especially on or near foundations, pavement subgrades, and near walls or slopes. In addition, surface water should never be allowed to flow uncontrolled over the crests of slopes and down the slope faces.

It should be noted that earthwork construction during wet weather can significantly increase costs by making placement of fill soils difficult due to over-optimum moisture contents, increasing the cost for off-site disposal of unsuitable excavated soils, increasing the effort to control water, and increasing subgrade disturbance resulting in the possible need for soil admixtures, geotextiles, and/or rock working mats.

4.2.2 Subgrade and Foundation Preparation

It is our understanding that the only proposed structural element at the Ash Mountain site is the 100,000-gallon water tank. We understand the proposed tank would be installed on a reinforced concrete slab on grade foundation that is constructed on top of compacted engineered fill placed within the limits of the existing lined ponds. As such, it is our understanding that the subgrade soils will consist of the existing material (fill or native material depending on the specific location at the site, based on the Golder (2021) exploration) beneath the lined ponds prior to placement and compaction of engineered fill, and the compacted engineered fill prior to construction of the slab on grade foundation.

Anticipated geotechnical site construction activities include minor clearing and grubbing, removal and disposal of the existing geosynthetic liners, excavation, subgrade preparation, placement and compaction of engineered fills and construction of foundations. During construction, surface water runoff should be controlled and directed away from any excavation and any temporary cut slopes. Based on the information provided at the time this report was prepared, we are not aware of any significant temporary cuts, including those related to local cut-to-fill earthwork to provide a source of engineered fill. However, in addition to possible cut-to-fill excavations, we suspect minor excavations will be required as part of rough grading activities once the geosynthetic liner is removed. If there is a change to the design that requires use of significant temporary cuts, Golder should be notified and allowed the opportunity to revise our recommendations as appropriate.

Exposed deleterious, vegetative, organic, inert, and oversized materials (materials greater than 3 inches in maximum dimension) partially exposed at the subgrade elevation should be stripped and isolated prior to removal of reusable soils. We recommend that the finished subgrade conditions be observed by a qualified geotechnical engineer or engineering geologist prior to the placement of engineered fill, rebar, and/or concrete. Additional removals may be required as a result of observation and testing of the exposed subgrade soil.

Construction of the tank foundation over a cut-fill transition should be avoided to the extent possible. If it is necessary to construct the tank foundation over a cut-fill transition, then the entire footprint of the tank foundation should be over-excavated to a minimum depth that is at least 85 percent of the maximum depth of the fill underlying the foundation. The entire overexcavation should then be backfilled with engineered fill. The overexcavation should extend beyond the foundation limits in all directions for a minimum horizontal distance that is equal to the overexcavation depth, as measured from the base of the foundation.

Subgrade that is or becomes wet and unsuitable, or that becomes loosened by the contractor's operation, should be properly moisture conditioned and compacted or over-excavated and replaced with a suitable engineered fill. Subgrade that is loosened by the contractor's operations should be repaired or replaced at the contractor's expense. Foundation excavations should be free of any loose, soft, disturbed material or water prior to placement of reinforcing bars and concrete.

4.2.3 Fill Materials

Based on the subsurface conditions encountered during the Golder (2021) study, we anticipate that the majority of the existing on-site native and fill soils may be reused as engineered fill. Particles greater than 3 inches in maximum dimension should be removed or crushed and any vegetative or deleterious material and debris should be removed.

Imported materials to be used as engineered fill, if required, should have the following characteristics:

- No particles greater than 3-inches in maximum dimension.
- Well-graded with no less than 70 percent passing the ¾-inch sieve and no greater than 25 percent passing the No. 200 sieve.
- The percent passing the No. 40 sieve should have a plasticity index less than 10.
- Non-expansive.
- Non-corrosive to buried concrete and metallic structures.

If the imported materials deviate from the above-listed properties, then special earthwork recommendations may be required.

Additionally, we recommend engineered fill be placed as follows:

- Prior to placement of the first lift of engineered fill on a soil subgrade, the uppermost 8 inches of the exposed soil subgrade should be brought to within 3 percent of its optimum moisture content and compacted to a minimum of 90 percent (95 percent if under foundations) of its maximum dry density as determined by ASTM D1557 to provide a uniform bearing surface.
- Engineered fill should be placed in 8-inch thick (or less) loose lifts.

- Engineered fill placed beneath and within 3 feet around the proposed slab on grade foundation should be compacted to at least 95 percent of its ASTM D1557 maximum dry density.
- Engineered fill placed elsewhere, including beneath utility trenches and other structural components not underlying foundations, should be compacted to at least 90 percent of its ASTM D1557 maximum dry density.
- After the densification process, a firm, unyielding, stable surface should be produced.
- In all areas in which engineered fill is to be placed on a surface having a slope greater than 15 percent, the fill should be benched a minimum horizontal distance of 4 feet into existing competent native material or existing competent engineered fill. Where fill slopes daylight above cutslopes, the fill slope shall daylight on a minimum 10-foot-wide horizontal bench. Similarly, a minimum 10-foot-wide and 3-foot-deep keyway should be excavated into competent native material along the toes of all fill slopes placed on grades that are steeper than 15 percent.
- In landscaping or other areas not supporting loads, utility trench backfill should be adequately compacted to prevent excessive future settlement.
- No fill should be placed around concrete until all forms have been removed and the concrete has cured sufficiently to withstand the loading incurred due to backfilling.

5.0 SLOPE STABILITY AND TANK OFFSET EVALUATION

Slope stability was analyzed on a representative, critical cross-section of the southwestern slope of the existing Ash Mountain wastewater treatment plant. The cross-section captures the greatest slope height and inclination and was generated using the site-specific topographic survey data that was provided to us by HECO. In general, the existing slope has an inclination of approximately 1.5H:1V (horizontal to vertical). The location of the critical cross-section is shown in Figure 5.

The objective of the slope stability analysis was to estimate the factor of safety (FOS) of the existing slope given the current site conditions and to estimate the minimum offset distance that the proposed 100,000-gallon water tank should be offset from the existing slope crest in order to maintain an acceptable slope stability FOS. Based on our correspondence with HECO, we understand the existing ponds will be infilled using compacted engineered fill, and the proposed tank would be constructed within the footprint of the infilled pond(s). The following sections describe the analyses in greater detail.

5.1 Method of Analysis

Slope stability analyses were used to assess the global stability of the slope and to evaluate the minimum FOS along failure planes that initiate at/near the crest of the existing slope and daylight at/near its toe. To estimate the minimum offset distance of the tank from the slope crest, the minimum FOS along shear surfaces that extend beyond the crest of the slope and engage the tank (and daylight at/near the toe of slope) were considered. The analyses were performed using the computer program Slide (Version 8.026), by Rocscience, which uses the two-dimensional, limit-equilibrium approach to calculate the FOS against potential sliding. Spencer's method was used for the analyses because it satisfies both horizontal and vertical force equilibrium as well as moment equilibrium.

Based on our correspondence with HECO, we understand a range in tank diameters from 31 to 42 feet is being considered, and that the selected tank will be founded on a concrete slab on grade. Our analyses conservatively

used the 31-foot diameter tank because this results in the greatest magnitude of distributed load. Based on the information provided by HECO, we analyzed a 31-foot diameter tank that is 20-feet tall, has a storage capacity of 107,000-gallons, and has a maximum total weight of 1,355,000 pounds (includes weight of tank, concrete and water when full), which corresponds to a distributed load of approximately 1,800 pounds per square foot (psf).

The stability of the existing slope condition was analyzed considering the static loading condition only. It is our understanding that the Ash Mountain wastewater treatment plant was constructed in the late 1970s or early 1980s. Based on our observations of the site and review of topographic data, it appears the slopes have performed well over the past approximately 40 years and do not indicate any signs of instability or deformation. The calculated static FOS of the existing slope is considered approximate and served as a reference point to evaluate if the existing slope face is affected by placement of the tank.

Both static and pseudo-static slope stability were analyzed to estimate the minimum offset of the proposed tank from the existing slope crest. Pseudo-static slope stability was analyzed by incorporating a horizontal seismic loading coefficient that was calculated according to the procedures outlined in Stewart, Blake, and Hollingsworth (2003). The seismic coefficient is a function of the return period of the seismic event and allowable seismic displacement. We used a 2,475-year mean return period (i.e., 2 percent probability of exceedance in 50 years) for Site Class C and 1-inch of allowable seismic displacement. These are conservative parameters considering the intended serviceability of the proposed tank and the perceived low consequence of failure (i.e., no population at risk and water would runoff into the Kaweah River below). Site Class C (very dense soil and soft rock) was assumed based on the conditions encountered during the Golder (2021) exploration. According to the Stewart, Blake, and Hollingsworth (2003) method, a seismic coefficient of 0.17 was used to perform the pseudo-static slope stability analysis.

Based on our understanding of the project, we recommend the proposed water tank is offset from the existing slope the minimum distance required to achieve static and pseudo-static FOS values of 1.5 and 1.0, respectively, considering shear surfaces that engage the tank as previously described.

5.2 Model Development

Slope stability model geometry and stratigraphy were based on the materials encountered during the Golder (2021) investigation. As shown in Figure 5, test borings AM-B-1, AM-B-1a, AM-B-2 and AM-B-5 are within the vicinity of the critical cross-section location and were used as the basis of the model stratigraphy. Test boring AM-B-1a encountered a thicker layer of fill than AM-B-1 (14 feet compared to 7 feet), as did AM-B-2 than AM-B-5 (7 feet compared to 2 feet). Therefore, our model incorporated the conditions encountered at AM-B-1a and AM-B-2. Since the test borings do not coincide exactly with the cross-section alignment, their subsurface conditions have been superimposed at the respective depths and elevations. The logs for these borings are included in Appendix A of Golder (2021).

Based on our observations of the site, the conditions encountered during the Golder (2021) exploration, and review of the topographic survey data, it is apparent that the Ash Mountain wastewater treatment plant site was constructed by locally cutting-and-filling native material from the northeast side of the site to the southwest side of the site. The exposed cuts along the northeast side near borings AM-B-3 and AM-B-4, various fill thicknesses encountered at the test boring locations, and the uniform face of the southwestern slope support this conclusion. Therefore, our slope stability model assumes native material beyond the toe of the southwestern slope, and native-existing fill interfaces based on the contacts observed at borings AM-B-1a and AM-B-2. Competent bedrock was not encountered during the Golder (2021) exploration and was therefore not incorporated into our

slope stability model. Bedrock may be present at the site, but the depth to its contact has not been delineated. Additionally, the topographic survey data is truncated just past the toe of the southwestern slope; therefore, we have assumed a constant elevation past the toe. This was necessary to develop a functional model, but the results indicate the analyses are not sensitive to this assumption. Furthermore, our stability models do not include groundwater or a phreatic surface because groundwater was not encountered at the test borings during the Golder (2021) exploration. The depth to groundwater at the site has not been delineated, but it is considered to be deeper than the limits of the test borings and, as such, does not contribute to the analyses.

As described in Section 5.1, our model incorporated a 31-foot diameter tank that exerts a load of 1,800 psf per the information provided to us from HECO. We iteratively adjusted the offset of the front edge of the tank from the crest of the existing slope until the critical shear surface that engaged the tank achieved minimum static and pseudo-static FOS values of 1.5 and 1.0, respectively.

There are three geotechnical units that are incorporated into the slope stability analyses. The respective material properties of each unit were derived using correlations for friction angle (Φ) based on the SPT blow counts (Peck et al., 1974) measured during the Golder (2021) exploration as well as engineering judgement. The slope stability result outputs provided in Appendix D show the model geometry and stratigraphy in detail, and the geotechnical units and corresponding material properties used in the analyses are summarized in Table 3.

Table 3: Material Properties for Slope Stability Analyses

Material	Unit Weight (pcf)	Cohesion Intercept (psf)	Effective Friction Angle (degrees)
Native	125	0	38
Existing Fill	125	0	32
Engineered Fill	125	0	32

Notes: pcf = pounds per cubic foot
psf = pounds per square foot

5.3 Results

The results of our slope stability analyses are summarized in Table 4 and in Appendix D.

Table 4: Slope Stability Analyses Results Summary

Analysis Description	Factor of Safety	
	Static	Pseudo-Static
Existing Conditions – Shear Surface at Existing Slope Face	1.10	--
Proposed Tank – Shear Surface at Existing Slope Face	1.10	--
Proposed Tank – Shear Surface Engages Tank	1.54	1.01

Note: -- indicates analysis was not performed

5.4 Conclusions

The results of our slope stability analyses indicate the proposed 31-foot diameter tank that exerts 1,800 psf should be setback a minimum horizontal distance of 34 feet from the crest of the existing slope in order to achieve the appropriate minimum static FOS of 1.5. The analyses also indicate the overall (gross) stability of the existing slope is not affected by infilling the ponds and constructing the proposed tank 34 feet from the slope crest. Although conservative assumptions were made to conduct the pseudo-static analyses, as described in Section 5.1, the recommended minimum pseudo-static FOS of 1.0 was achieved.

Our current scope of work did not include evaluating the performance of the existing slope face for a given design seismic event. HECO informed Golder that the existing slope may be regraded as part of the proposed wastewater system rehabilitation project; however, a regrading design had not been completed at the time this report was prepared. The recommended minimum tank setback of 34 feet from the slope crest is based on the existing slope configuration. If the existing slope is proposed to be regraded, then additional slope stability analyses can be performed to evaluate the effect of the slope regrading on the required setback.

6.0 CLOSING

Golder would like to thank HECO for the opportunity to provide support on the Rehabilitate Ash Mountain Wastewater Systems Project. If you have any questions or require any clarifications regarding the information presented in this report, please contact the undersigned.

Golder Associates Inc.

Robert Paul C. Erickson, PE - CA C84750
Senior Engineer

Ryan Hillman
Senior Consultant

RPCE/RH/kkm

7.0 USE OF THIS REPORT

This report has been prepared exclusively for the use of HECO/NPS and their consultants and contractors for specific application to the Rehabilitate Ash Mountain Wastewater Systems Project in Tulare County, California. If the project objectives and remediation concepts vary, or are changed, from that assumed in this report, Golder should be provided an opportunity to review the revised documents or information and, if necessary, complete additional explorations and/or modify our recommendations, as may be appropriate.

We encourage review of this report by bidders and/or contractors as it relates to factual data only (laboratory test results, conclusions, etc.). The conclusions presented in this report are based on the explorations and observations completed for this study and are not intended, nor should they be construed to represent, a warranty regarding the conditions, but are forwarded to assist with the planning and/or design process.

Engineering judgment has been applied in interpreting and presenting the results. We recommend that, if construction activities are pursued, HECO/NPS retain Golder to provide construction observation to confirm the soil conditions, provide supplementary recommendations as needed, and help assure compliance with the conclusions contained in this report. It is possible, and common, for significant variations in the subsurface conditions between the test borings, as well as variations over time, and actual conditions encountered during construction may be different from those interpreted herein.

The site exploration was completed in general accordance with the locally accepted standard of care for geotechnical engineering practice that existed at the time of the exploration, subject to the time limits and financial and physical constraints applicable to the services for this project, to provide information for the areas explored.

The conclusions contained in this report do not include an assessment of the presence or implication(s) of possible surface and/or subsurface contamination resulting from previous site activities and/or resulting from the introduction of materials from offsite sources.

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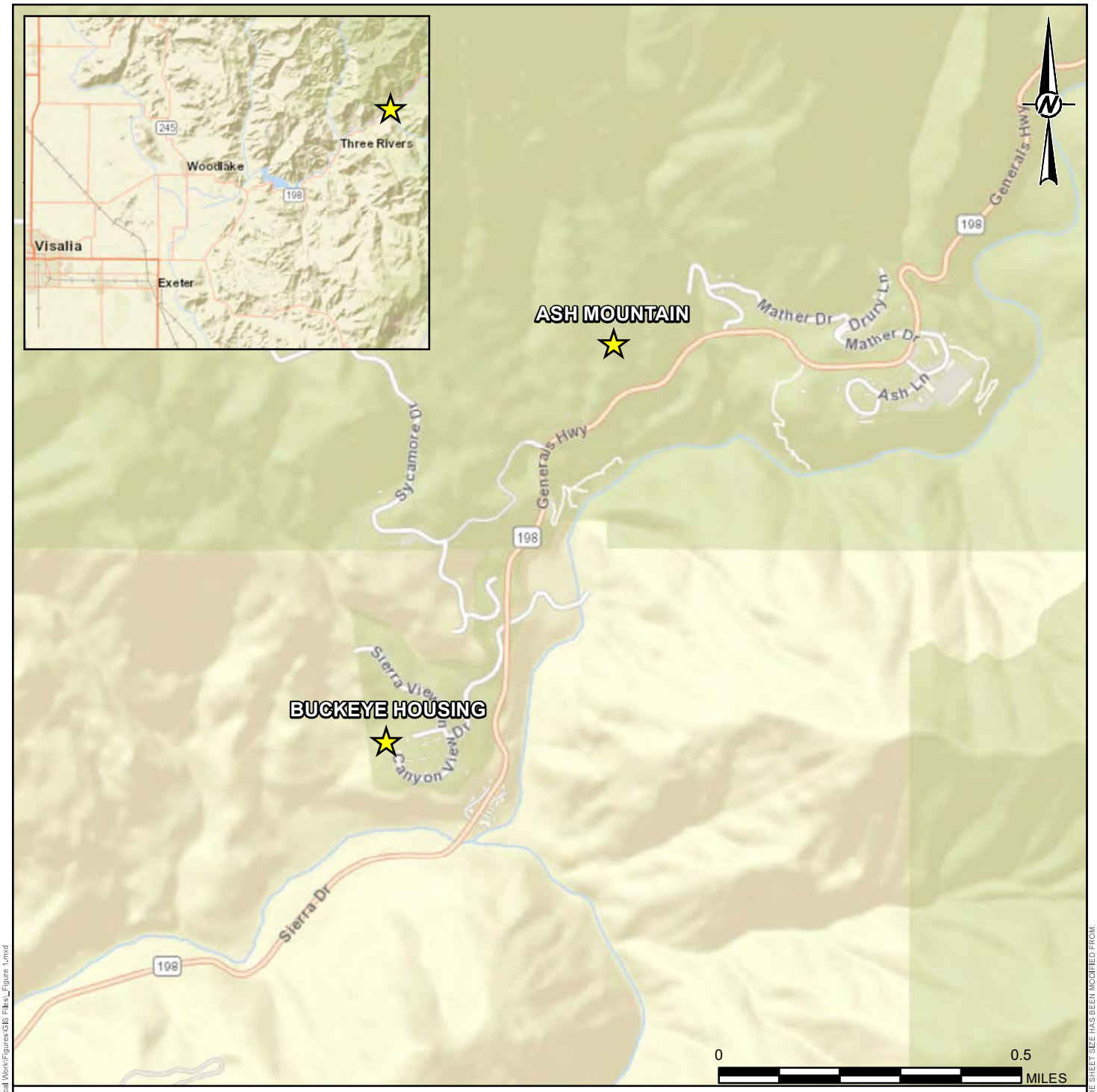
Figures



LEGEND

★ PROJECT LOCATIONS

REFERENCE

1. BASEMAP OBTAINED FROM ESRI BASEMAP WEB SERVICE.
2. KEY MAP OBTAINED FROM ESRI BASEMAP WEB SERVICE.

CLIENT
HECO ENGINEERS
32 N MAIN STREET PO BOX 235
PAYETTE, ID 83661

PROJECT
ADDITIONAL GEOTECHNICAL EXPLORATION
REHABILITATE ASH MOUNTAIN WASTEWATER SYSTEMS

TITLE
SITE VICINITY MAP

CONSULTANT
GOLDER

YYYY-MM-DD	2020-11-23
PREPARED	JHC
DESIGN	JHC
REVIEW	RPCE
APPROVED	RH

PROJECT 20350934 | Rev. 0 | FIGURE 1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 1 in

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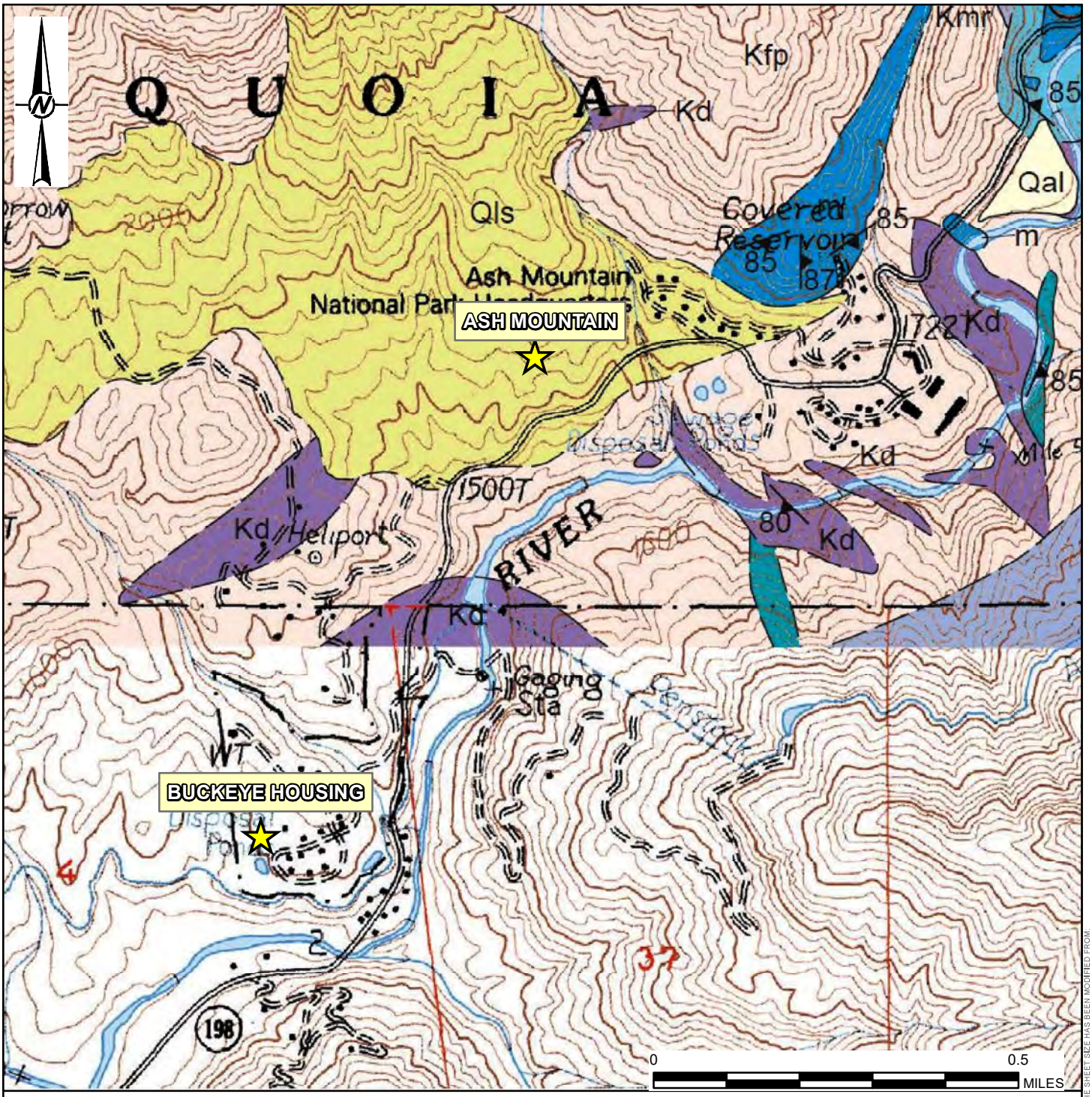

LEGEND

Qls	**Landslide deposits (Holocene and Pleistocene)** - Bouldery and hummocky landslide and debris deposits
Kd	**Diorite (Cretaceous)** - Small intrusions of fine- and medium-grained hornblende diorite and quartz diorite
Kfp	**Granite of Frys Point (Early Cretaceous)** - Medium- and coarse-grained biotite granite that lacks mafic inclusions but is locally cut by diorite and granodiorite dikes
qb	**Quartz-biotite schist and hornfels (Mesozoic)** - Encompasses quartzofeldspathic micaceous schist, phyllite, slate, and hornfels
slp	**Slate and phyllite (Mesozoic)** - Fissile slate, phyllite, and dark-colored argillaceous hornfels derived from mudstone

NOTE(S)

1. GEOLOGIC MAP AND UNIT DESCRIPTIONS OBTAINED FROM: UNITED STATES GEOLOGICAL SURVEY (USGS). 2013. GEOLOGIC MAP OF SOUTHWESTERN SEQUOIA NATIONAL PARK, TULARE COUNTY, CALIFORNIA. OPEN-FILE REPORT 2013-1096.
2. GEOLOGY FOR THE BUCKEYE HOUSING AREA NOT SHOWN ON USGS (2013).

CLIENT
HECO ENGINEERS
32 N MAIN STREET PO BOX 235
PAYETTE, ID 83661

PROJECT
ADDITIONAL GEOTECHNICAL EXPLORATION
REHABILITATE ASH MOUNTAIN WASTEWATER SYSTEMS

TITLE
LOCAL GEOLOGIC MAP

CONSULTANT
GOLDER

YYYY-MM-DD	2020-12-03
PREPARED	JHC
DESIGN	JHC
REVIEW	RPCE
APPROVED	RH

PROJECT 20350934 | Rev. 0 | FIGURE **2**

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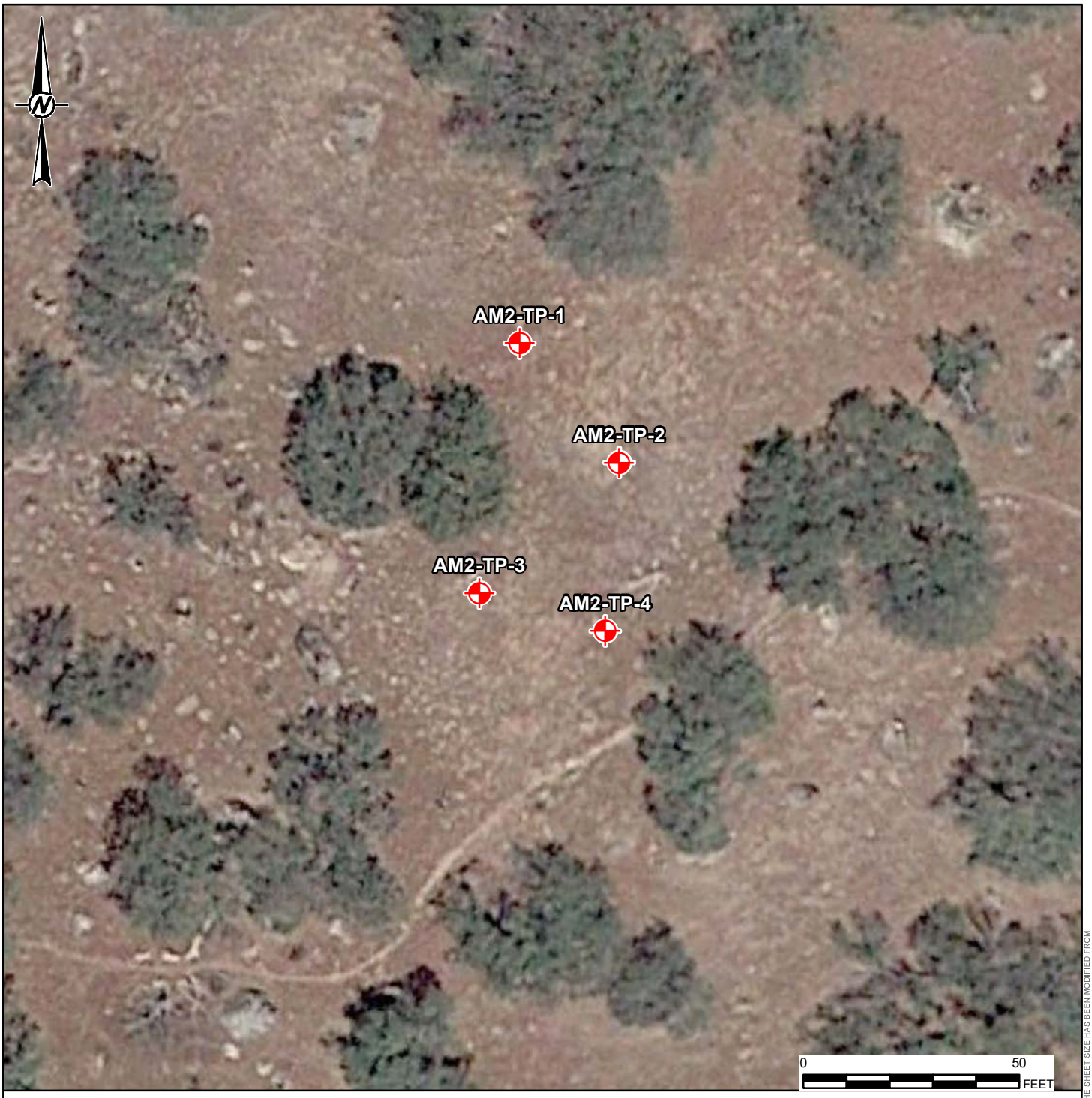


LEGEND

TEST PIT / PERCOLATION BORING

REFERENCE

1. DATE OF IMAGERY: MAY 2014.

CLIENT
HECO ENGINEERS
32 N MAIN STREET PO BOX 235
PAYETTE, ID 83661

PROJECT
ADDITIONAL GEOTECHNICAL EXPLORATION
REHABILITATE ASH MOUNTAIN WASTEWATER SYSTEMS

TITLE
ASH MOUNTAIN ALTERNATIVE DISPOSAL SITE PLAN

CONSULTANT
GOLDER

YYYY-MM-DD	2020-12-03
PREPARED	JHC
DESIGN	JHC
REVIEW	RPCE
APPROVED	RH

PROJECT	Rev.	FIGURE
20350934	0	3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 1 in 0

Path: C:\Users\jconsell\Golder Associates\20350934 - HECO SER Additional Geotech CA - Project Files\5 Technical Work\Figures\GIS Files_Figure 3.mxd

LEGEND

- TEST BORING
- TEST PIT / PERCOLATION BORING

REFERENCE

1. DATE OF IMAGERY: MAY 2014.

CLIENT
HECO ENGINEERS
32 N MAIN STREET PO BOX 235
PAYETTE, ID 83661

PROJECT
ADDITIONAL GEOTECHNICAL EXPLORATION
REHABILITATE ASH MOUNTAIN WASTEWATER SYSTEMS

TITLE
BUCKEYE HOUSING ALTERNATIVE DISPOSAL SITE PLAN

CONSULTANT
GOLDER

YYYY-MM-DD	2020-12-03
PREPARED	JHC
DESIGN	JHC
REVIEW	RPCE
APPROVED	RH

PROJECT 20350934 | Rev. 0 | FIGURE **4**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 1 in 0

Path: C:\Users\jconsell\Golder Associates\20350934 - HECO SER Additional Geotech CA - Project Files\5 Technical Work\Figures\GIS Files_Figure 4.mxd

LEGEND

TEST BORING

SLOPE STABILITY CROSS SECTION LOCATION

NOTES

1. GEOTECHNICAL DRILLING AND SOIL SAMPLING WAS CONDUCTED DURING A GEOTECHNICAL FIELD EXPLORATION ON MARCH 24 AND 25, 2020.
2. DATE OF IMAGERY: MAY 2014.
3. TEST BORING AND SLOPE STABILITY CROSS-SECTION LOCATIONS SHOWN ARE APPROXIMATE.

CLIENT
HECO ENGINEERS
32 N MAIN STREET PO BOX 235
PAYETTE, ID 83661

PROJECT
ADDITIONAL GEOTECHNICAL EXPLORATION
REHABILITATE ASH MOUNTAIN WASTEWATER SYSTEMS

TITLE
SLOPE STABILITY CROSS-SECTION LOCATION

CONSULTANT
GOLDER

YYYY-MM-DD	2020-12-16
PREPARED	HSG
DESIGN	HSG
REVIEW	RPCE
APPROVED	RH

PROJECT 20350934 | Rev. 0 | FIGURE **5**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:
1 in
0

Path: M:\Sites\Ash Mountain WWTP\GIS\20350934_FIG-5_2020-12-16.mxd

APPENDIX A

Logs of Test Borings and Test Pits

RECORD OF BOREHOLE LEGEND

PROJECT: Sequoia National Park
PROJECT NO.: 20350934
LOCATION: Three Rivers, CA

DRILLING START: 2020 November 17 00:00
DRILLING END: 2020 November 17 00:00
COORDINATES: ,

SHEET: 1 of 1
GS ELEV.:
TOC ELEV.: na
DATUM: WGS 84

DEPTH (ft)	BORING METHOD	SOIL PROFILE: Depth	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	SAMPLES: SAMPLE TYPE & NUMBER	SAMPLES: BLOWS per 6 in (ASTM D1586 140 lb hammer 30 inch drop)	SAMPLES: REC/ATT (in)	PENETRATION RESISTANCE BLOWS / ft; WATER CONTENT (%)	NOTES WATER LEVELS LABORATORY DATA	ADDITIONAL LAB TESTING
0		0.0	(GP); **Graphic Log:** Standard symbols for soil types **USCS:** Unified Soil Classification System per ASTM D2487 **MATERIAL DESCRIPTION FOR SOIL:** Soil classifications are based on the Unified Soil Classification System per ASTM D2487 and include density, particle size, color, moisture, and minor components Standard Penetration Test (SPT) or Modified California (MC) Penetration Test. **Blows Per 6 Inches/Penetration:** Number of hammer blows required to drive the sampler 6 inches or the indicated length (i.e., 50/4" indicates 50 hammer blows to drive the sampler 4 inches). Symbol "> >" indicates blow counts >50. **Sampler Types:** Standard Penetration Test (SPT) - 2-inch outside diameter, 1.4-inch inside diameter split-spoon sampler Shelby Tube Sample - 3-inch outside diameter thin-walled tube sampler pushed into the bottom of the borehole Auger Cuttings Sample Grab Sample	GP		DO	5-10-15 **(25)**	17/18	25		
5											
10						DS		10/10			
						AS		10/10			
15						GB		8/8			
		17.0	(SP); Inferred material contact (dashed line) - actual material contact may be gradual **Laboratory Test Abbreviations:** LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index **Other Abbreviations:** REC/ATT = length of sample recovered/length of sample attempted	SP							
20											
25		25.0	Bottom of borehole at 25.0 ft.								
30											

DRILLING CO.: Gulf Shore Construction Services
DRILLER:
DRILL RIG:

LOGGED:
CHECKED:
REVIEWED:

GOLDER

LEGEND

RECORD OF BOREHOLE AM2-TP-1

PROJECT: Sequoia National Park
PROJECT NO.: 20350934
LOCATION: Three Rivers, CA

DRILLING START: 2020 November 17 00:00
DRILLING END: 2020 November 17 00:00
COORDINATES: 36.491036,-118.834737

SHEET: 1 of 1
GS ELEV.: 1692.0
TOC ELEV.: na
DATUM: WGS 84

DEPTH (ft)	BORING METHOD	SOIL PROFILE: Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLES: SAMPLE TYPE & NUMBER	BLOWS per 6 in (ASTM D1586 140 lb hammer 30 inch drop)	REC / ATT (in)	PENETRATION RESISTANCE BLOWS / ft; WATER CONTENT (%)	NOTES WATER LEVELS LABORATORY DATA	ADDITIONAL LAB TESTING
0	MINI-EXCAVATOR	0.0		1692.0								
		0.1	1" dark brown organic-rich topsoil	1691.9								
			(SC), clayey sand, brown to red-brown; non-cohesive, dry, Completely weathered rock to residual soil		SC		GB		24/24			
			2.5': Becomes highly to completely weathered rock, excavation becomes very difficult				GB		24/24		2 - 4: Sieve: Gravel = 1%, Sand = 63%, Fines = 36%. Atterberg: LL = 30, PL = 21, PI = 9. Moisture: 8.0%.	
		4.0		1688.0								
5			Bottom of test pit at 4.0 ft. Groundwater was not encountered during excavation. Backfilled with cuttings.									
10												
15												
20												
25												
30												

DRILLING CO.: Gulf Shore Construction Services
DRILLER: Amador Arroyo
DRILL RIG: Mini-Excavator

LOGGED: JHC
CHECKED: RPCE
REVIEWED: RH

GOLDER

AM2-TP-1

RECORD OF BOREHOLE AM2-TP-2

PROJECT: Sequoia National Park
PROJECT NO.: 20350934
LOCATION: Three Rivers, CA

DRILLING START: 2020 November 17 00:00
DRILLING END: 2020 November 17 00:00
COORDINATES: 36.49095,-118.83468

SHEET: 1 of 1
GS ELEV.: 1684.0
TOC ELEV.: na
DATUM: WGS 84

DEPTH (ft)	BORING METHOD	SOIL PROFILE: Depth	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: Elev	USCS	GRAPHIC LOG	SAMPLES: SAMPLE TYPE & NUMBER	SAMPLES: BLOWS per 6 in (ASTM D1586 140 lb hammer 30 inch drop)	SAMPLES: REC ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS LABORATORY DATA	ADDITIONAL LAB TESTING
0		0.0		1684.0								
	MINI-EXCAVATOR	0.1	1" dark brown organic-rich topsoil	1683.9								
			(SC), clayey sand, brown to red-brown; non-cohesive, dry, Completely weathered rock to residual soil		SC		GB		24/24		2 - 4: Sieve: Gravel = 6%, Sand = 57%, Fines = 37%.	
			2': Becomes highly to completely weathered rock, excavation becomes very difficult				GB		24/24			
		4.0		1680.0								
5			Bottom of test pit at 4.0 ft. Groundwater was not encountered during excavation. Backfilled with cuttings.									
10												
15												
20												
25												
30												

DRILLING CO.: Gulf Shore Construction Services
DRILLER: Amador Arroyo
DRILL RIG: Mini-Excavator

LOGGED: JHC
CHECKED: RPCE
REVIEWED: RH

GOLDER

AM2-TP-2

RECORD OF BOREHOLE AM2-TP-3

PROJECT: Sequoia National Park
PROJECT NO.: 20350934
LOCATION: Three Rivers, CA

DRILLING START: 2020 November 17 00:00
DRILLING END: 2020 November 17 00:00
COORDINATES: 36.490858,-118.834683

SHEET: 1 of 1
GS ELEV.: 1675.0
TOC ELEV.: na
DATUM: WGS 84

DEPTH (ft)	BORING METHOD	SOIL PROFILE: Depth	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: Elev	USCS	GRAPHIC LOG	SAMPLES: SAMPLE TYPE & NUMBER	SAMPLES: BLOWS per 6 in (ASTM D1586 140 lb hammer 30 inch drop)	SAMPLES: REC / ATT (in)	PENETRATION RESISTANCE BLOWS / ft; WATER CONTENT (%)	NOTES WATER LEVELS LABORATORY DATA	ADDITIONAL LAB TESTING
0	MINI-EXCAVATOR	0.0		1675.0								
		0.1	1" dark brown organic-rich topsoil	1674.9								
			(SC-SM), silty clayey sand, brown to red-brown; non-cohesive, dry, Completely weathered rock to residual soil		SC-SM		GB		24/24			
			2': Becomes highly to completely weathered rock, excavation becomes very difficult. Becomes grayish-brown.				GB		24/24		2 - 4: Sieve: Gravel = 5%, Sand = 66%, Fines = 29%. Atterberg: LL = 28, PL = 21, PI = 7. Moisture: 6.9%.	
		4.0		1671.0								
5			Bottom of test pit at 4.0 ft. Groundwater was not encountered during excavation. Backfilled with cuttings.									
10												
15												
20												
25												
30												

DRILLING CO.: Gulf Shore Construction Services
DRILLER: Amador Arroyo
DRILL RIG: Mini-Excavator

LOGGED: JHC
CHECKED: RPCE
REVIEWED: RH

GOLDER

AM2-TP-3

RECORD OF BOREHOLE AM2-TP-4

PROJECT: Sequoia National Park
PROJECT NO.: 20350934
LOCATION: Three Rivers, CA

DRILLING START: 2020 November 17 00:00
DRILLING END: 2020 November 17 00:00
COORDINATES: 36.490871,-118.834774

SHEET: 1 of 1
GS ELEV.: 1676.0
TOC ELEV.: na
DATUM: WGS 84

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLES SAMPLE TYPE & NUMBER	BLOWS per 6 in (ASTM D1586 140 lb hammer 30 inch drop)	REC ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS LABORATORY DATA	ADDITIONAL LAB TESTING
0		0.0		1676.0								
	MINI-EXCAVATOR	0.1	1" dark brown organic-rich topsoil	1675.9								
			(SC), clayey sand, brown to red-brown; non-cohesive, dry, Comletely weathered rock to residual soil 1.5': Becomes highly to completely weathered rock, excavation becomes very difficult. Becomes grayish brown.		SC		GB		24/24		0 - 4: Corrosion: pH = 6.46, Minimum Resistivity = 2280 ohm-cm, Chloride = 35.7 ppm, Sulfate = 10.4 ppm. 2 - 4: Sieve: Gravel = 3%, Sand = 65%, Fines = 32%.	
							GB		24/24			
		4.0		1672.0								
5			Bottom of test pit at 4.0 ft. Groundwater was not encountered during excavation. Backfilled with cuttings.									
10												
15												
20												
25												
30												

DRILLING CO.: Gulf Shore Construction Services
DRILLER: Amador Arroyo
DRILL RIG: Mini-Excavator

LOGGED: JHC
CHECKED: RPCE
REVIEWED: RH

GOLDER

AM2-TP-4

RECORD OF BOREHOLE BE2-B-1

PROJECT: Sequoia National Park
PROJECT NO.: 20350934
LOCATION: Three Rivers, CA

DRILLING START: 2020 November 18 08:25
DRILLING END: 2020 November 18 10:55
COORDINATES: 36.481389,-118.841901

SHEET: 1 of 2
GS ELEV.: 1375.0
TOC ELEV.: na
DATUM: WGS 84

DEPTH (ft)	BORING METHOD	SOIL PROFILE: Depth	DESCRIPTION	SOIL PROFILE: Elev	USCS	GRAPHIC LOG	SAMPLES: SAMPLE TYPE & NUMBER	SAMPLES: BLOWS per 6 in (ASTM D1586 140 lb hammer 30 inch drop)	SAMPLES: REC ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS LABORATORY DATA	ADDITIONAL LAB TESTING
0	8-INCH DIAMETER HOLLOW STEM AUGER	0.0	0.3 3" dark brown organic-rich topsoil (SC)	1375.0 / 1374.8								
			Clayey sand, brown to dark brown, strong cementation; non-cohesive, very dense, dry, Completely weathered rock to residual soil.				DO	18-17-36 **(53)**	10/18	>>		
5			Becomes brownish gray, fine to medium sand; no gravel.				DO	38-50/3" **(50/3")**	9/9	>>	5 - 6.5: Sieve: Gravel = 0%, Sand = 54%, Fines = 46%.	
			Becomes gray, moderately cemented.				DO	28-50/3" **(50/3")**	9/9	>>		
10							DO	28-50/3" **(50/3")**	5/9	>>		
							DO	34-50/3" **(50/3")**	9/9	>>		
15					SC		DO	28-50/3" **(50/3")**	9/9	>>		
20							DO	50/3" **(50/3")**	3/3	>>		
25							DO	50/2" **(50/2")**	1/2	>>		
30												

Log continued on next page

DRILLING CO.: Gulf Shore Construction Services
DRILLER: Amador Arroyo
DRILL RIG: LANDA 55

LOGGED: JHC
CHECKED: RPCE
REVIEWED: RH

GOLDER

RECORD OF BOREHOLE BE2-B-1

PROJECT: Sequoia National Park
PROJECT NO.: 20350934
LOCATION: Three Rivers, CA

DRILLING START: 2020 November 18 08:25
DRILLING END: 2020 November 18 10:55
COORDINATES: 36.481389,-118.841901

SHEET: 2 of 2
GS ELEV.: 1375.0
TOC ELEV.: na
DATUM: WGS 84

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	SOIL PROFILE Elev	USCS	GRAPHIC LOG	SAMPLES SAMPLE TYPE & NUMBER	SAMPLES BLOWS per 6 in (ASTM D1586 140 lb hammer 30 inch drop)	SAMPLES REC ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS LABORATORY DATA	ADDITIONAL LAB TESTING
30		30.0		1345.0								
			(SC) *(continued)*		SC		DO	50/2" **(50/2")**	1/2			
35		35.1		1339.9			DO	50/1" **(50/1")**	0/1			
			Bottom of borehole at 35.1 ft. Groundwater was not encountered during drilling. Backfilled with cement grout.									
40												
45												
50												
55												
60												

DRILLING CO.: Gulf Shore Construction Services
DRILLER: Amador Arroyo
DRILL RIG: LANDA 55

LOGGED: JHC
CHECKED: RPCE
REVIEWED: RH

GOLDER

BE2-B-1
2 of 2

01 - GOLDER - BOREHOLE RECORD - DF STD US LAB E-M.GDT - 20/12/23 14:48
C:\USERS\JCONSOLI\GOLDER ASSOCIATES\20350934, HECO SEKI ADDITIONAL GEOTECH CA - PROJECT FILES\5 TECHNICAL WORK\GINT\HECO SEKI LOGS 20201215.GPJ

RECORD OF BOREHOLE BE2-B-2

PROJECT: Sequoia National Park
PROJECT NO.: 20350934
LOCATION: Three Rivers, CA

DRILLING START: 2020 November 18 12:05
DRILLING END: 2020 November 18 14:00
COORDINATES: 36.481389,-118.841901

SHEET: 1 of 2
GS ELEV.: 1375.0
TOC ELEV.: na
DATUM: WGS 84

DEPTH (ft)	BORING METHOD	SOIL PROFILE: Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLES: SAMPLE TYPE & NUMBER	BLOWS per 6 in (ASTM D1586 140 lb hammer 30 inch drop)	REC / ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS LABORATORY DATA	ADDITIONAL LAB TESTING
0	8-INCH DIAMETER HOLLOW STEM AUGER	0.0		1375.0								
		0.3	3" dark brown organic-rich topsoil	1374.8								
			(SC) Clayey sand, brown to dark brown; non-cohesive, dry, mostly fine to medium sand. Completely weathered rock to residual soil.				AS		48/48		0 - 4: Corrosion: pH = 7.31, Minimum Resistivity = 3750 ohm-cm, Chloride = 12.2 ppm, Sulfate = 22.7 ppm.	
5			Becomes brown, dense, moderately cemented, no gravel.				DO	15-25-22 **(47)**	17/18	47 ■	5 - 6.5: Sieve: Gravel = 0%, Sand = 69%, Fines = 31%.	
10			Becomes very dense.				DO	50/5" **(50/5")**	5/5	>> ■		
15			Becomes grayish brown.		SC		DO	50 **(50/")**	5/6	>> ■		
20							DO	50/2" **(50/2")**	1/2	>> ■		
25							DO	50/1" **(50/1")**	1/1	>> ■		
30												

Log continued on next page

DRILLING CO.: Gulf Shore Construction Services
DRILLER: Amador Arroyo
DRILL RIG: LANDA 55

LOGGED: JHC
CHECKED: RPCE
REVIEWED: RH

GOLDER

RECORD OF BOREHOLE BE2-B-2

PROJECT: Sequoia National Park
PROJECT NO.: 20350934
LOCATION: Three Rivers, CA

DRILLING START: 2020 November 18 12:05
DRILLING END: 2020 November 18 14:00
COORDINATES: 36.481389,-118.841901

SHEET: 2 of 2
GS ELEV.: 1375.0
TOC ELEV.: na
DATUM: WGS 84

DEPTH (ft)	BORING METHOD	SOIL PROFILE Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLES SAMPLE TYPE & NUMBER	BLOWS per 6 in (ASTM D1586 140 lb hammer 30 inch drop)	REC ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS LABORATORY DATA	ADDITIONAL LAB TESTING
30		30.0		1345.0								
			(SC) *(continued)*		SC		DO	50/1" **(50/1")**	1/1			
35		35.1		1339.9			DO	50/1" **(50/1")**	0/1			
			Bottom of borehole at 35.1 ft. Groundwater was not encountered during drilling. Backfilled with cement grout.									
40												
45												
50												
55												
60												

DRILLING CO.: Gulf Shore Construction Services
DRILLER: Amador Arroyo
DRILL RIG: LANDA 55

LOGGED: JHC
CHECKED: RPCE
REVIEWED: RH

GOLDER

BE2-B-2
2 of 2

01 - GOLDER - BOREHOLE RECORD - DF STD US LAB E-M.GDT - 20/12/23 14:48
C:\USERS\JCONSOLI\GOLDER ASSOCIATES\20350934, HECO SEKI ADDITIONAL GEOTECH CA - PROJECT FILES\5 TECHNICAL WORK\GINT\HECO SEKI LOGS 20201215.GPJ

RECORD OF BOREHOLE BE2-TP-1

PROJECT: Sequoia National Park
PROJECT NO.: 20350934
LOCATION: Three Rivers, CA

DRILLING START: 2020 November 17 00:00
DRILLING END: 2020 November 17 00:00
COORDINATES: 36.481425,-118.841794

SHEET: 1 of 1
GS ELEV.: 1383.0
TOC ELEV.: na
DATUM: WGS 84

DEPTH (ft)	BORING METHOD	SOIL PROFILE: Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLES: SAMPLE TYPE & NUMBER	BLOWS per 6 in (ASTM D1586 140 lb hammer 30 inch drop)	REC ATT (in)	PENETRATION RESISTANCE BLOWS / ft; WATER CONTENT (%)	NOTES WATER LEVELS LABORATORY DATA	ADDITIONAL LAB TESTING
0		0.0		1383.0								
	MINI-EXCAVATOR	0.3	3" dark brown organic-rich topsoil	1382.8								
			(SC-SM), silty clayey sand, brown; non-cohesive, dry, mostly fine sand. Completely weathered rock to residual soil.				GB		24/24			
			Mostly fine to medium sand.		SC-SM		GB		24/24		2 - 4: Sieve: Gravel = 0%, Sand = 83%, Fines = 17%. Atterberg: LL = 24, PL = 19, PI = 5. Moisture: 6.9%.	
		4.0		1379.0								
5			Bottom of test pit at 4.0 ft. Groundwater was not encountered during excavation. Backfilled with cuttings.									
10												
15												
20												
25												
30												

DRILLING CO.: Gulf Shore Construction Services
DRILLER: Amador Arroyo
DRILL RIG: Mini-Excavator

LOGGED: CB
CHECKED: RPCE
REVIEWED: RH

GOLDER

BE2-TP-1
1 of 1

RECORD OF BOREHOLE BE2-TP-2

PROJECT: Sequoia National Park
PROJECT NO.: 20350934
LOCATION: Three Rivers, CA

DRILLING START: 2020 November 17 00:00
DRILLING END: 2020 November 17 00:00
COORDINATES: 36.481304,-118.841703

SHEET: 1 of 1
GS ELEV.: 1382.0
TOC ELEV.: na
DATUM: WGS 84

DEPTH (ft)	BORING METHOD	SOIL PROFILE: Depth	DESCRIPTION	Elev	USCS	GRAPHIC LOG	SAMPLES: SAMPLE TYPE & NUMBER	BLOWS per 6 in (ASTM D1586 140 lb hammer 30 inch drop)	REC ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS LABORATORY DATA	ADDITIONAL LAB TESTING
0		0.0		1382.0								
	MINI-EXCAVATOR	0.5	6" dark brown organic-rich topsoil	1381.5								
			(SC), clayey sand, brown; non-cohesive, dry, Mostly fine sand. Completely weathered rock to residual soil		SC		GB		24/24		2 - 4: Sieve: Gravel = 2%, Sand = 49%, Fines = 49%.	
			2.5': Mostly fine to medium sand.				GB		24/24			
		4.0	3.5': Becomes highly to completely weathered rock. Excavation becomes very difficult.	1378.0								
5			Bottom of test pit at 4.0 ft. Groundwater was not encountered during excavation. Backfilled with cuttings.									
10												
15												
20												
25												
30												

DRILLING CO.: Gulf Shore Construction Services
DRILLER: Amador Arroyo
DRILL RIG: Mini-Excavator

LOGGED: CB
CHECKED: RPCE
REVIEWED: RH

GOLDER

BE2-TP-2

RECORD OF BOREHOLE BE2-TP-3

PROJECT: Sequoia National Park
PROJECT NO.: 20350934
LOCATION: Three Rivers, CA

DRILLING START: 2020 November 17 00:00
DRILLING END: 2020 November 17 00:00
COORDINATES: 36.481234,-118.841865

SHEET: 1 of 1
GS ELEV.: 1377.0
TOC ELEV.: na
DATUM: WGS 84

DEPTH (ft)	BORING METHOD	SOIL PROFILE: Depth	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: Elev	USCS	GRAPHIC LOG	SAMPLES: SAMPLE TYPE & NUMBER	SAMPLES: BLOWS per 6 in (ASTM D1586 140 lb hammer 30 inch drop)	SAMPLES: REC ATT (in)	PENETRATION RESISTANCE BLOWS / ft; WATER CONTENT (%)	NOTES WATER LEVELS LABORATORY DATA	ADDITIONAL LAB TESTING
0		0.0		1377.0								
	MINI-EXCAVATOR	0.3	3" dark brown organic-rich topsoil	1376.8								
			(SC), clayey sand, brown; non-cohesive, dry, Mostly fine sand. Completely weathered rock to residual soil		SC		GB		24/24			
			2': Becomes highly to completely weathered rock. Mostly fine to medium sand. Excavation becomes very difficult.				GB		24/24		2 - 4: Sieve: Gravel = 3%, Sand = 67%, Fines = 30%. Atterberg: LL = 25, PL = 17, PI = 8. Moisture: 5.2%.	
		4.0		1373.0								
5			Bottom of test pit at 4.0 ft. Groundwater was not encountered during excavation. Backfilled with cuttings.									
10												
15												
20												
25												
30												

DRILLING CO.: Gulf Shore Construction Services
DRILLER: Amador Arroyo
DRILL RIG: Mini-Excavator

LOGGED: JHC
CHECKED: RPCE
REVIEWED: RH

GOLDER

BE2-TP-3
1 of 1

RECORD OF BOREHOLE BE2-TP-4

PROJECT: Sequoia National Park
PROJECT NO.: 20350934
LOCATION: Three Rivers, CA

DRILLING START: 2020 November 17 00:00
DRILLING END: 2020 November 17 00:00
COORDINATES: 36.481389,-118.841901

SHEET: 1 of 1
GS ELEV.: 1375.0
TOC ELEV.: na
DATUM: WGS 84

DEPTH (ft)	BORING METHOD	SOIL PROFILE: Depth	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: Elev	USCS	GRAPHIC LOG	SAMPLES: SAMPLE TYPE & NUMBER	SAMPLES: BLOWS per 6 in (ASTM D1586 140 lb hammer 30 inch drop)	SAMPLES: REC ATT (in)	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (%) (W_p W W_l) (20 40 60 80)	NOTES WATER LEVELS LABORATORY DATA	ADDITIONAL LAB TESTING
0		0.0		1375.0								
	MINI-EXCAVATOR	0.3	3" dark brown organic-rich topsoil	1374.8								
			(SC), clayey sand, brown; non-cohesive, dry, Mostly fine sand. Completely weathered rock to residual soil				GB		24/24			
			2': Becomes highly to completely weathered rock. Mostly fine to medium sand. Excavation becomes very difficult. 3': Becomes dry to moist.		SC		GB		24/24		2 - 4: Sieve: Gravel = 1%, Sand = 61%, Fines = 38%.	
		4.0		1371.0								
5			Bottom of test pit at 4.0 ft. Groundwater was not encountered during excavation. Backfilled with cuttings.									
10												
15												
20												
25												
30												

DRILLING CO.: Gulf Shore Construction Services
DRILLER: Amador Arroyo
DRILL RIG: Mini-Excavator

LOGGED: JHC
CHECKED: RPCE
REVIEWED: RH

GOLDER

BE2-TP-4
1 of 1

APPENDIX B

Percolation Test Data

Percolation Boring Test Data Sheet

Project Name: HECO SEKI Additional Geotechnical Exploration
Project Number: 20350934
Date: 11/18/2020
Location: Ash Mountain
Boring ID: AM2-TP-1

Test hole dimensions	
Boring Depth (feet)*:	4.0
Boring Diameter (inches):	8
Total Pipe Length (feet):	5.0
Pipe Diameter (inches):	1

*measured at time of test

Miscellaneous Test Details	
Liquid Description:	Clean water
Measurement Method:	Water level sounder
Depth to Water Table:	Unknown, not encountered
Water Remaining In Boring:	Yes
Tested By:	C. Battistella
Checked By:	J. Consoli

Pre-Soak/Pre-Test

Reading No.	Start Time	Stop Time	Time Interval (min)	Initial Depth to Water (feet)	Final Depth to Water (feet)	Total Change in Water Level (feet)	Comments
Pre-Test	11/17/20 12:27	11/17/20 16:15	228.0	3.50	4.15	0.65	
Pre-Test	11/17/20 16:15	11/18/20 12:00	1185.0	3.28	4.62	1.34	

Percolation Test Data

Reading No.	Start Time	Stop Time	Time Interval, Δt (min)	Initial Depth to Water, D_o (feet)	Final Depth to Water, D_f (feet)	Change in Water Level, ΔD (inches)	% Change from Prior Reading	Percolation Rate (in/hr)	Percolation Rate (min/in)
1	12:00	12:30	30.0	4.34	4.34	0.00		0.0	Cannot Calculate
2	12:30	13:00	30.0	4.34	4.37	0.36	Cannot Calculate	0.7	83.3
3	13:00	13:30	30.0	4.37	4.38	0.12	67%	0.2	250.0
4	13:30	14:00	30.0	4.38	4.40	0.24	100%	0.5	125.0
5	14:00	14:30	30.0	4.40	4.40	0.00	100%	0.0	Cannot Calculate
6	14:30	15:00	30.0	4.40	4.43	0.36	Cannot Calculate	0.7	83.3
7	15:00	15:30	30.0	4.43	4.44	0.12	67%	0.2	250.0
8	15:30	16:00	30.0	4.44	4.46	0.24	100%	0.5	125.0

Percolation Test Results

Percolation Rate (minutes/inch): 125.0

Percolation Boring Test Data Sheet

Project Name: HECO SEKI Additional Geotechnical Exploration
Project Number: 20350934
Date: 11/18/2020
Location: Ash Mountain
Boring ID: AM2-TP-2

Test hole dimensions	
Boring Depth (feet)*:	4.0
Boring Diameter (inches):	8
Total Pipe Length (feet):	5.0
Pipe Diameter (inches):	1

*measured at time of test

Miscellaneous Test Details	
Liquid Description:	Clean water
Measurement Method:	Water level sounder
Depth to Water Table:	Unknown, not encountered
Water Remaining In Boring:	Yes
Tested By:	C. Battistella
Checked By:	J. Consoli

Pre-Soak/Pre-Test

Reading No.	Start Time	Stop Time	Time Interval (min)	Initial Depth to Water (feet)	Final Depth to Water (feet)	Total Change in Water Level (feet)	Comments
Pre-Test	11/17/20 12:30	11/17/20 16:20	230.0	3.96	4.15	0.19	
Pre-Test	11/17/20 16:20	11/18/20 12:05	1185.0	3.41	3.69	0.28	

Percolation Test Data

Reading No.	Start Time	Stop Time	Time Interval, Δt (min)	Initial Depth to Water, D_o (feet)	Final Depth to Water, D_f (feet)	Change in Water Level, ΔD (inches)	% Change from Prior Reading	Percolation Rate (in/hr)	Percolation Rate (min/in)
1	12:05	12:35	30.0	3.69	3.69	0.00		0.0	Cannot Calculate
2	12:35	13:05	30.0	3.69	3.70	0.12	Cannot Calculate	0.2	250.0
3	13:05	13:35	30.0	3.70	3.71	0.12	0%	0.2	250.0
4	13:35	14:05	30.0	3.71	3.71	0.00	100%	0.0	Cannot Calculate
5	14:05	14:35	30.0	3.71	3.71	0.00	0%	0.0	Cannot Calculate
6	14:35	15:05	30.0	3.71	3.71	0.00	0%	0.0	Cannot Calculate
7	15:05	15:35	30.0	3.71	3.71	0.00	0%	0.0	Cannot Calculate
8	15:35	16:05	30.0	3.71	3.71	0.00	0%	0.0	Cannot Calculate

Percolation Test Results

Percolation Rate (minutes/inch): 250.0

Percolation Boring Test Data Sheet

Project Name: HECO SEKI Additional Geotechnical Exploration
Project Number: 20350934
Date: 11/18/2020
Location: Ash Mountain
Boring ID: AM2-TP-3

Test hole dimensions	
Boring Depth (feet)*:	4.0
Boring Diameter (inches):	8
Total Pipe Length (feet):	5.0
Pipe Diameter (inches):	1

*measured at time of test

Miscellaneous Test Details	
Liquid Description:	Clean water
Measurement Method:	Water level sounder
Depth to Water Table:	Unknown, not encountered
Water Remaining In Boring:	Yes
Tested By:	C. Battistella
Checked By:	J. Consoli

Pre-Soak/Pre-Test

Reading No.	Start Time	Stop Time	Time Interval (min)	Initial Depth to Water (feet)	Final Depth to Water (feet)	Total Change in Water Level (feet)	Comments
Pre-Test	11/17/20 12:37	11/17/20 16:25	228.0	3.58	3.96	0.38	
Pre-Test	11/17/20 16:25	11/18/20 12:10	1185.0	3.47	4.21	0.74	

Percolation Test Data

Reading No.	Start Time	Stop Time	Time Interval, Δt (min)	Initial Depth to Water, D_o (feet)	Final Depth to Water, D_f (feet)	Change in Water Level, ΔD (inches)	% Change from Prior Reading	Percolation Rate (in/hr)	Percolation Rate (min/in)
1	12:10	12:40	30.0	4.21	4.22	0.12		0.2	250.0
2	12:40	13:10	30.0	4.22	4.23	0.12	0%	0.2	250.0
3	13:10	13:40	30.0	4.23	4.24	0.12	0%	0.2	250.0
4	13:40	14:10	30.0	4.24	4.25	0.12	0%	0.2	250.0
5	14:10	14:40	30.0	4.25	4.25	0.00	100%	0.0	Cannot Calculate
6	14:40	15:10	30.0	4.25	4.26	0.12	Cannot Calculate	0.2	250.0
7	15:10	15:40	30.0	4.26	4.27	0.12	0%	0.2	250.0
8	15:40	16:10	30.0	4.27	4.28	0.12	0%	0.2	250.0

Percolation Test Results

Percolation Rate (minutes/inch): 250.0

Percolation Boring Test Data Sheet

Project Name: HECO SEKI Additional Geotechnical Exploration
Project Number: 20350934
Date: 11/18/2020
Location: Ash Mountain
Boring ID: AM2-TP-4

Test hole dimensions	
Boring Depth (feet)*:	4.0
Boring Diameter (inches):	8
Total Pipe Length (feet):	5.0
Pipe Diameter (inches):	1

*measured at time of test

Miscellaneous Test Details	
Liquid Description:	Clean water
Measurement Method:	Water level sounder
Depth to Water Table:	Unknown, not encountered
Water Remaining In Boring:	Yes
Tested By:	C. Battistella
Checked By:	J. Consoli

Pre-Soak/Pre-Test

Reading No.	Start Time	Stop Time	Time Interval (min)	Initial Depth to Water (feet)	Final Depth to Water (feet)	Total Change in Water Level (feet)	Comments
Pre-Test	11/17/20 12:42	11/17/20 16:30	228.0	3.55	4.31	0.76	
Pre-Test	11/17/20 16:30	11/18/20 12:15	1185.0	3.16	4.59	1.43	

Percolation Test Data

Reading No.	Start Time	Stop Time	Time Interval, Δt (min)	Initial Depth to Water, D_o (feet)	Final Depth to Water, D_f (feet)	Change in Water Level, ΔD (inches)	% Change from Prior Reading	Percolation Rate (in/hr)	Percolation Rate (min/in)
1	12:15	12:45	30.0	4.41	4.60	2.28		4.6	13.2
2	12:45	13:15	30.0	4.42	4.43	0.12	95%	0.2	250.0
3	13:15	13:45	30.0	4.43	4.44	0.12	0%	0.2	250.0
4	13:45	14:15	30.0	4.44	4.46	0.24	100%	0.5	125.0
5	14:15	14:45	30.0	4.46	4.48	0.24	0%	0.5	125.0
6	14:45	15:15	30.0	4.48	4.50	0.24	0%	0.5	125.0
7	15:15	15:45	30.0	4.50	4.52	0.24	0%	0.5	125.0
8	15:45	16:15	30.0	4.52	4.54	0.24	0%	0.5	125.0

Percolation Test Results

Percolation Rate (minutes/inch): 250.0

Percolation Boring Test Data Sheet

Project Name: HECO SEKI Additional Geotechnical Exploration
Project Number: 20350934
Date: 11/19/2020
Location: Buckeye
Boring ID: BE2-TP-1

Test hole dimensions	
Boring Depth (feet)*:	4.2
Boring Diameter (inches):	8
Total Pipe Length (feet):	5.0
Pipe Diameter (inches):	1

*measured at time of test

Miscellaneous Test Details	
Liquid Description:	Clean water
Measurement Method:	Water level sounder
Depth to Water Table:	Unknown, not encountered
Water Remaining In Boring:	Yes
Tested By:	C. Battistella
Checked By:	J. Consoli

Pre-Soak/Pre-Test

Reading No.	Start Time	Stop Time	Time Interval (min)	Initial Depth to Water (feet)	Final Depth to Water (feet)	Total Change in Water Level (feet)	Comments
Pre-Test	11/17/20 15:10	11/18/20 9:58	1128.0	3.15	dry	>1.85	
Pre-Test	11/18/20 9:58	11/18/20 10:28	30.0	2.99	3.20	0.21	

Percolation Test Data

Reading No.	Start Time	Stop Time	Time Interval, Δt (min)	Initial Depth to Water, D_o (feet)	Final Depth to Water, D_f (feet)	Change in Water Level, ΔD (inches)	% Change from Prior Reading	Percolation Rate (in/hr)	Percolation Rate (min/in)
1	8:00	8:30	30.0	3.87	4.01	1.68		3.4	17.9
2	8:30	9:00	30.0	4.01	4.08	0.84	50%	1.7	35.7
3	9:00	9:30	30.0	4.08	4.16	0.96	14%	1.9	31.2
4	9:30	10:00	30.0	4.16	4.24	0.96	0%	1.9	31.3
5	10:00	10:30	30.0	4.24	4.31	0.84	13%	1.7	35.7
6	10:30	11:00	30.0	4.31	4.38	0.84	0%	1.7	35.7
7	11:00	11:30	30.0	4.38	4.43	0.60	29%	1.2	50.0
8	11:30	12:00	30.0	4.43	4.47	0.48	20%	1.0	62.5

Percolation Test Results

Percolation Rate (minutes/inch): 31.3

Percolation Boring Test Data Sheet

Project Name: HECO SEKI Additional Geotechnical Exploration
Project Number: 20350934
Date: 11/19/2020
Location: Buckeye
Boring ID: BE2-TP-2

Test hole dimensions	
Boring Depth (feet)*:	4.0
Boring Diameter (inches):	8
Total Pipe Length (feet):	5.0
Pipe Diameter (inches):	1

*measured at time of test

Miscellaneous Test Details	
Liquid Description:	Clean water
Measurement Method:	Water level sounder
Depth to Water Table:	Unknown, not encountered
Water Remaining In Boring:	Yes
Tested By:	C. Battistella
Checked By:	J. Consoli

Pre-Soak/Pre-Test

Reading No.	Start Time	Stop Time	Time Interval (min)	Initial Depth to Water (feet)	Final Depth to Water (feet)	Total Change in Water Level (feet)	Comments
Pre-Test	11/17/20 15:17	11/18/20 9:53	1116.0	3.58	dry	>1.42	
Pre-Test	11/18/20 9:53	11/18/20 10:23	30.0	3.02	3.19	0.17	

Percolation Test Data

Reading No.	Start Time	Stop Time	Time Interval, Δt (min)	Initial Depth to Water, D_o (feet)	Final Depth to Water, D_f (feet)	Change in Water Level, ΔD (inches)	% Change from Prior Reading	Percolation Rate (in/hr)	Percolation Rate (min/in)
1	8:05	8:35	30.0	3.79	3.90	1.32		2.6	22.7
2	8:35	9:05	30.0	3.90	4.00	1.20	9%	2.4	25.0
3	9:05	9:35	30.0	4.00	4.04	0.48	60%	1.0	62.5
4	9:35	10:05	30.0	4.04	4.10	0.72	50%	1.4	41.7
5	10:05	10:35	30.0	4.10	4.16	0.72	0%	1.4	41.7
6	10:35	11:05	30.0	4.16	4.22	0.72	0%	1.4	41.7
7	11:05	11:35	30.0	4.22	4.28	0.72	0%	1.4	41.7
8	11:35	12:05	30.0	4.28	4.33	0.60	17%	1.2	50.0

Percolation Test Results

Percolation Rate (minutes/inch): 41.7

Percolation Boring Test Data Sheet

Project Name: HECO SEKI Additional Geotechnical Exploration
Project Number: 20350934
Date: 11/19/2020
Location: Buckeye
Boring ID: BE2-TP-3

Test hole dimensions	
Boring Depth (feet)*:	4.0
Boring Diameter (inches):	8
Total Pipe Length (feet):	5.0
Pipe Diameter (inches):	1

*measured at time of test

Miscellaneous Test Details	
Liquid Description:	Clean water
Measurement Method:	Water level sounder
Depth to Water Table:	Unknown, not encountered
Water Remaining In Boring:	Yes
Tested By:	C. Battistella
Checked By:	J. Consoli

Pre-Soak/Pre-Test

Reading No.	Start Time	Stop Time	Time Interval (min)	Initial Depth to Water (feet)	Final Depth to Water (feet)	Total Change in Water Level (feet)	Comments
Pre-Test	11/17/20 14:58	11/18/20 9:28	1110.0	3.66	dry	>1.34	
Pre-Test	11/18/20 9:42	11/18/20 10:12	30.0	3.06	3.27	0.21	

Percolation Test Data

Reading No.	Start Time	Stop Time	Time Interval, Δt (min)	Initial Depth to Water, D_o (feet)	Final Depth to Water, D_f (feet)	Change in Water Level, ΔD (inches)	% Change from Prior Reading	Percolation Rate (in/hr)	Percolation Rate (min/in)
1	8:10	8:40	30.0	3.83	3.88	0.60		1.2	50.0
2	8:40	9:10	30.0	3.88	3.93	0.60	0%	1.2	50.0
3	9:10	9:40	30.0	3.93	3.98	0.60	0%	1.2	50.0
4	9:40	10:10	30.0	3.98	4.02	0.48	20%	1.0	62.5
5	10:10	10:40	30.0	4.02	4.05	0.36	25%	0.7	83.3
6	10:40	11:10	30.0	4.05	4.09	0.48	33%	1.0	62.5
7	11:10	11:40	30.0	4.09	4.13	0.48	0%	1.0	62.5
8	11:40	12:10	30.0	4.13	4.16	0.36	25%	0.7	83.3

Percolation Test Results

Percolation Rate (minutes/inch): 50.0

Percolation Boring Test Data Sheet

Project Name: HECO SEKI Additional Geotechnical Exploration
Project Number: 20350934
Date: 11/19/2020
Location: Buckeye
Boring ID: BE2-TP-4

Test hole dimensions	
Boring Depth (feet)*:	4.1
Boring Diameter (inches):	8
Total Pipe Length (feet):	5.0
Pipe Diameter (inches):	1

*measured at time of test

Miscellaneous Test Details	
Liquid Description:	Clean water
Measurement Method:	Water level sounder
Depth to Water Table:	Unknown, not encountered
Water Remaining In Boring:	Yes
Tested By:	C. Battistella
Checked By:	J. Consoli

Pre-Soak/Pre-Test

Reading No.	Start Time	Stop Time	Time Interval (min)	Initial Depth to Water (feet)	Final Depth to Water (feet)	Total Change in Water Level (feet)	Comments
Pre-Test	11/17/20 15:05	11/18/20 9:45	1120.0	3.20	4.34	1.14	
Pre-Test	11/18/20 9:45	11/18/20 10:15	30.0	3.14	3.20	0.06	

Percolation Test Data

Reading No.	Start Time	Stop Time	Time Interval, Δt (min)	Initial Depth to Water, D_o (feet)	Final Depth to Water, D_f (feet)	Change in Water Level, ΔD (inches)	% Change from Prior Reading	Percolation Rate (in/hr)	Percolation Rate (min/in)
1	8:15	8:45	30.0	4.23	4.24	0.12		0.2	250.0
2	8:45	9:15	30.0	4.24	4.26	0.24	100%	0.5	125.0
3	9:15	9:45	30.0	4.26	4.27	0.12	50%	0.2	250.0
4	9:45	10:15	30.0	4.27	4.29	0.24	100%	0.5	125.0
5	10:15	10:45	30.0	4.29	4.30	0.12	50%	0.2	250.0
6	10:45	11:15	30.0	4.30	4.31	0.12	0%	0.2	250.0
7	11:15	11:45	30.0	4.31	4.32	0.12	0%	0.2	250.0
8	11:45	12:15	30.0	4.32	4.34	0.24	100%	0.5	125.0

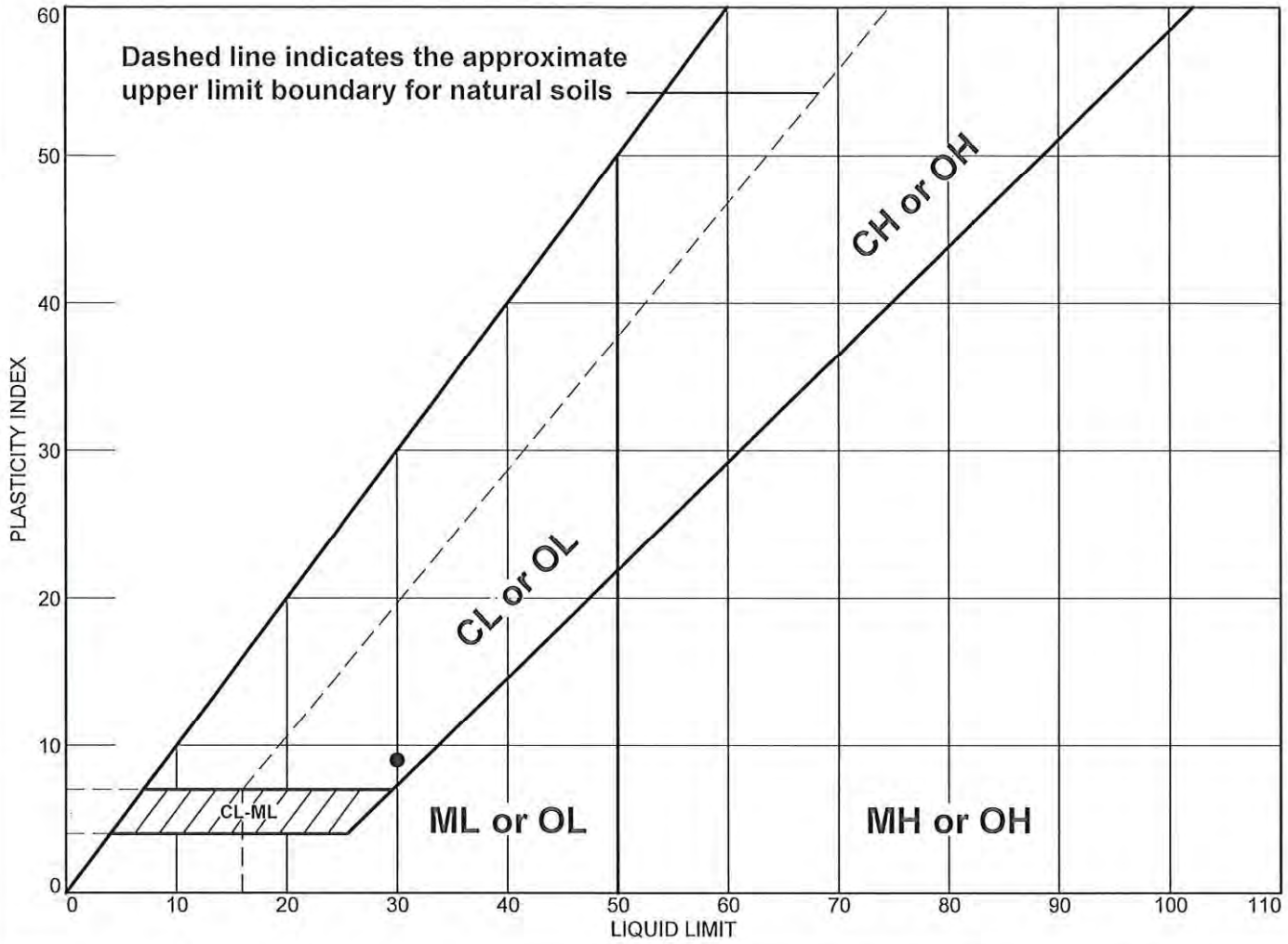
Percolation Test Results

Percolation Rate (minutes/inch): 250.0

APPENDIX C

Geotechnical Laboratory Testing Results

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		30	21	9	79	36	SC

Project No. 20-141 **Client:** Golder Associates

Project: HECO SEKI

● **Location:** AM2-TP-1 **Depth:** 2'-4' **Sample Number:** 58833

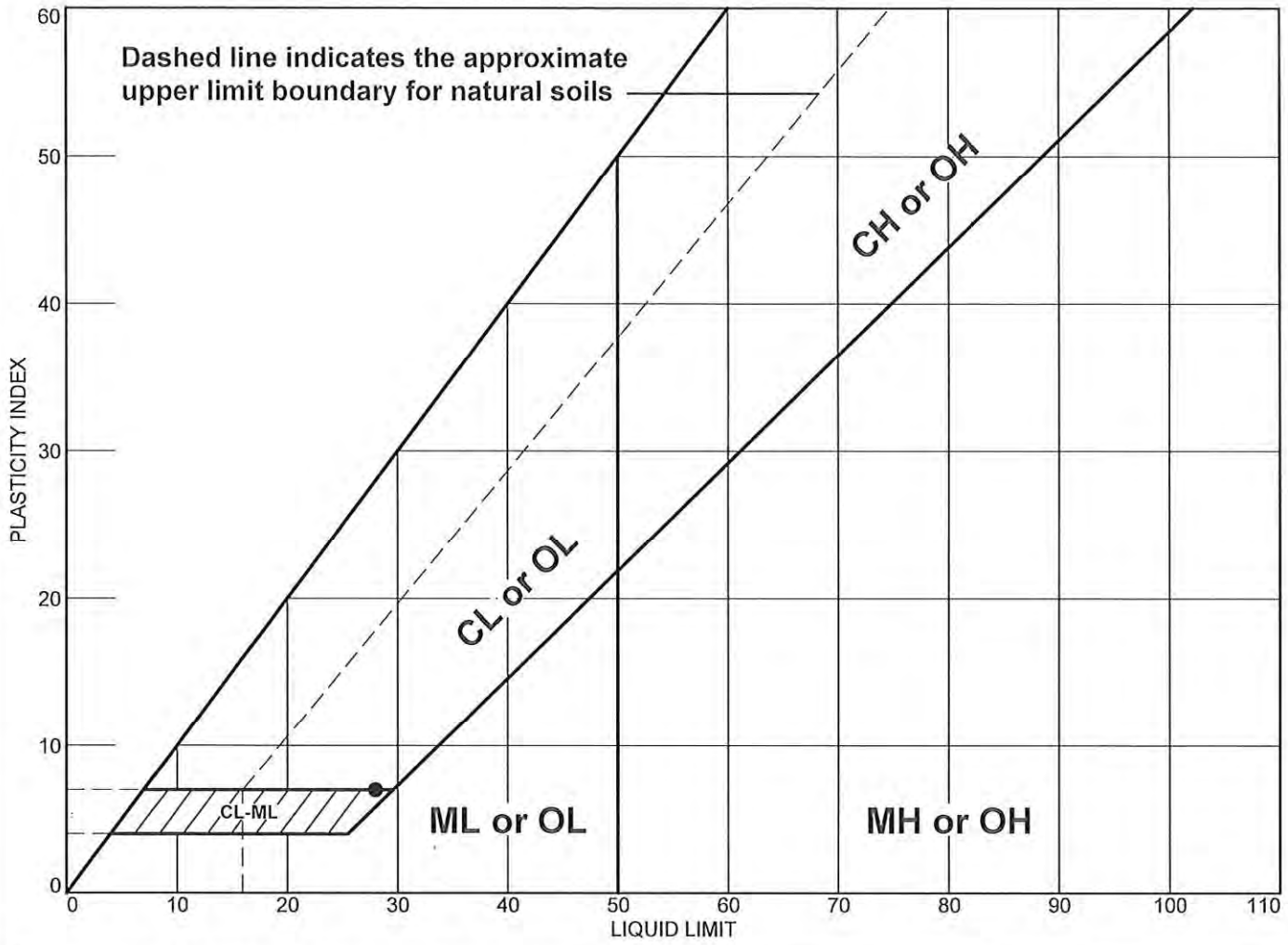
Remarks:

GULF SHORE EXPLORATION AND TESTING

Figure

Tested By: CP **Checked By:** JML

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		28	21	7	64	29	SC-SM

Project No. 20-141 **Client:** Golder Associates

Project: HECO SEKI

● **Location:** AM2-TP-3 **Depth:** 2'-4' **Sample Number:** 58835

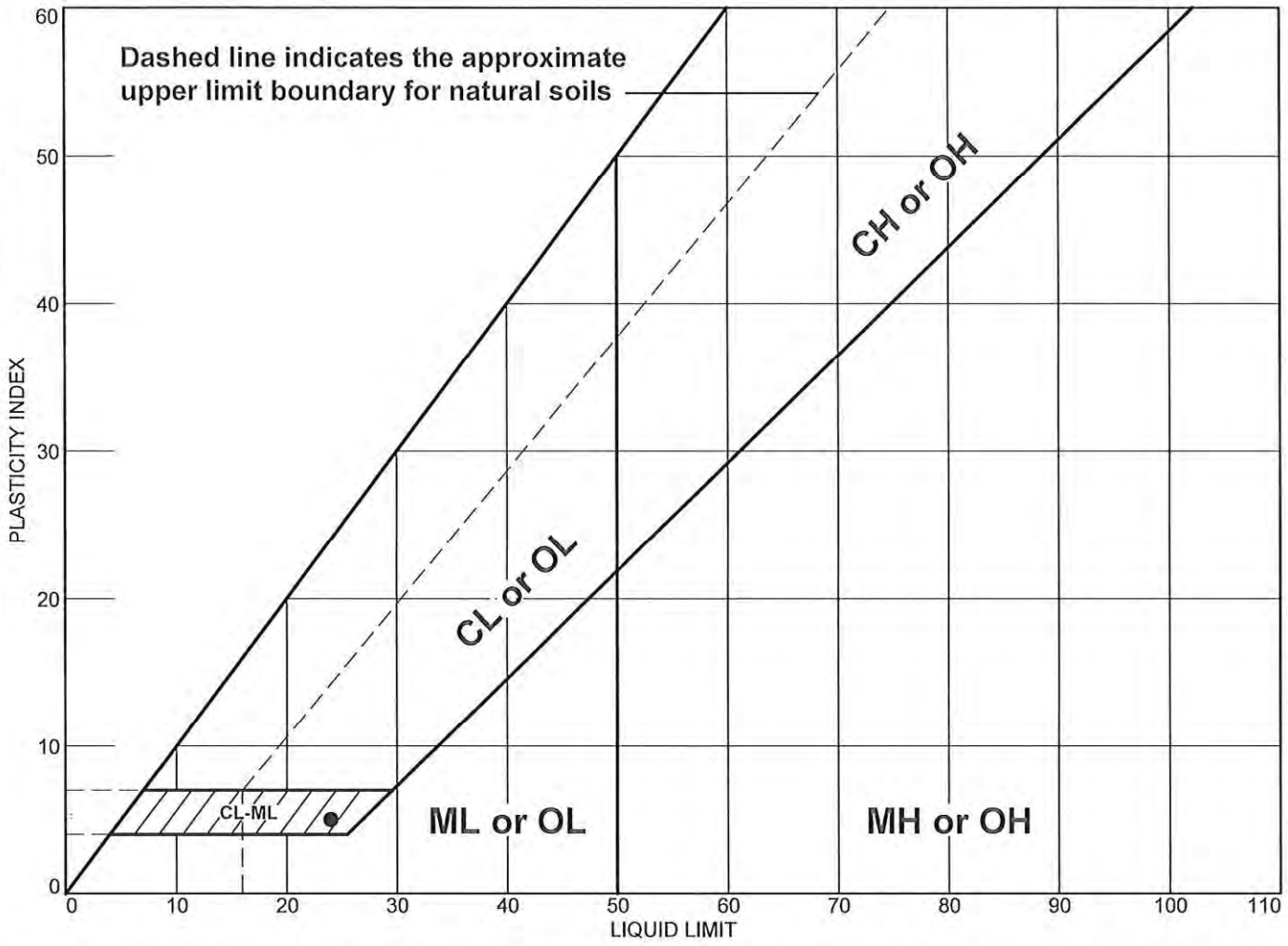
Remarks:

GULF SHORE EXPLORATION AND TESTING

Figure

Tested By: FI **Checked By:** JML

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		24	19	5	66	17	SC-SM

Project No. 20-141 **Client:** Golder Associates

Project: HECO SEKI

● **Location:** BE2-TP-1 **Depth:** 2'-4' **Sample Number:** 58840

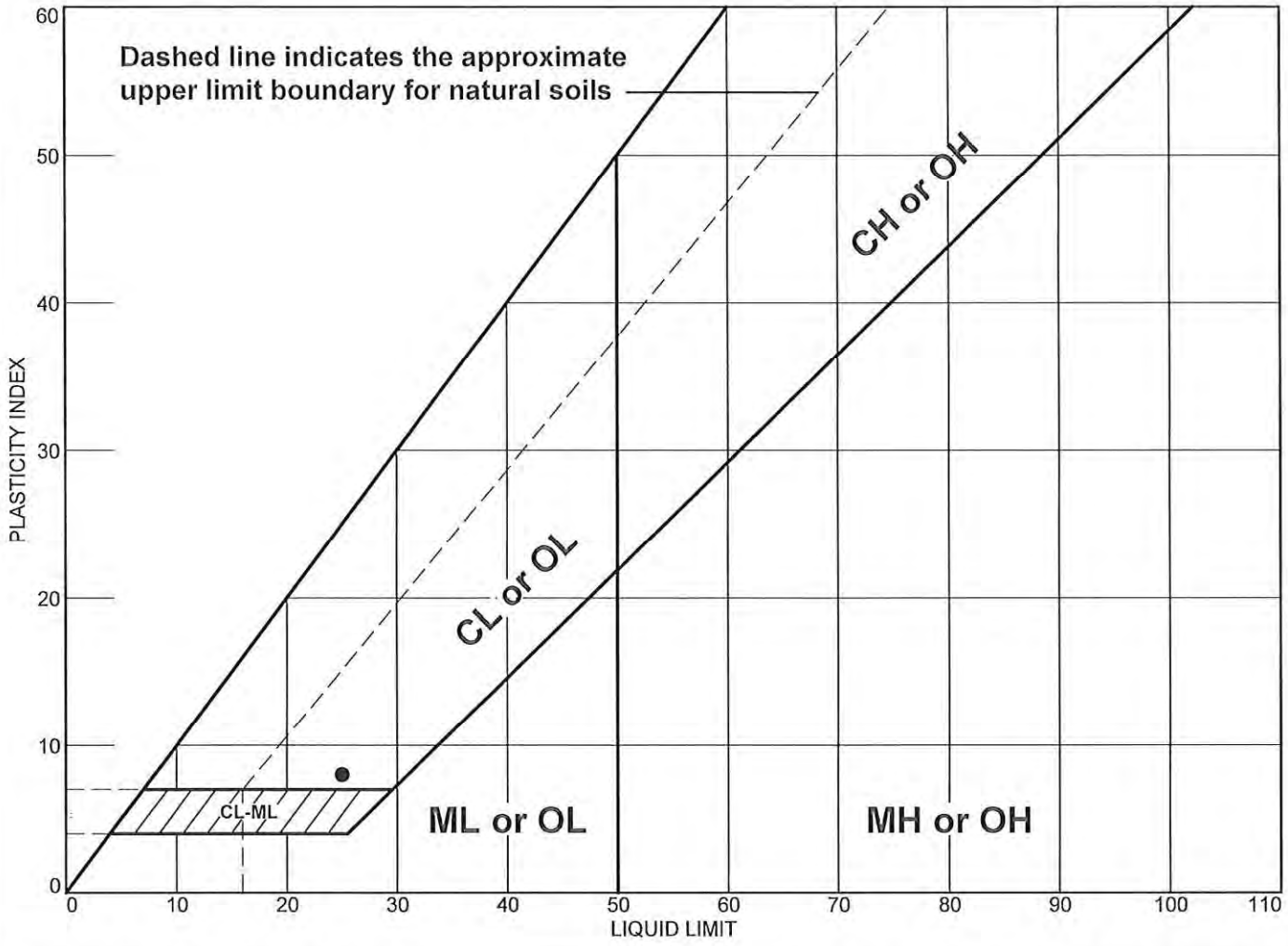
Remarks:

GULF SHORE EXPLORATION AND TESTING

Figure

Tested By: MM **Checked By:** JML

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		25	17	8	75	30	SC

Project No. 20-141 **Client:** Golder Associates

Project: HECO SEKI

● **Location:** BE2-TP-3 **Depth:** 2'-4' **Sample Number:** 58842

Remarks:

GULF SHORE EXPLORATION AND TESTING

Figure

Tested By: FI **Checked By:** JML

MOISTURE CONTENT TEST RESULTS

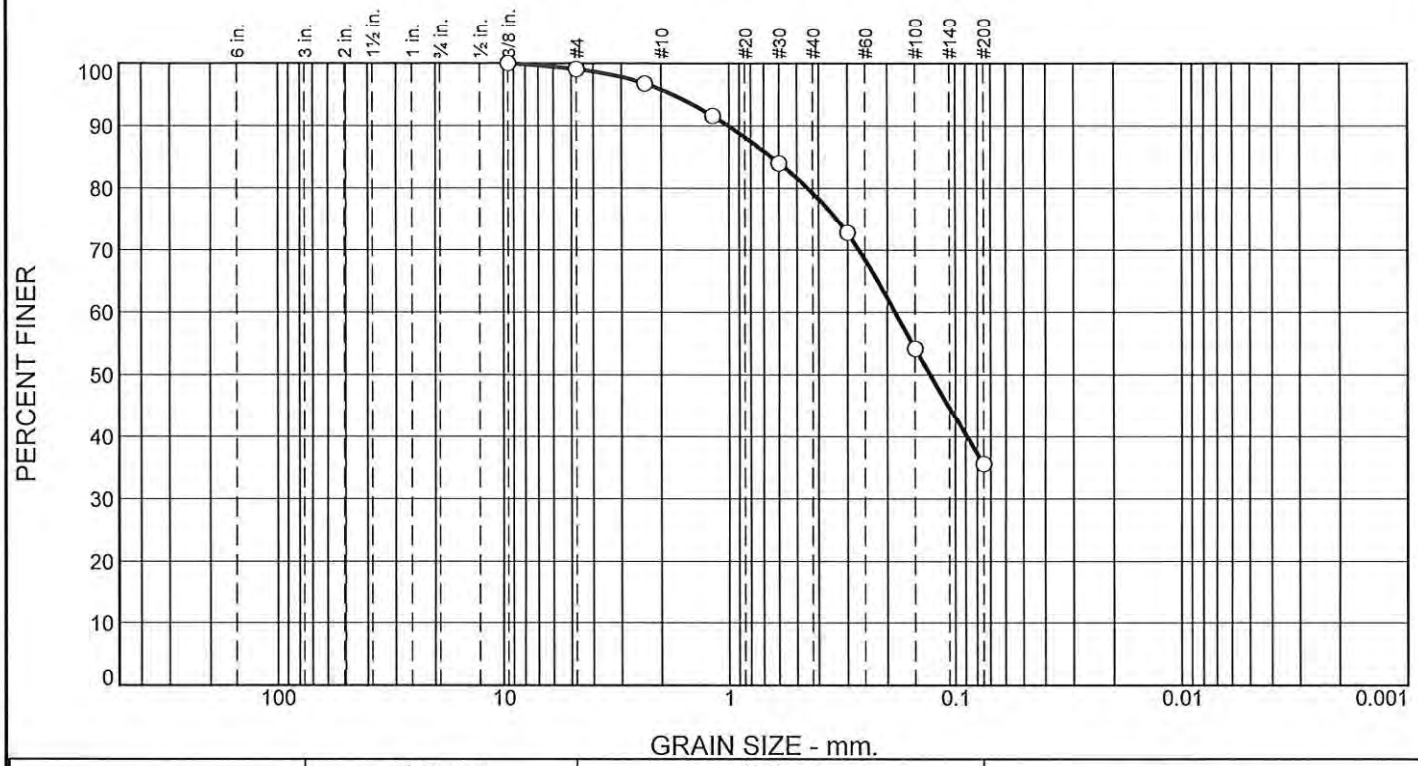
Sample Identification	Depth, ft.	Moisture Content, %
AM2-TP-1	2'-4'	8.0
AM2-TP-3	2'-4'	6.9
BE2-TP-1	2'-4'	6.9
BE2-TP-3	2'-4'	5.2

Test Method: ASTM D2216

PROJECT NUMBER:	20-141	December 1, 2020	HECO SEKI

GULF SHORE EXPLORATION AND TESTING
3362 Fitzgerald Road
Rancho Cordova, CA 95742
Phone: (916) 939-4117
FAX: (916) 635-4315

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
0	0	1	3	17	43	36

Test Results (ASTM D6913 & ASTM D1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3/8 Inch	100		
#4	99		
#8	97		
#16	92		
#30	84		
#50	73		
#100	54		
#200	36		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= 21 LL= 30 PI= 9

Classification

USCS (D 2487)= SC AASHTO (M 145)= A-4(0)

Coefficients

D_{90}= 1.0071 D_{85}= 0.6490 D_{60}= 0.1839
D_{50}= 0.1289 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

F.M.=1.02

Date Received: 11/23/20 **Date Tested:** 12/2/20

Tested By: JB

Checked By: JML

Title: PM

Location: AM2-TP-1 **Date Sampled:** -

Sample Number: 58833 **Depth:** 2'-4'

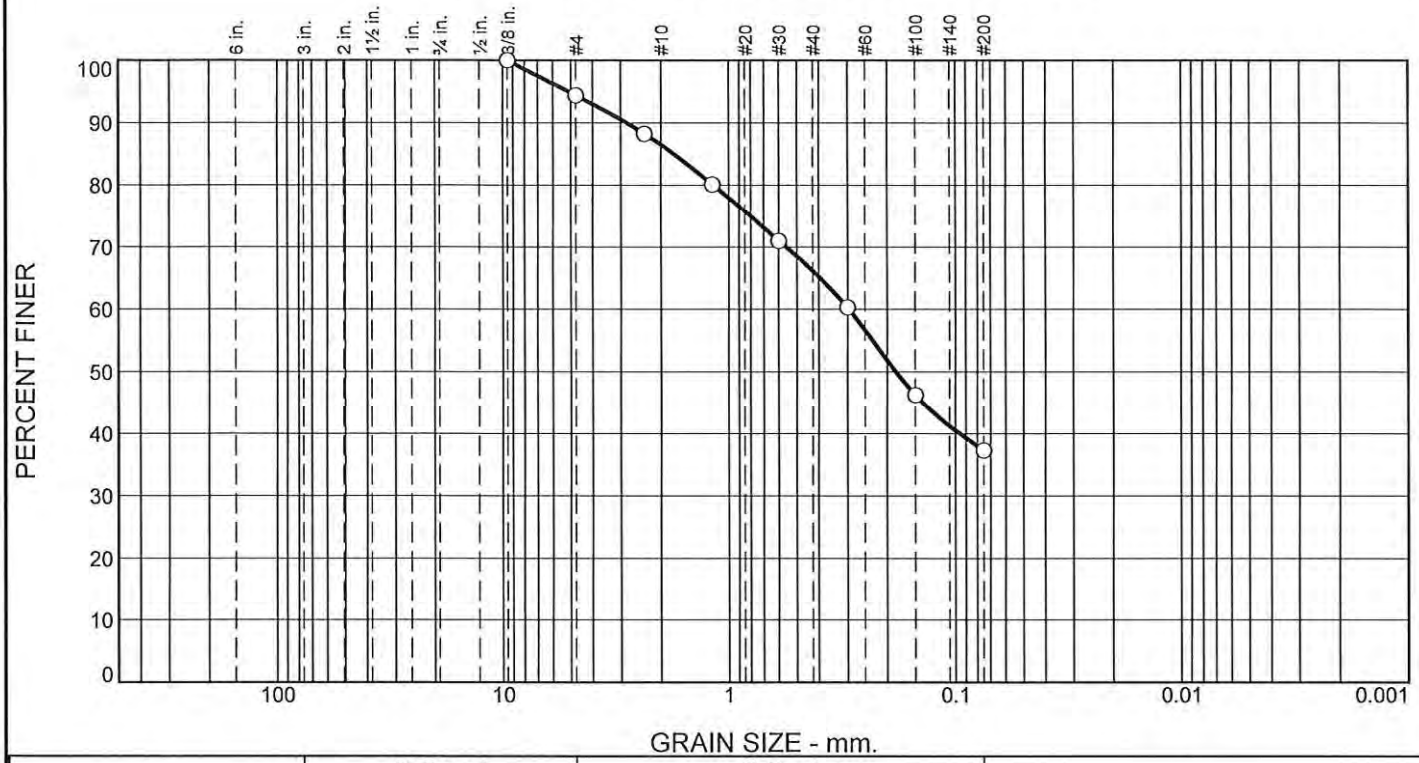
GULF SHORE EXPLORATION AND TESTING

Client: Golder Associates

Project: HECO SEKI

Project No: 20-141 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
0	0	6	7	21	29	37

Test Results (ASTM D6913 & ASTM D1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3/8 Inch	100		
#4	94		
#8	88		
#16	80		
#30	71		
#50	60		
#100	46		
#200	37		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS (D 2487)= AASHTO (M 145)=

Coefficients

D_{90}= 2.8276 D_{85}= 1.7501 D_{60}= 0.2950
D_{50}= 0.1823 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

F.M.=1.60

Date Received: 11/23/20 **Date Tested:** 12/2/20

Tested By: JB

Checked By: JML

Title: PM

Location: AM2-TP-2
Sample Number: 58834 **Depth:** 2'-4'

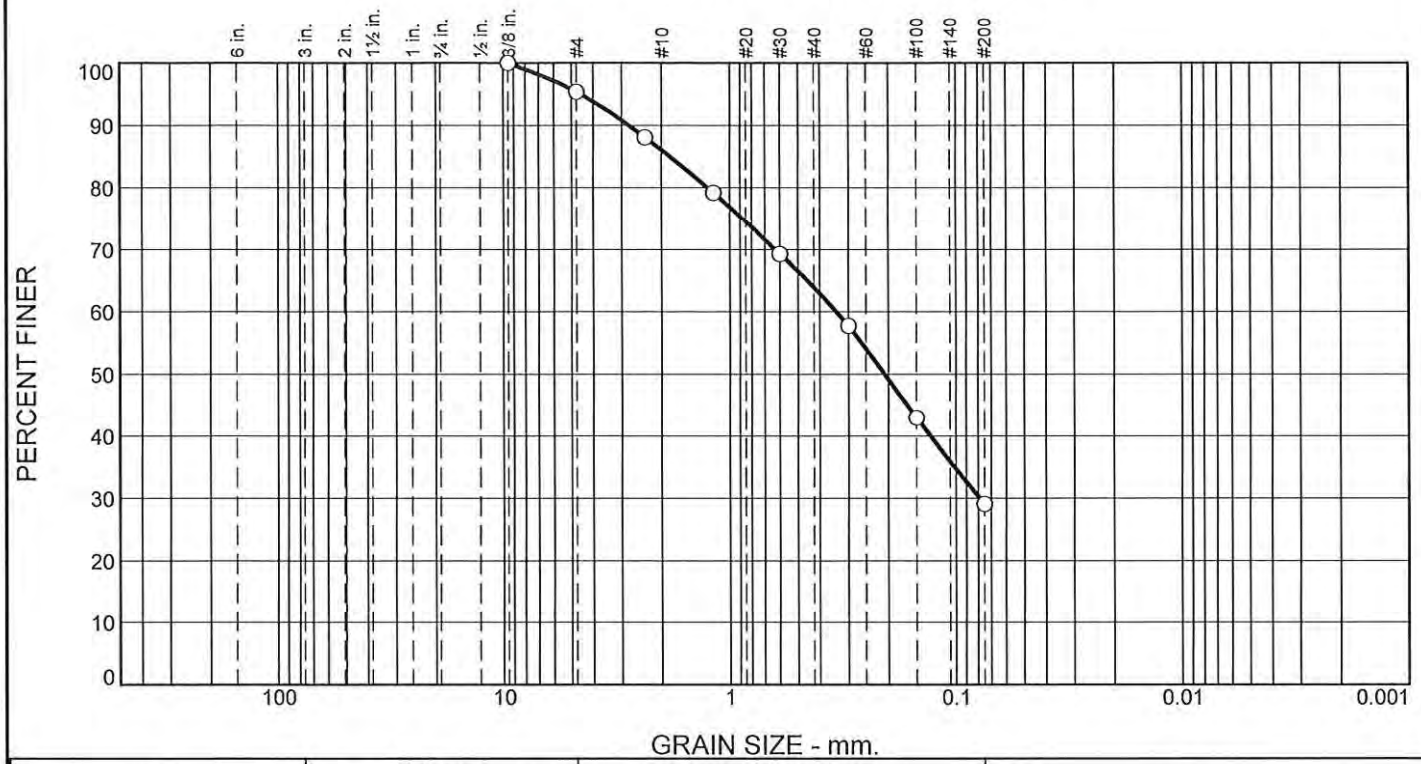
Date Sampled: -

GULF SHORE EXPLORATION AND TESTING

Client: Golder Associates
Project: HECO SEKI

Project No: 20-141 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
0	0	5	9	22	35	29

Test Results (ASTM D6913 & ASTM D1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3/8 Inch	100		
#4	95		
#8	88		
#16	79		
#30	69		
#50	58		
#100	43		
#200	29		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= 21 LL= 28 PI= 7

Classification

USCS (D 2487)= SC-SM AASHTO (M 145)= A-2-4(0)

Coefficients

D_{90}= 2.7880 D_{85}= 1.8353 D_{60}= 0.3385
D_{50}= 0.2069 D_{30}= 0.0786 D_{15}=
D_{10}= C_u= C_c=

Remarks

F.M.=1.67

Date Received: 11/23/20 **Date Tested:** 12/2/20

Tested By: JB

Checked By: JML

Title: PM

Location: AM2-TP-3 **Date Sampled:** -

Sample Number: 58835 **Depth:** 2'-4'

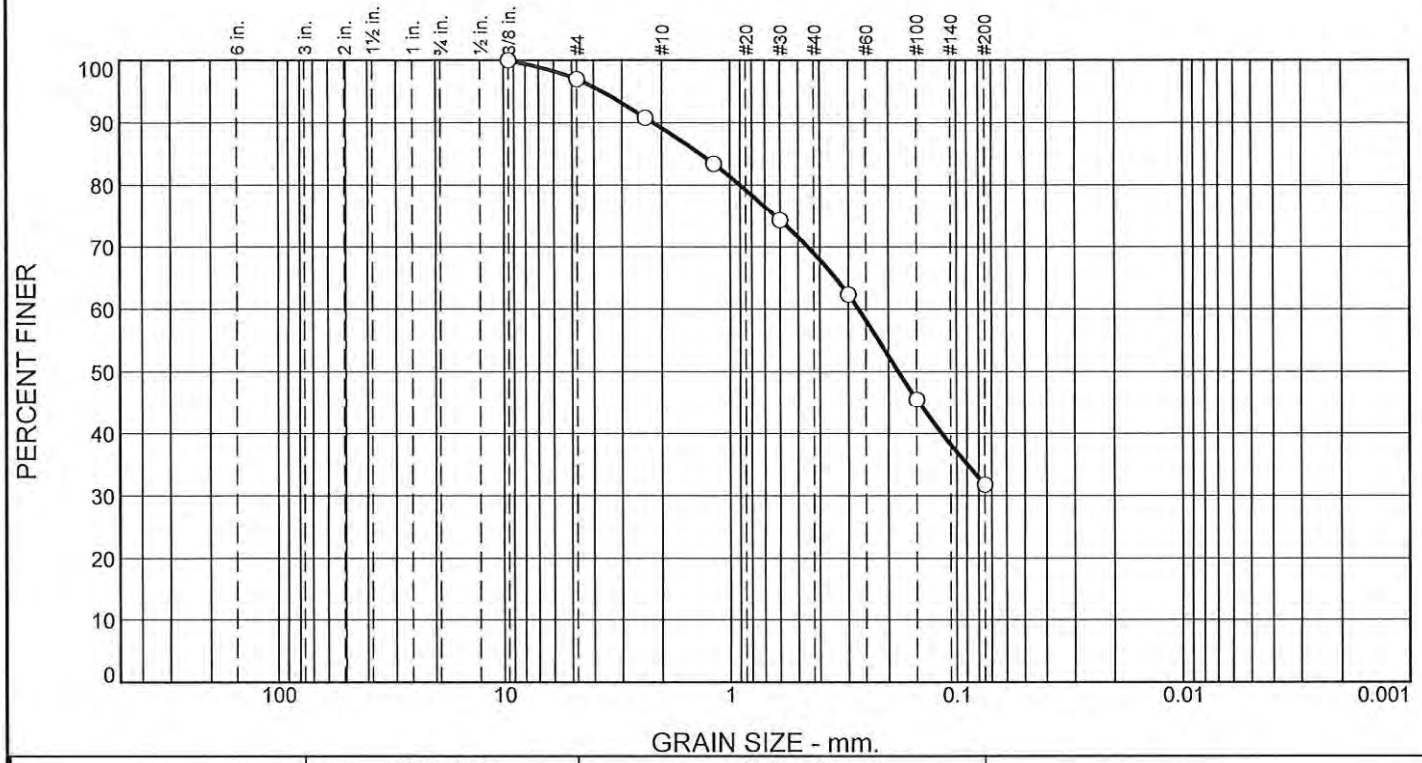
GULF SHORE EXPLORATION AND TESTING

Client: Golder Associates

Project: HECO SEKI

Project No: 20-141 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
0	0	3	8	20	37	32

Test Results (ASTM D6913 & ASTM D1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3/8 Inch	100		
#4	97		
#8	91		
#16	83		
#30	74		
#50	62		
#100	46		
#200	32		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS (D 2487)= AASHTO (M 145)=

Coefficients

D_{90}= 2.1843 D_{85}= 1.3532 D_{60}= 0.2701
D_{50}= 0.1806 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

F.M.=1.47

Date Received: 11/23/20 **Date Tested:** 12/2/20

Tested By: JB

Checked By: JML

Title: PM

Location: AM2-TP-4 **Date Sampled:** -

Sample Number: 58836 **Depth:** 2'-4'

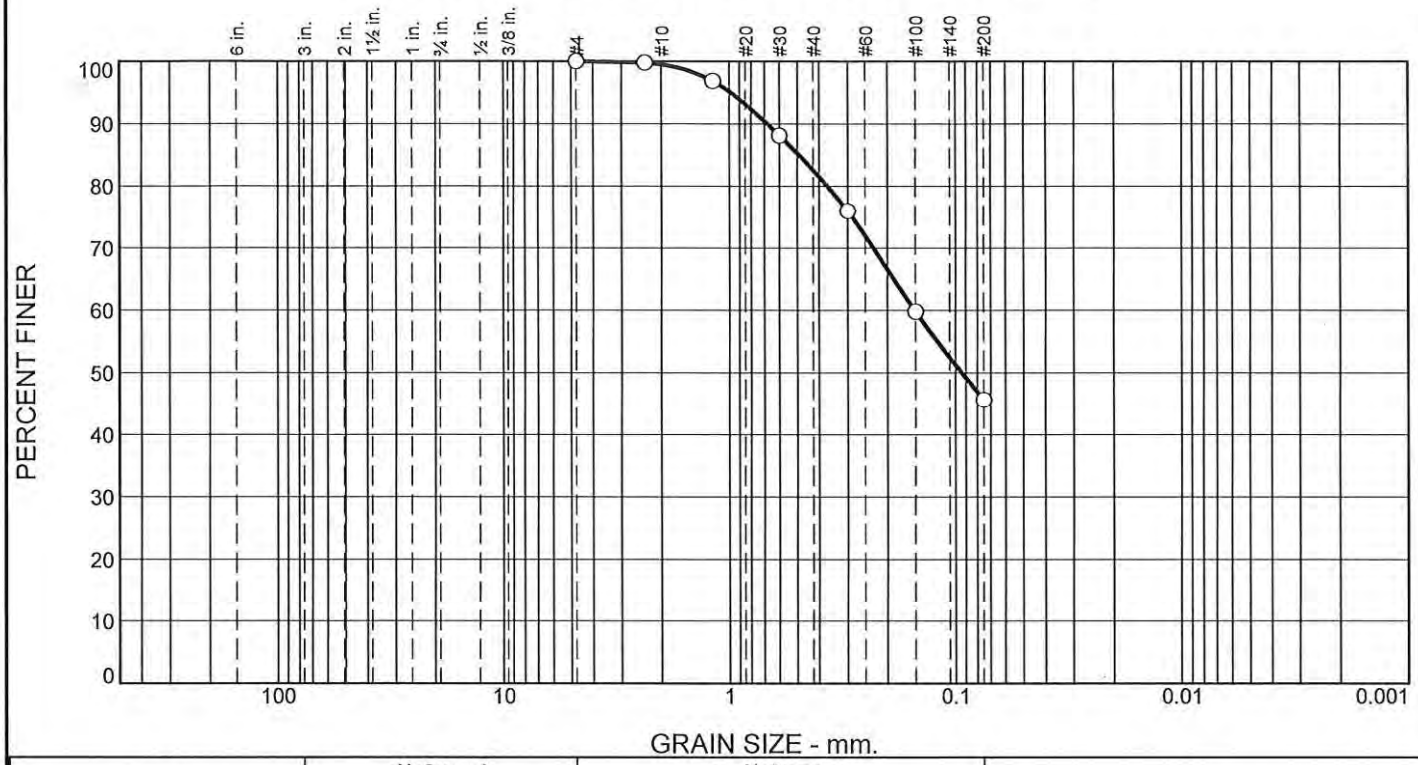
GULF SHORE EXPLORATION AND TESTING

Client: Golder Associates

Project: HECO SEKI

Project No: 20-141 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
0	0	0	0	17	37	46

Test Results (ASTM D6913 & ASTM D1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100		
#8	100		
#16	97		
#30	88		
#50	76		
#100	60		
#200	46		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS (D 2487)= AASHTO (M 145)=

Coefficients

D_{90}= 0.6796 D_{85}= 0.4915 D_{60}= 0.1512
D_{50}= 0.0938 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

F.M.=0.79

Date Received: 11/23/20 **Date Tested:** 12/2/20

Tested By: JB

Checked By: JML

Title: PM

Location: BE2-B-1
Sample Number: 58838 **Depth:** 5'-6.5'

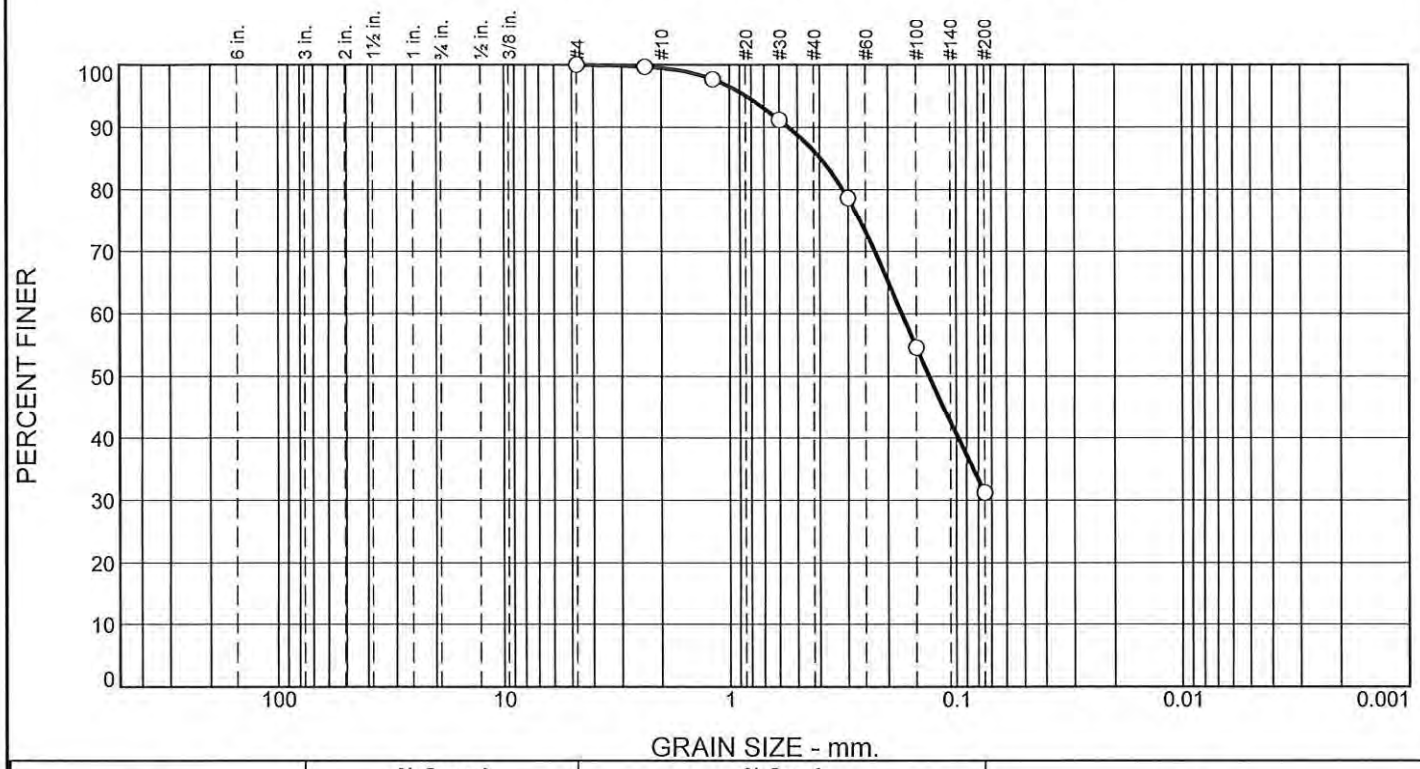
Date Sampled: -

GULF SHORE EXPLORATION AND TESTING

Client: Golder Associates
Project: HECO SEKI

Project No: 20-141 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
0	0	0	1	13	55	31

Test Results (ASTM D6913 & ASTM D1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100		
#8	100		
#16	98		
#30	91		
#50	79		
#100	55		
#200	31		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS (D 2487)= AASHTO (M 145)=

Coefficients

D_{90}= 0.5474 D_{85}= 0.3966 D_{60}= 0.1735
D_{50}= 0.1317 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

F.M.=0.78

Date Received: 11/23/20 **Date Tested:** 12/2/20

Tested By: JB

Checked By: JML

Title: PM

Location: BE2-B-2
Sample Number: 58839 **Depth:** 5'-6.5'

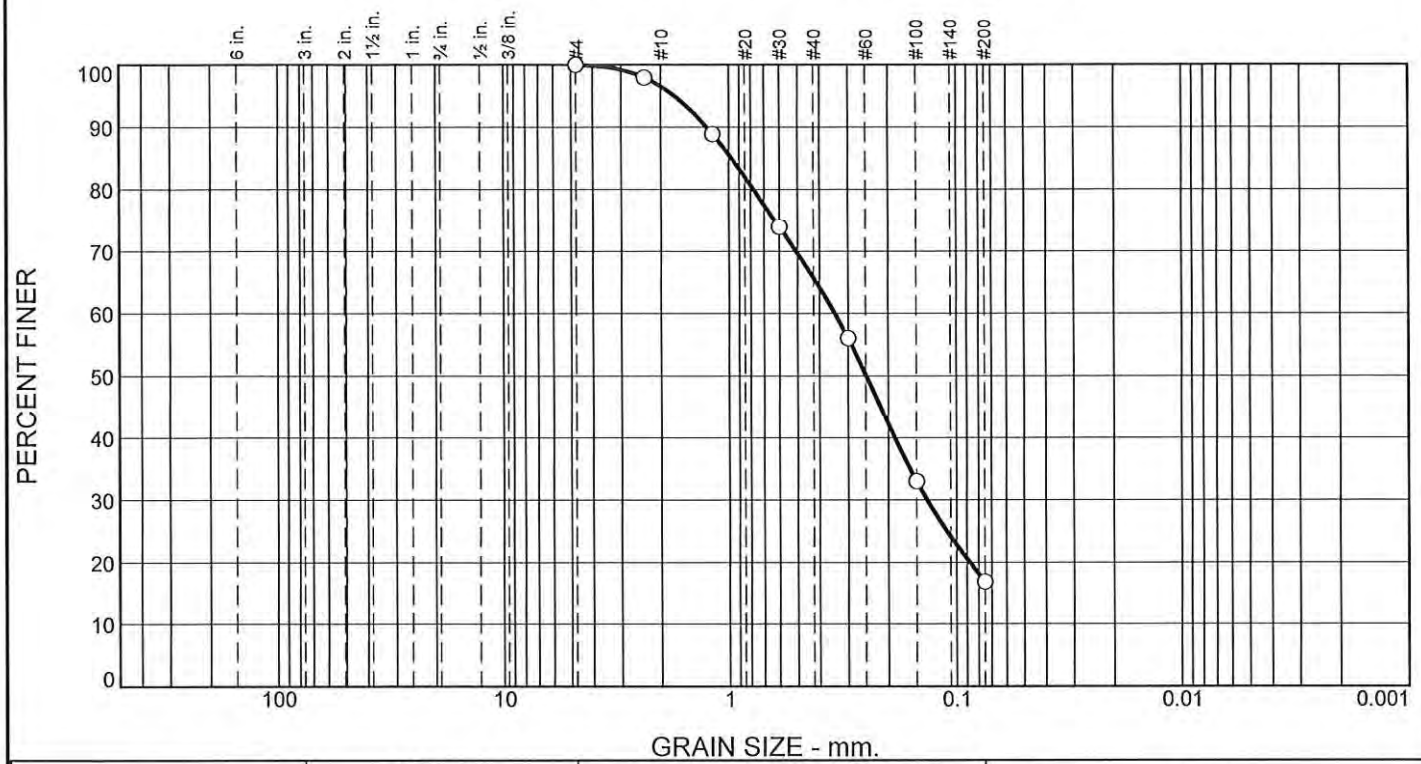
Date Sampled: -

GULF SHORE EXPLORATION AND TESTING

Client: Golder Associates
Project: HECO SEKI

Project No: 20-141 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
0	0	0	3	31	49	17

Test Results (ASTM D6913 & ASTM D1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100		
#8	98		
#16	89		
#30	74		
#50	56		
#100	33		
#200	17		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= 19 LL= 24 PI= 5

Classification

USCS (D 2487)= SC-SM AASHTO (M 145)= A-2-4(0)

Coefficients

D_{90}= 1.2529 D_{85}= 0.9729 D_{60}= 0.3427
D_{50}= 0.2492 D_{30}= 0.1349 D_{15}=
D_{10}= C_u= C_c=

Remarks

F.M.=1.50

Date Received: 11/23/20 **Date Tested:** 12/2/20

Tested By: JB

Checked By: JML

Title: PM

Location: BE2-TP-1
Sample Number: 58840 **Depth:** 2'-4'

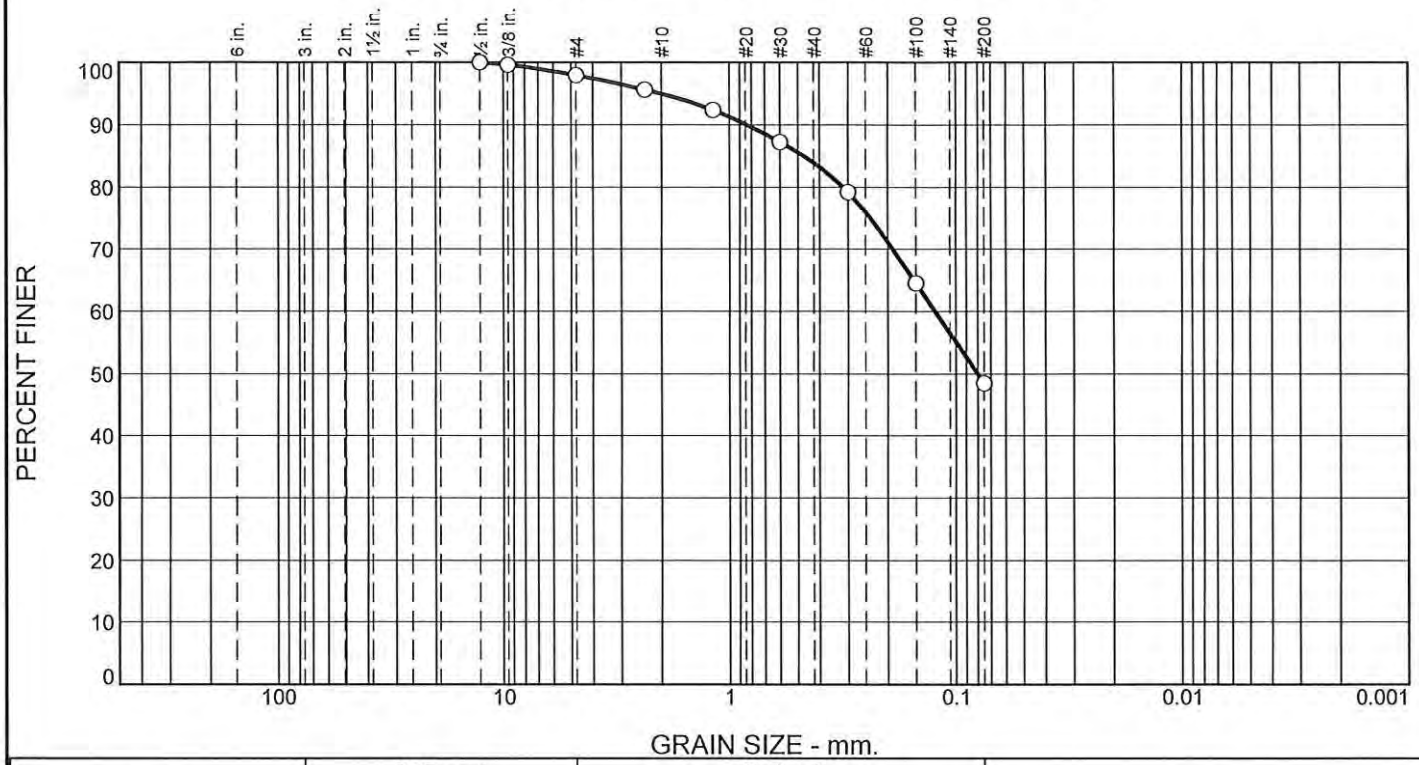
Date Sampled: -

GULF SHORE EXPLORATION AND TESTING

Client: Golder Associates
Project: HECO SEKI

Project No: 20-141 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
0	0	2	3	11	35	49

Test Results (ASTM D6913 & ASTM D1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1/2 Inch	100		
3/8 Inch	100		
#4	98		
#8	96		
#16	92		
#30	87		
#50	79		
#100	65		
#200	49		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS (D 2487)= AASHTO (M 145)=

Coefficients

D_{90}= 0.8410 D_{85}= 0.4707 D_{60}= 0.1234
D_{50}= 0.0800 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

F.M.=0.84

Date Received: 11/23/20 **Date Tested:** 12/2/20

Tested By: JB

Checked By: JML

Title: PM

Location: BE2-TP-2
Sample Number: 58841 **Depth:** 2'-4'

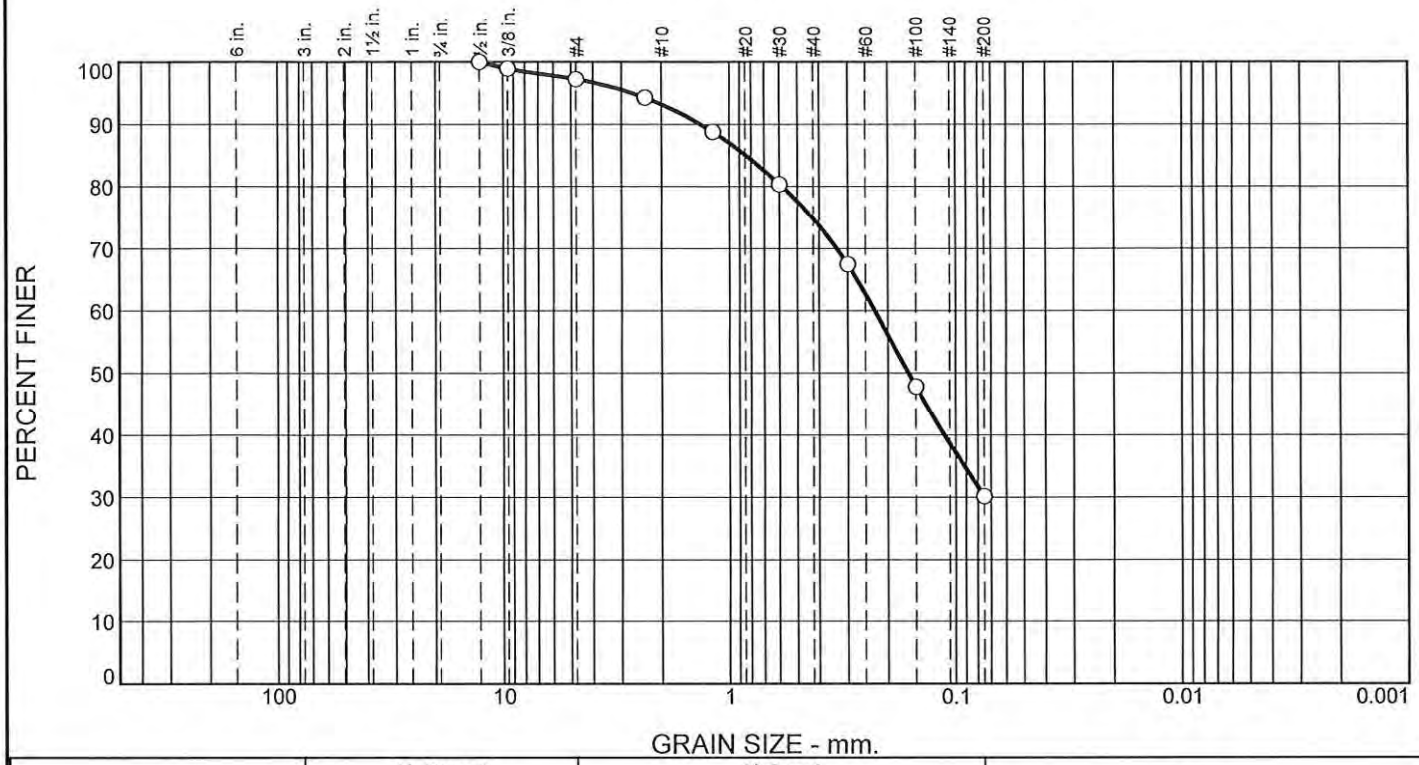
Date Sampled: -

GULF SHORE EXPLORATION AND TESTING

Client: Golder Associates
Project: HECO SEKI

Project No: 20-141 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
0	0	3	4	18	45	30

Test Results (ASTM D6913 & ASTM D1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1/2 Inch	100		
3/8 Inch	99		
#4	97		
#8	94		
#16	89		
#30	80		
#50	67		
#100	48		
#200	30		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= 17 LL= 25 PI= 8

Classification

USCS (D 2487)= SC AASHTO (M 145)= A-2-4(0)

Coefficients

D_{90}= 1.3381 D_{85}= 0.8435 D_{60}= 0.2276
D_{50}= 0.1619 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

F.M.=1.25

Date Received: 11/23/20 **Date Tested:** 12/2/20

Tested By: JD

Checked By: JML

Title: PM

Location: BE2-TP-3
Sample Number: 58842 **Depth:** 2'-4'

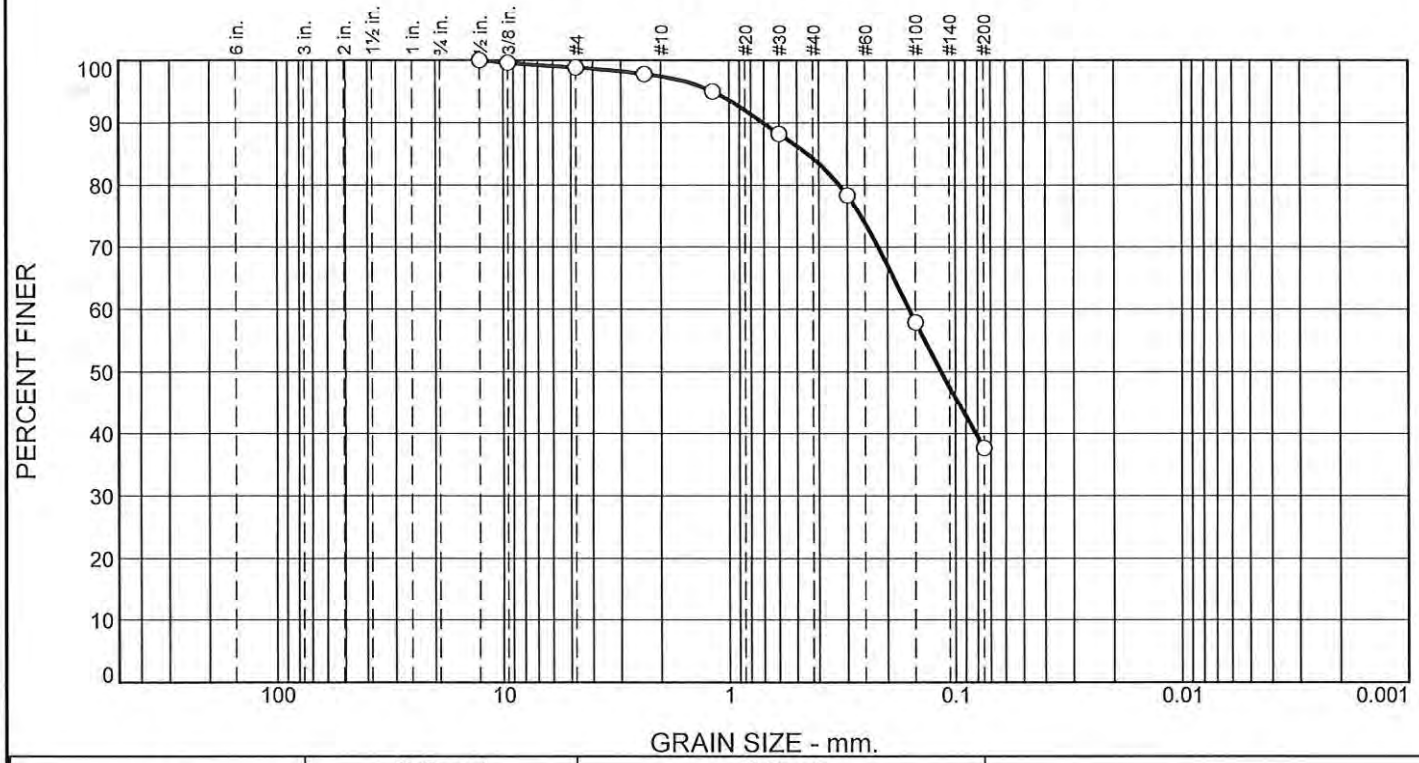
Date Sampled: -

GULF SHORE EXPLORATION AND TESTING

Client: Golder Associates
Project: HECO SEKI

Project No: 20-141 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	
0	0	1	2	13	46	38

Test Results (ASTM D6913 & ASTM D1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1/2 Inch	100		
3/8 Inch	100		
#4	99		
#8	98		
#16	95		
#30	88		
#50	78		
#100	58		
#200	38		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS (D 2487)= AASHTO (M 145)=

Coefficients

D_{90}= 0.7052 D_{85}= 0.4487 D_{60}= 0.1601
D_{50}= 0.1155 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

F.M.=0.84

Date Received: 11/23/20 **Date Tested:** 12/2/20

Tested By: JB

Checked By: JML

Title: PM

Location: BE2-TP-4
Sample Number: 58843 **Depth:** 2'-4'

Date Sampled: -

GULF SHORE EXPLORATION AND TESTING

Client: Golder Associates
Project: HECO SEKI

Project No: 20-141 **Figure**

Sunland Analytical

11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 12/02/2020
Date Submitted 11/25/2020

To: Joe Llamas
Gulf Shore Construction Services
3362 Fitzgerald Rd
Rancho Cordova, CA 95742

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 20-141 Site ID : AM2-TP-4@0-4FT.
Thank you for your business.

* For future reference to this analysis please use SUN # 83552-174320.

EVALUATION FOR SOIL CORROSION

Soil pH	6.46		
Minimum Resistivity	2.28 ohm-cm (x1000)		
Chloride	35.7 ppm	00.00357	%
Sulfate	10.4 ppm	00.00104	%

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m

Sunland Analytical

11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 12/02/2020
Date Submitted 11/25/2020

To: Joe Llamas
Gulf Shore Construction Services
3362 Fitzgerald Rd
Rancho Cordova, CA 95742

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 20-141 Site ID : BE2-B-2@0-4FT.
Thank you for your business.

* For future reference to this analysis please use SUN # 83552-174321.

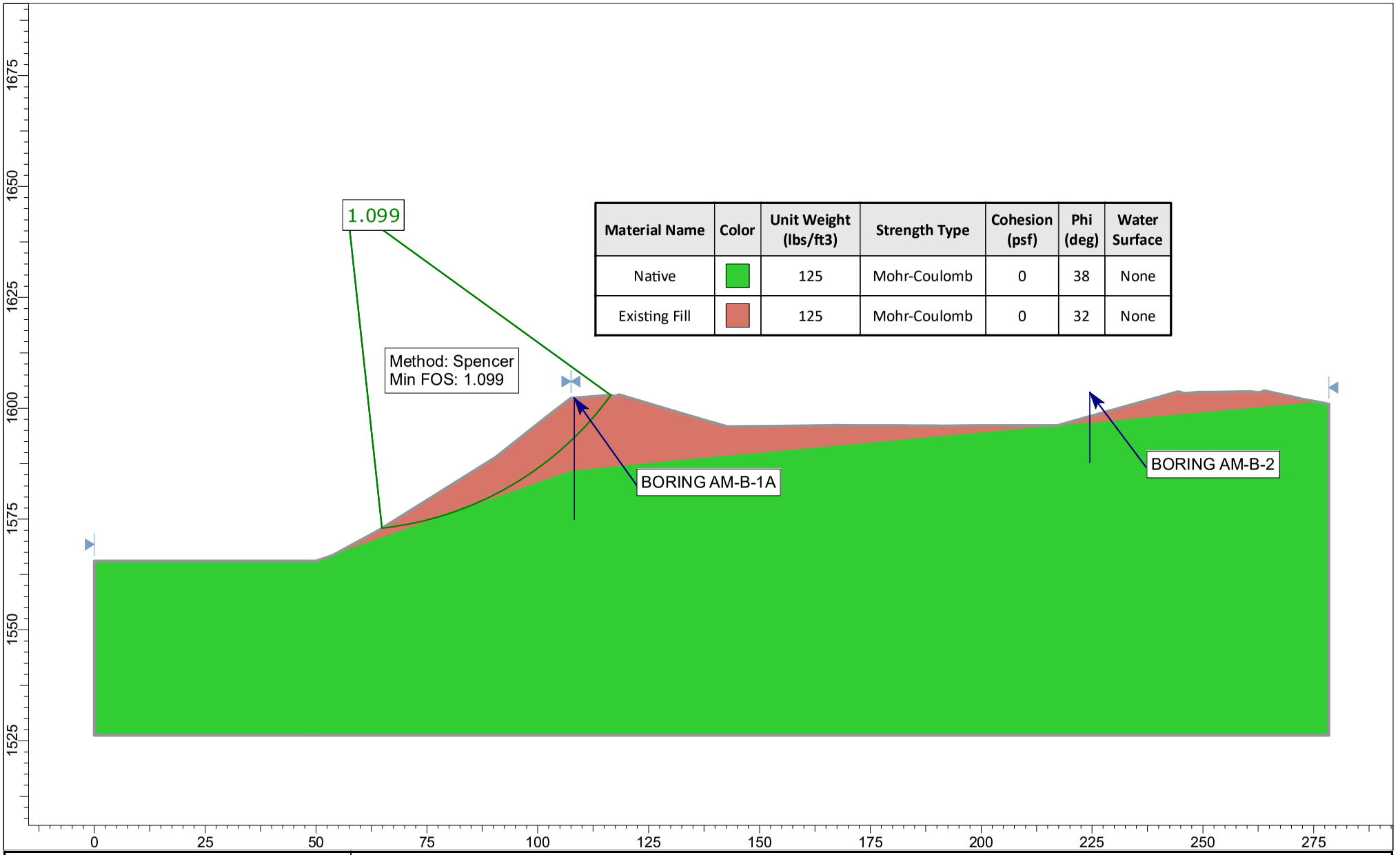
EVALUATION FOR SOIL CORROSION

Soil pH	7.31	
Minimum Resistivity	3.75 ohm-cm (x1000)	
Chloride	12.2 ppm	00.00122 %
Sulfate	22.7 ppm	00.00227 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m

APPENDIX D

Slope Stability Analysis Results

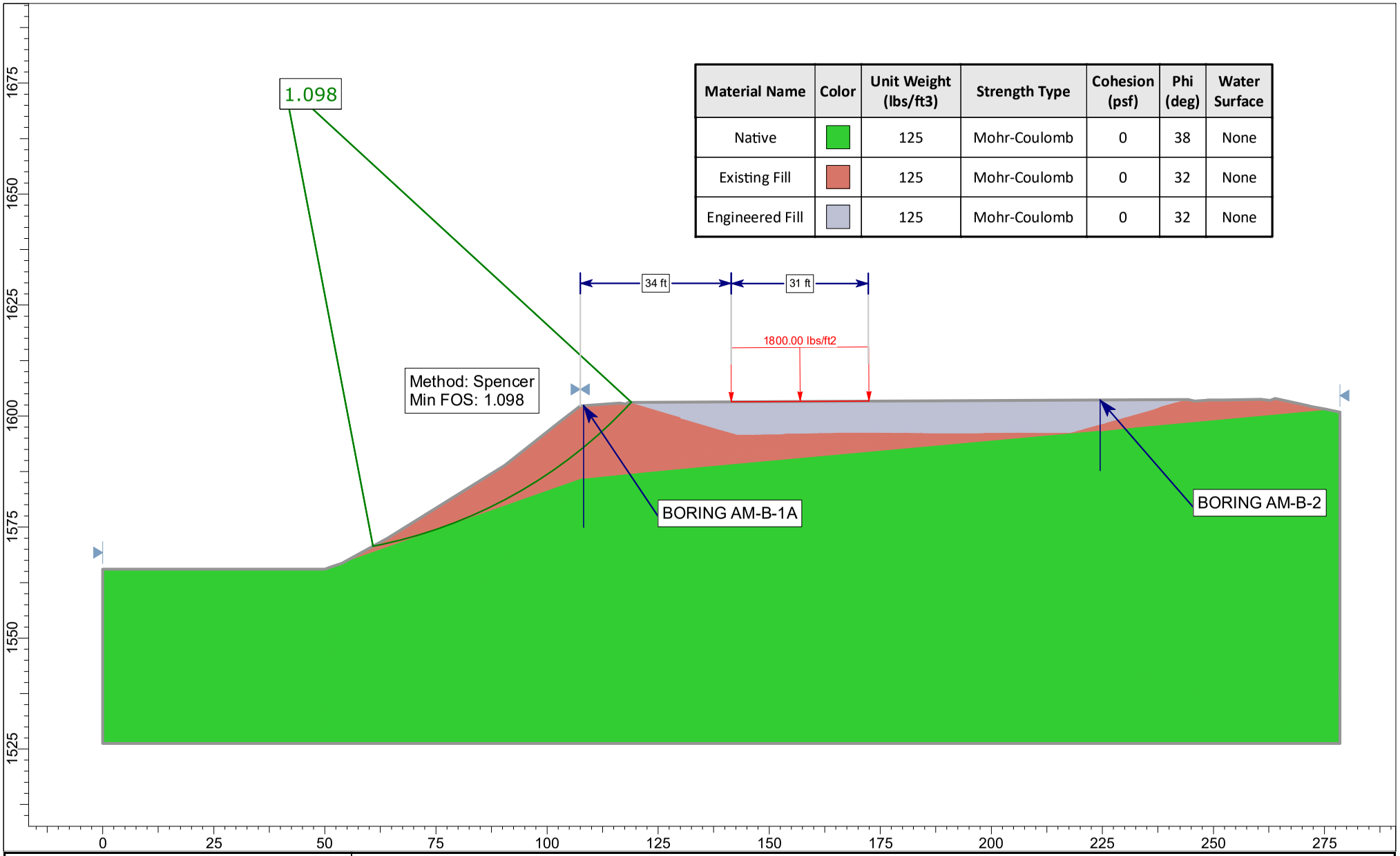


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Native		125	Mohr-Coulomb	0	38	None
Existing Fill		125	Mohr-Coulomb	0	32	None

GOLDER

SLIDEINTERPRET 8.026

Project	WATER TANK SLOPE STABILITY ANALYSIS			
Analysis Description	EXISTING CONDITIONS - STATIC ANALYSIS			
Drawn By HSG	*Checked By* RPCE	Reveiwed by RH	*Scale* 1:358	*File Name* SLIDE FILE 12 16 2020.slmd
Date 10:22:07 AM 12/16/2020				FIGURE 1



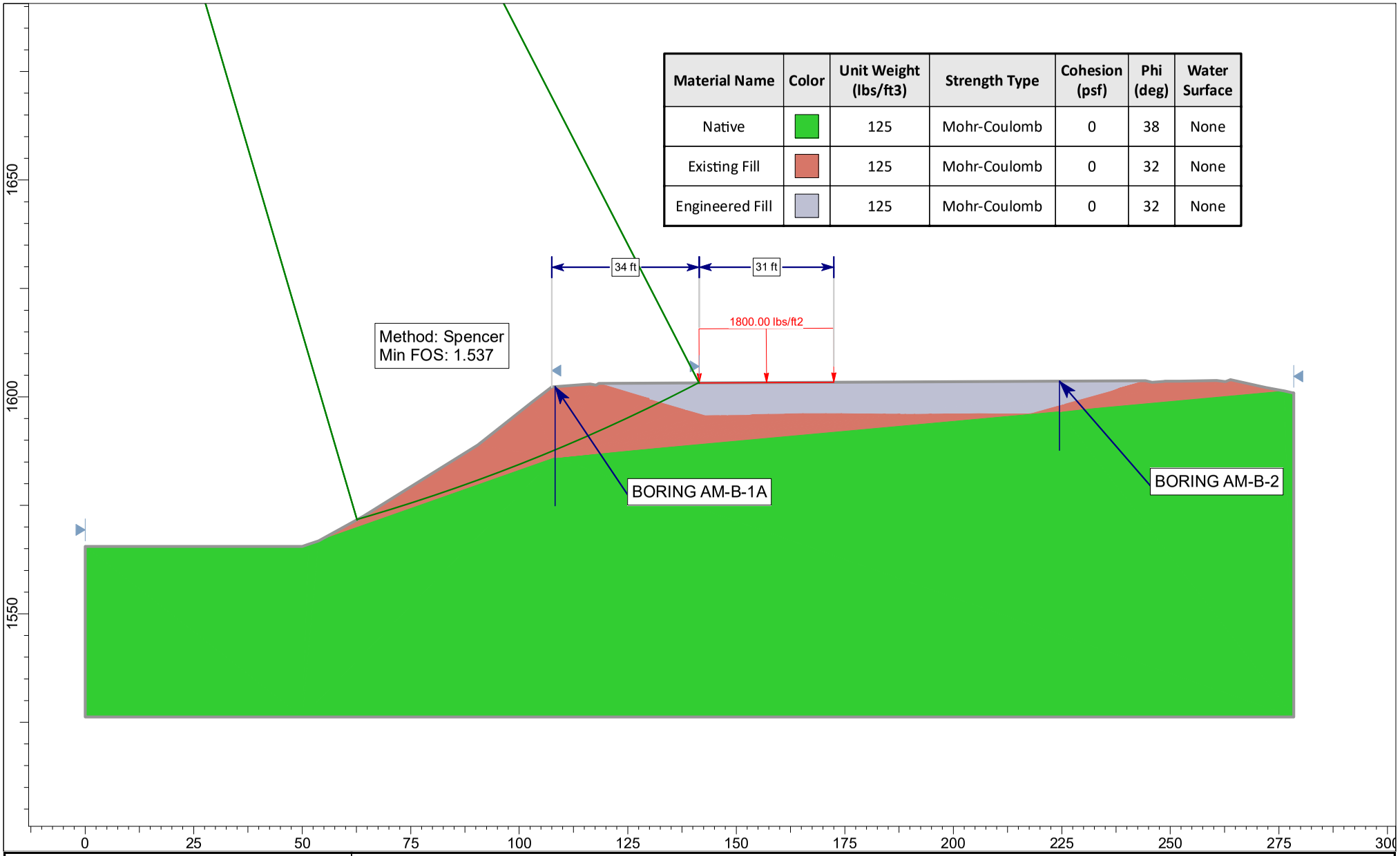
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Native		125	Mohr-Coulomb	0	38	None
Existing Fill		125	Mohr-Coulomb	0	32	None
Engineered Fill		125	Mohr-Coulomb	0	32	None

GOLDER

SLIDEINTERPRET 8.026

Project	WATER TANK SLOPE STABILITY ANALYSIS				
Analysis Description	EXISTING SLOPE UNDER PROPOSED CONDITIONS - STATIC ANALYSIS				
Drawn By HSG	*Checked By* RPCE	Reveiwed by RH	*Scale* 1:358	*File Name*	SLIDE FILE 12 16 2020.slmd
Date	10:23:30 AM 12/16/2020				FIGURE 2

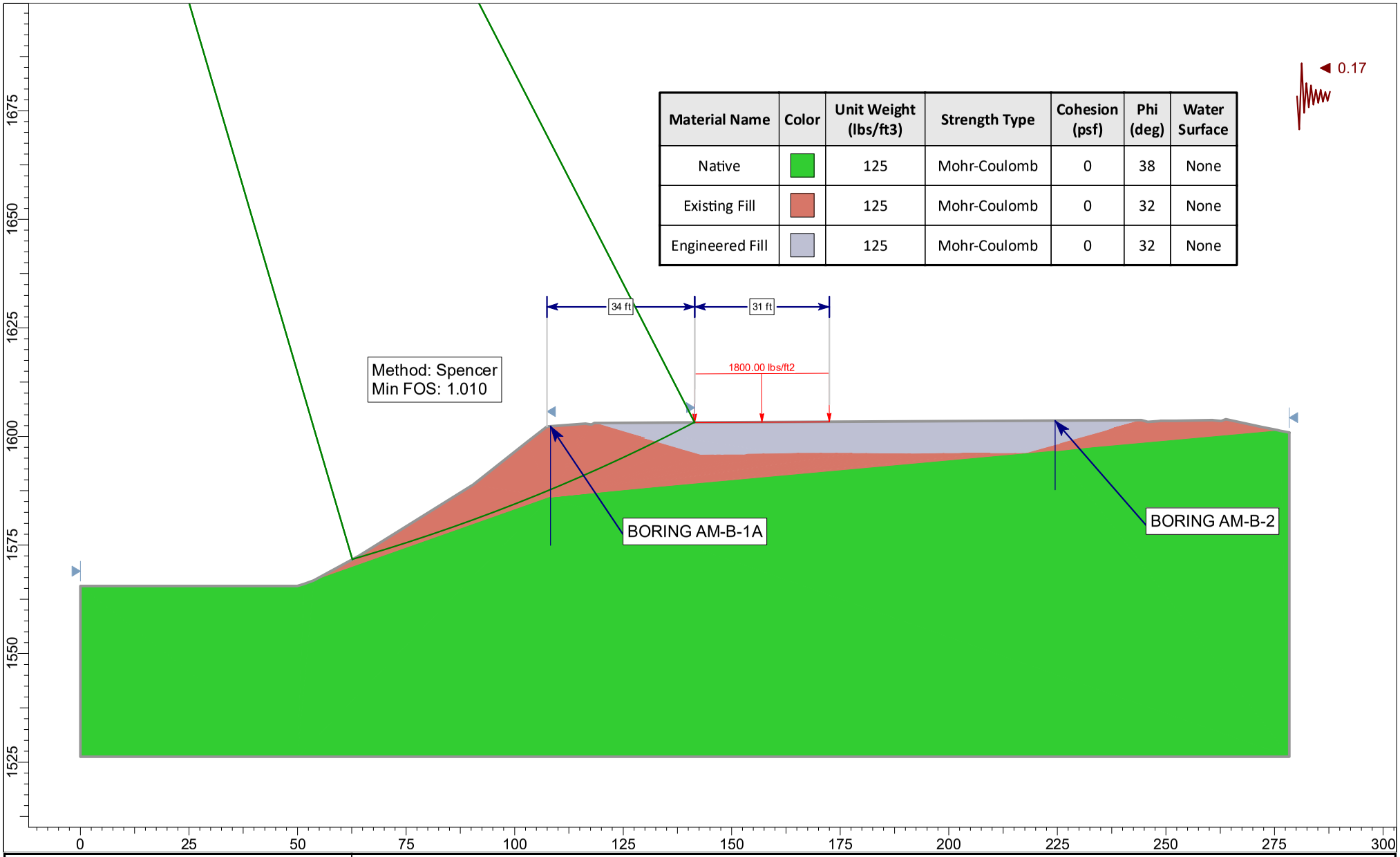
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Native		125	Mohr-Coulomb	0	38	None
Existing Fill		125	Mohr-Coulomb	0	32	None
Engineered Fill		125	Mohr-Coulomb	0	32	None



GOLDER

SLIDEINTERPRET 8.026

Project	WATER TANK SLOPE STABILITY ANALYSIS				
Analysis Description	PROPOSED CONDITIONS - STATIC ANALYSIS				
Drawn By: HSG	Checked By: RPCE	Reveiwed by: RH	Scale: 1:367	File Name: SLIDE FILE 12 16 2020.slmd	
Date: 10:24:20 AM 12/16/2020				FIGURE 3	



GOLDER

SLIDEINTERPRET 8.026

Project	WATER TANK SLOPE STABILITY ANALYSIS				
Analysis Description	PROPOSED CONDITIONS - SEISMIC ANALYSIS				
Drawn By: HSG	Checked By: RPCE	Reveiwed by: RH	Scale: 1:367	File Name: SLIDE FILE 12 16 2020.slmd	
Date: 10:25:30 AM 12/16/2020				FIGURE 4	

golder.com

APPENDIX E

Important Information About This Geotechnical-Engineering Report (by GBA)

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled*. No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only*. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.*** Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

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