ATTACHMENT B

ISSUED FOR AGENCY REVIEW
PROJECT MANUAL

For

CITY OF EMMONAK
ALL-SEASON RIVER INTAKE

TECHNICAL SPECIFCATIONS: DIVISIONS 01-40

OWNER: City of Emmonak
P.O. Box 9
Emmonak, Alaska 99581

ENGINEER: CRW Engineering Group, LLC
3940 Arctic Boulevard, Suite 300
Anchorage, Alaska 99503

October 23, 2019

INDEX TO CONTRACT DOCUMENTS

DIVISION 40 PROCESS INTERCONNECTIONS

DRAWINGS (under separate cover)

GEOTECHNICAL REPORTS

1) Geotechnical Exploration and Engineering Recommendations - Emmonak Water and Wastewater Utility Upgrades, Golder Associates, 2013.

2) Geotechnical Report Alaska Village Electric Cooperative - Bulk Fuel Upgrades Emmonak Alaska, HDL Engineering Consultants 2014.

DIVISION 01 GENERAL REQUIREMENTS

SECTION 01 00 00
GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. See specification Section 5, Technical Specification and Section 01 10 00, SUMMARY

B. **WEATHER LIMITATIONS**

1. The Contractor shall protect each increment of completed work against detrimental effects due to weather, by approved methods. Any increment of completed work that is damaged by freezing or rain, shall be reconditioned, reshaped, re-compacted, or replaced by the Contractor in conformance with the requirements of this specification without additional cost to the Owner.

C. **NOTICE TO BE GIVEN**

1. The Contractor shall notify the Engineer's Resident Project Representative at least 24 hours prior to the following:

   a. Disruptions in water service
   b. Testing

END OF SECTION

SECTION 01 10 00
SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Work by Owner or other Work at the Site.
   2. Contractor's use of Site and premises.
   3. Work sequence.
   4. Owner occupancy.
   5. Permits.
   6. Specification conventions.

B. Perform Work of the Contract under stipulated sum in accordance with the Contract with Owner according to Conditions of Contract.

1.2 WORK BY OWNER OR OTHERS

A. If Owner-awarded contracts interfere with each other due to work being performed at the same time or at the same Site, Owner will determine the sequence of work under all contracts according to "Work Sequence" and "Contractor's Use of Site and Premises" Articles in this Section.

B. Coordinate Work with utilities of Owner and public or private agencies.

C. Any items noted NIC (Not in Contract), will be furnished and installed by Owner after construction of the proposed improvements.

D. Remove and deliver to Owner the following items before completion of Work:
   1. Materials to be salvaged per the Drawings and/or elsewhere in the Specifications.

1.3 CONTRACTOR'S USE OF SITE [AND PREMISES]

A. Limit use of Water Treatment Plant and Work in public rights-of-way and private facilities to allow:

   1. Occupancy by Owner.
   2. Work by Owner.
   3. Work by Others.
   4. Public Access (in public rights-of-way only)
   5. Occupancy by facility owners.

B. Access to Site by Owner personnel to operate and maintain the water treatment plant, water distribution and wastewater collection facilities.

C. Emergency Building Exits during Construction: Maintain access at all times.

D. Construction Operations: Limited to areas indicated on Drawings.

1. Noisy and Disruptive Operations (such as use of welding equipment, saws, and other equipment that can inhibit proper operations):
   a. Not allowed inside existing building during regular hours of operation. Coordinate and schedule such operations with Owner to minimize disruptions.
   b. Only allowed between 8:00 AM and 8:00 PM in public rights-of-way and private residences.

2. Coordinate and schedule access to private facilities with Owner, and property occupant to minimize disruptions. Coordinate access a minimum of 7 days in advance of proposed construction schedule date and adjust as necessary to maintain overall construction progress.

E. Utility Outages and Shutdown:

1. Coordinate and schedule electrical and other utility outages with Owner.
2. Outages: Allowed only at previously agreed upon times.
3. At least one week before scheduled outage, submit Outage Request Plan to Engineer itemizing the dates, times, and duration of each requested outage.

F. Construction Plan: Before start of construction, submit three copies of construction plan regarding access to Work, use of Site, and utility outages for acceptance by Owner. After acceptance of plan, construction operations shall comply with accepted plan unless deviations are accepted by Owner in writing.

1.4 WORK SEQUENCE

A. Construct Work in stages in order to accommodate Owner's occupancy requirements during construction period. Coordinate construction schedule and operations with Engineer. Raw water supply to the WTP and water service must remain in operation at all times throughout construction except for approved shutdowns. Full system shutdowns will be scheduled for off peak hours (10:00 PM to 5:00 AM) and must be a maximum of six hours in duration.

B. Sequencing of Construction Plan: Before start of construction, submit three copies of construction plan regarding phasing of demolition, renovation, and new Work for acceptance by Owner. After acceptance of plan, construction sequencing shall comply with accepted plan unless deviations are accepted by Owner in writing.

1.5 OWNER OCCUPANCY

A. Schedule and substantially complete designated portions of the Work for occupancy before Substantial Completion of the entire Work as required to meet sequencing requirements identified in Article 1.4 above.

B. Owner will occupy WTP premises during entire period of construction to conduct normal operations and maintenance of existing facilities.

C. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.

D. Schedule the Work to accommodate Owner occupancy.

1.6 PERMITS

A. All permits of a permanent nature will be secured by Owner.

B. The Contractor shall furnish all necessary temporary permits for construction of Work. including the following:

1. Contained Water Discharge Permit (ADEC).

2. Storm Water Pollution Prevention Plan (SWPPP) (ADEC).

1.7 SPECIFICATION CONVENTIONS

A. These Specifications are written in imperative mood and streamlined form. This imperative language is directed to Contractor unless specifically noted otherwise.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION

SECTION 01 31 19
PROJECT MEETINGS

PART 1 - GENERAL

1.1 PRECONSTRUCTION CONFERENCE

A. Before start of construction, Engineer will arrange a meeting with the Contractor. The meeting agenda will include the following:

1. Minimum Agenda:
   a. Correspondence procedures
   b. Designation of responsible personnel
   c. Labor standards provisions
   d. Payroll reports
   e. Changes
   f. Payments to Contractor
   g. Subcontractors
   h. Accident prevention program (including name of responsible supervisor)
   i. Accident reporting
   j. Documents required under the contract
   k. Saturday, Sunday, holiday and night work
   l. Safety program (compliance with the "Accident Prevention" clause of the
   m. General Provisions)
   n. Tentative construction schedule
   o. Submittal of shop drawings, project data, and samples
   p. Relationship of Division 01 to other divisions
   q. Local Hire Opportunities

1.2 PROGRESS MEETINGS

A. The Engineer will schedule meetings every week, or less if agreed upon by Owner, Engineer, and the Contractor, with the Contractor and subcontractors. The Engineer will be responsible for recording, and distribution, of the meeting minutes. The meeting agenda will include the following as a minimum:
   1. Approval of minutes of previous meetings
   2. Field observations, problems, and decisions
   3. Identification of problems which impede planned progress
   4. Review of submittals schedule and status of submittals
   5. Review of off-site fabrication and delivery schedules
   6. Status of project record drawings/specifications
   7. Maintenance of progress schedule

8. Corrective measures to regain projected schedules
9. Planned progress during succeeding work period (Note: planned progress will be provided on a weekly basis)
10. Coordination of projected progress
11. Maintenance of quality and work standards
12. Effect of proposed changes on progress schedule and coordination
13. Other business relating to work
14. Review of the monthly progress payment

1.3 SUBMITTALS

A. The Engineer will provide meeting minutes for review and approval to all meeting participants prior to the next meeting or within one week of meeting, whichever is sooner. If no comments are returned in writing to the Engineer then the meeting minutes will be assumed correct.

PART 2 - PRODUCTS (NOT USED).

PART 3 - EXECUTION (NOT USED).

END OF SECTION

SECTION 01 32 16

CONSTRUCTION PROGRESS SCHEDULE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Submittals.

B. Network analysis schedules

C. Review and evaluation

D. Updating schedules

E. Distribution

1.2 SUBMITTALS

A. Schedule Updates:

1. Overall percent complete, projected and actual.
2. Completion progress by listed activity and sub-activity, to within five working days prior to submittal.
3. Changes in work scope and activities modified since submittal.
4. Delays in submittals or resubmittals, deliveries, or work.
5. Adjusted or modified sequences of work.
6. Other identifiable changes.
7. Revised projections of progress and completion.

B. Narrative Progress Report:

1. Submit with each monthly submission of Progress Schedule.
2. Summary of work completed during the past period between reports.
3. Work planned during the next period.
4. Explanation of differences between summary of work completed and work planned in previously submitted report.
5. Current and anticipated delaying factors and estimated impact on other activities and completion milestones.
6. Corrective action taken or proposed.

1.3 NETWORK ANALYSIS SCHEDULES

A. Prepare network analysis diagrams and supporting mathematical analyses using critical path method.

B. Illustrate order and interdependence of activities and sequence of work; how start of given activity depends on completion of preceding activities, and how completion of activity may restrain start of subsequent activities.

C. Illustrate complete sequence of construction by activity, identifying work of separate stages. Indicate dates for submittals and return of submittals; dates for procurement and delivery of critical products; and dates for installation and provision for testing. Include legend for symbols and abbreviations used.

D. Prepare subschedules for each stage of Work and Sequencing of Construction Plan identified in Section 01 10 00 - Summary.

1.4 REVIEW AND EVALUATION

A. Participate in joint review and evaluation of schedules with Engineer at each submittal.

B. Evaluate Project status to determine work behind schedule and work ahead of schedule.

C. After review, revise schedules incorporating results of review, and resubmit within 10 days.

1.5 UPDATING SCHEDULES

A. Maintain schedules to record actual start and finish dates of completed activities.

B. Indicate progress of each activity to date of revision, with projected completion date of each activity. Update schedules to depict current status of work.

C. Identify activities modified since previous submittal, major changes in work, and other identifiable changes.

D. Upon approval of a Change Order, include the change in the next schedule submittal.

E. Indicate changes required to maintain Date of Substantial Completion.

F. Submit documentation as required to support recommended changes.

G. Prepare narrative report to define problem areas, anticipated delays, and impact on schedule. Report corrective action taken (or proposed) and its effect.

1.6 DISTRIBUTION

A. Following joint review, distribute copies of updated schedules to Contractor's Project site file, to Subcontractors, suppliers, and Engineer.

B. Instruct recipients to promptly report, in writing, problems anticipated by projections shown in schedules.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION

SECTION 01 33 00

SUBMITTALS PROCEDURES

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work of this section consists of submittal requirements before and during construction.

1.2 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES:

A. General Procedures:
   1. As specified in the individual sections, forward submittals to Engineer at least 30 days before need for approval. Unless a different number is specified, submit one electronic version of each shop drawing, one specimen of each sample, and one electronic version of all other submittals requested.
   2. Coordinate all submittals and review them for legibility, accuracy, completeness, and compliance with contract requirements. Forward submittals that are related to or affect one another as a package to facilitate coordinated review.
   3. Submittals will not be accepted for review if identification or approval stamps are missing or are placed on the back of the submittal, an incorrect amount of submittals are submitted, the transmittal form is incorrectly filled out, submittals are not coordinated, or submittals do not show evidence of the Contractor's approval.
   4. Engineer reserves the right to require submittals in addition to those called for in individual sections.

B. Specific Procedures:
   1. Shop Drawings: Identify each copy of shop drawings with contract drawing number in lower right hand corner.
   2. Samples: Samples shall be large enough to illustrate clearly the functional characteristics and full range of color, texture, or pattern.
   3. Manufacturers' Literature: Submit only pertinent pages; mark each copy of standard printed data to identify products referenced in specification section.

C. Engineer Approval:
   1. Engineer will indicate approval or disapproval of each submittal and the reasons for disapproval.
   2. After Engineer review, revise and resubmit as required. Identify changes made since previous submittal.
   3. When Engineer has approved submittals, the Contractor's copies will be returned. Any work done before approval shall be at the Contractor's own risk. No payment shall be made for any work performed without an approved submittal.

1.3 APPROVED EQUALS:

A. For each item proposed as an "approved equal," submit a separate request that is clearly marked as an “approved equal request” to the Engineer. With each request submit supporting data, including:
   1. Drawings and samples as appropriate.
   2. Comparison of the qualities of the proposed item with that specified.
   3. Changes required in other elements of the work because of the substitution.
   4. Name, address, and telephone number of vendor.
   5. Manufacturer's literature regarding installation, operation, and maintenance, including schematics for electrical and hydraulic systems, lubrication requirements, and parts lists. Describe availability of maintenance service, and state source of replacement materials.

B. A request for approval constitutes a representation that the Contractor:
   1. Has investigated the proposed item and determined that it is equal or superior in all respects to that specified.
   2. Will provide the same warranties for the proposed item as for the item specified.
   3. Has determined that the proposed item is compatible with interfacing items.
   4. Will coordinate the installation of an approved item and make all changes required in other elements of the work because of the substitution.
   5. Waives all claims for additional expenses that may be incurred as a result of the substitution.

C. The Engineer has final determination whether an item is approved and considered equal.

1.4 MANUFACTURER'S INSTALLATION INSTRUCTIONS

A. When contract documents require compliance with manufacturer's printed instructions, provide one complete set of instructions for Engineer and keep another complete set of instructions at the project site until substantial completion.

PART 2 - PRODUCTS: (NOT USED).

PART 3 - EXECUTION: (NOT USED).

END OF SECTION

SECTION 01 40 00

QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Quality control.

B. Tolerances.

C. References.

D. Labeling.

E. Testing and inspection services.

F. Manufacturers' field services.

1.2 QUALITY CONTROL

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

B. Comply with specified standards as the minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

C. Perform work using persons qualified to produce required and specified quality.

D. Products, materials, and equipment may be subject to inspection by Engineer at place of manufacture or fabrication. Such inspections shall not relieve Contractor of complying with requirements of Contract Documents.

E. Supervise performance of work in such manner and by such means to ensure that work, whether completed or in progress, will not be subjected to harmful, dangerous, damaging, or otherwise deleterious exposure during construction period.

1.3 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' recommended tolerances and tolerance requirements in reference standards. When such tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

1.4 REFERENCES

A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of standard except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard by date of issue current as of date of Contract Documents except where specific date is established by code.

C. Obtain copies of standards and maintain on Site when required by product Specification Sections.

D. When requirements of indicated reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.

E. Neither contractual relationships, duties, or responsibilities of parties in Contract nor those of Engineer shall be altered from Contract Documents by mention or inference in reference documents.

1.5 LABELING

A. Attach label from agency approved by authorities having jurisdiction for products, assemblies, and systems required to be labeled by applicable code or State statute.

B. Label Information: Include manufacturer's or fabricator's identification, approved agency identification, and the following information, as applicable, on each label:

1. Model number.
2. Serial number.
3. Performance characteristics.

1.6 TESTING AND INSPECTION SERVICES

A. Contractor shall employ and pay for services of an independent testing agency or laboratory acceptable to Owner to perform specified testing unless otherwise noted.
   1. Before starting Work, submit testing laboratory name, address, and telephone number, and name of responsible officer.

B. Testing, inspections, and source quality control may occur on or off Project Site. Perform off-Site testing as required by Engineer or Owner.

C. Reports shall be submitted by independent firm to Engineer, Contractor, and authorities having jurisdiction, indicating observations and results of tests and compliance or noncompliance with Contract Documents.

1. Submit final report indicating correction of Work previously reported as noncompliant.

D. Employment of testing agency or laboratory shall not relieve Contractor of obligation to perform Work according to requirements of Contract Documents.

E. Retesting or re-inspection required because of nonconformance with specified or indicated requirements shall be performed by same independent firm on instructions from Engineer. Payment for retesting or re-inspection will be charged to Contractor by deducting testing charges from Contract Sum/Price.

F. Agency Responsibilities:
1. Provide qualified personnel at Site. Cooperate with Engineer and Contractor in performance of services.
2. Perform indicated sampling and testing of products according to specified standards.
3. Ascertain compliance of materials with requirements of Contract Documents.
4. Promptly notify Engineer and Contractor of observed irregularities or nonconformance of Work or products.
5. Perform additional tests required by Engineer.

G. Agency Reports: After each test, promptly submit two copies of report to Engineer, Contractor, and authorities having jurisdiction. When requested by Engineer, provide interpretation of test results. Include the following:

1. Date issued.
2. Project title and number.
3. Name of inspector.
4. Date and time of sampling or inspection.
5. Identification of product and Specification Section.
6. Location in Project.
7. Type of inspection or test.
8. Date of test.
9. Results of tests.
10. Conformance with Contract Documents.

H. Limits on Testing Authority:

1. Agency or laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
2. Agency or laboratory may not approve or accept any portion of the Work.
3. Agency or laboratory may not assume duties of Contractor.
4. Agency or laboratory has no authority to stop the Work.

1.7 MANUFACTURER'S FIELD SERVICES

A. When specified in individual Specification Sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe Site conditions, conditions of surfaces and installation, quality of workmanship, startup of equipment, testing, adjusting, and balancing of equipment commissioning as applicable, and to initiate instructions when necessary.

B. Submit qualifications of observer to Engineer 30 days in advance of required observations.

C. Report observations and Site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturer's written instructions.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION

SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Temporary Utilities:
   1. Temporary electricity.
   2. Temporary lighting for construction purposes.
   3. Temporary heating.
   4. Temporary ventilation.
   5. Communication services.
   6. Temporary water service.
   7. Temporary sanitary facilities.

B. Construction Facilities:
   1. Field offices and sheds.
   2. Traffic regulation.
   3. Parking.
   4. Progress cleaning and waste removal.
   5. Project identification.
   6. Fire-prevention facilities.

C. Temporary Controls:
   1. Barriers.
   2. Enclosures and fencing.
   3. Security.
   4. Water control.
   5. Dust control.
   6. Noise control.
   7. Pollution control.
   8. Erosion and sediment control.

D. Special Controls:
   1. Recovery and Preservation of Archaeological and Cultural Resources

E. Removal of utilities, facilities, and controls.

1.2 TEMPORARY ELECTRICITY

A. The Contractor shall provide temporary electricity to project Work Site at Contractors expense. The Contractor shall pay for cost of energy at project Work Site.

B. The Contractor shall provide temporary electricity to field office and Engineer's field office at the Contractors expense. The Contractor shall pay for cost of energy at field offices.

C. Owner will pay cost of energy used in the water treatment plant. Exercise measures to conserve energy. Use Owner's existing power service.

1.3 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

A. Provide and maintain lighting for construction operations to achieve minimum lighting level of 2 watts/sq ft.

B. Maintain lighting and provide routine repairs.

C. Permanent building lighting may be used during construction.

1.4 TEMPORARY HEATING

A. Existing heating systems, where available, may be used to heat the construction area during construction.

B. The Contractor shall provide and pay for temporary heating to field office and Engineer's field office throughout construction.

C. When building heating system is offline during construction, the Contractor shall provide and pay for heating devices and heat as needed to maintain specified conditions for construction operations.

D. Before operating permanent equipment for temporary heating purposes, verify installation is approved for operation, equipment is lubricated, and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts. Replace filters at Substantial Completion.

E. Maintain minimum ambient temperature of 50 degrees F in areas where construction is in progress.

1.5 TEMPORARY VENTILATION

A. Ventilate enclosed areas to achieve curing of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

1.6 COMMUNICATION SERVICES

A. Telephone Service: Provide, maintain, and pay for telephone service to field office at time of Project mobilization and until completion of Work.

B. Internet Service: Provide, maintain, and pay for broadband Internet service to field office at time of Project mobilization. Provide desktop computer with Microsoft operating system and appropriate office function software (MS Word, MS Excel, MS Outlook, internet web browser, etc), modem, and printer.

1.7 TEMPORARY WATER SERVICE

A. Owner will pay cost of temporary water. Exercise measures to conserve water. Use Owner's existing water system, extended and supplemented with temporary devices as needed to maintain specified conditions for construction operations.

B. Extend piping as necessary with outlets located so that water is available by hoses with threaded connections. Provide backflow prevention devices at each hose connection.

C. Temporary water lines shall be drained during project shutdown or when the Contractor is offsite for extended period (more than 5 consecutive days).

1.8 TEMPORARY SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures. Existing facility use is not permitted. Provide facilities at time of Project mobilization.

1.9 FIELD OFFICES AND SHEDS

A. Field Office: Weathertight, with lighting, electrical outlets, heating equipment, and equipped with sturdy furniture.

B. Provide space for Project meetings, with table and chairs to accommodate six persons.

C. Construction: Portable or mobile buildings, or buildings constructed with floors raised aboveground, securely fixed to foundations with steps and landings at entrance doors.

1. Construction: Structurally sound, secure, weathertight enclosures for office and storage spaces. Maintain during progress of Work; remove enclosures at completion of Work.
2. Thermal Resistance of Floors, Walls, and Ceilings: Compatible with occupancy and storage requirements.
3. Exterior Materials: Weather-resistant.
4. Interior Materials in Field Offices: Sheet-type materials for walls and ceilings, prefinished or painted; resilient floors and bases.

5. Lighting for Field Offices: 50 ft-C at desktop height; exterior lighting at entrance doors.
6. Interior Materials in Storage Sheds: As required to provide specified conditions for storage of products.

D. Environmental Control:

1. Heating, Cooling, and Ventilating for Offices: Automatic equipment to maintain comfort conditions.
2. Storage Spaces: Heating and ventilating as needed to maintain products according to Contract Documents; lighting for maintenance and inspection of products.

E. Engineer Field Office – Not used.

F. Preparation: Fill and grade Sites for temporary structures sloped for drainage away from buildings.

G. Installation:

1. Install field office spaces ready for occupancy 15 days before start of construction.

H. Maintenance and Cleaning:

1. Weekly janitorial services for field offices; periodic cleaning and maintenance for sheds and storage areas.
2. Maintain walks free of mud, water, snow, and the like.

I. Removal: At completion of Work remove buildings, foundations, utility services, and debris. Restore areas to same or better condition as original condition.

1.10 TRAFFIC REGULATION

A. General: Work shall be conducted to interfere as infrequent as possible with public travel.

B. Construct temporary access roads as required from public thoroughfares to serve construction area, of width and load-bearing capacity to accommodate unimpeded traffic for construction purposes.

C. Construct temporary bridges and culverts to span low areas and allow unimpeded drainage.

D. Extend and relocate vehicular access as Work progress requires and provide detours as necessary for unimpeded traffic flow.

E. Locate as approved by Engineer.

F. Provide unimpeded access for emergency vehicles. Maintain 20 foot-wide driveways with turning space between and around combustible materials.

G. Provide and maintain access to fire hydrants free of obstructions.

H. Traffic detours and interruptions shall be publicly noticed ahead of time and marked with traffic cones and signage during construction and after hours.

I. Signs, Signals, and Devices:

1. Post-Mounted and Wall-Mounted Traffic Control and Informational Signs: As approved by authorities having jurisdiction.
2. Traffic Control Signals: As approved by local jurisdictions.
3. Traffic Cones, Drums, Flares, and Lights: As approved by authorities having jurisdiction.
4. Flag Person Equipment: As required by authorities having jurisdiction.

J. Flag Persons: Provide trained and equipped flag persons to regulate traffic when construction operations or traffic encroach on public traffic lanes.

K. Flares and Lights: Use flares and lights during hours of low visibility to delineate traffic lanes and to guide traffic.

L. Traffic Signs and Signals:

1. Provide signs at approaches to Site and on Site, at crossroads, detours, parking areas, and elsewhere as needed to direct construction and affected public traffic.
2. Provide, operate, and maintain traffic control signals to direct and maintain orderly flow of traffic in areas under the Contractor's control and areas affected by the Contractor's operations.
3. Relocate signs and signals as Work progresses, to maintain effective traffic control.

M. Removal:

1. Remove equipment and devices when no longer required.
2. Repair damage caused by installation.
3. Remove post settings to depth of 2 feet.

1.11 PARKING

A. Arrange for temporary gravel surface parking areas to accommodate construction personnel.

B. Locate as approved by Engineer.

C. If Site space is not adequate, provide additional off-Site parking.

D. Use of designated areas of existing on-Site streets and driveways used for construction traffic is permitted. Tracked vehicles are not allowed on paved areas.

E. Use of designated areas of existing parking facilities adjacent to the water treatment plant by construction personnel is not permitted.

F. Do not allow heavy vehicles or construction equipment in parking areas.

1.12 PROGRESS CLEANING AND WASTE REMOVAL

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

B. Remove debris and rubbish from closed or remote spaces before enclosing spaces.

C. Broom and vacuum clean interior areas before starting surface finishing, and continue cleaning to eliminate dust.

D. Collect and remove waste materials, debris, and rubbish from Site periodically and dispose of off-Site. Comply with Section 01 74 19 - Construction Waste Management and Disposal.

1.13 FIRE-PREVENTION FACILITIES

A. Prohibit smoking within buildings at all times. Designate area on Site where smoking is permitted. Provide approved ashtrays in designated smoking areas.

B. Establish fire watch for cutting, welding, and other hazardous operations capable of starting fires. Maintain fire watch before, during, and after hazardous operations until threat of fire does not exist.

C. Portable Fire Extinguishers: NFPA 10; 10-pound capacity, 4A-60B: C UL rating.

1. Provide one fire extinguisher within 10 feet of construction area.
2. Provide minimum of one fire extinguisher in every construction trailer and storage shed.
3. Provide minimum of one fire extinguisher on roof during roofing operations using heat-producing equipment.

1.14 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas, to allow for Owner's use of Site, and to protect existing facilities and adjacent properties from damage from construction operations.

B. Protect non-owned vehicles, stored materials, Site, and structures from damage.

1.15 ENCLOSURES AND FENCING

A. Construction: The Contractor's option.

B. Exterior Enclosures:

1. Provide temporary weathertight closure of exterior openings to accommodate acceptable working conditions and protection for products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual Specification Sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

C. Interior Enclosures – not used.

1.16 SECURITY

A. Security Program:

1. Protect Work on existing premises and Owner's operations from theft, vandalism, and unauthorized entry.
2. Initiate program at Project mobilization.
3. Maintain program throughout construction period until Owner's acceptance precludes need for the Contractor's security.
4. Owner will control entrance of persons and vehicles related to Owner's operations.

1.17 DUST CONTROL

A. Execute Work by methods that minimize raising dust from construction operations. Use water or other dust control measures to alleviate fugitive dust during construction.

B. Provide positive means to prevent airborne dust from dispersing into building atmosphere and into Owner-occupied areas.

1.18 NOISE CONTROL

A. Provide methods, means, and facilities to minimize noise produced by construction operations.

B. Mufflers shall be maintained on all construction equipment.

1.19 PEST AND RODENT CONTROL

A. Provide methods, means, and facilities to prevent pests and insects from entering facility during the Contractor’s operations.

1.20 WATER CONTROL

A. Grade Site to drain. Maintain excavations free of water. Provide, operate, and maintain necessary pumping equipment.

B. Protect Site from puddles or running water. Provide water barriers as required to protect Site and surrounding areas from soil erosion and contamination.’

C. If dewatering is to occur at excavation sites, the Contractor shall obtain a discharge permit from the Alaska Department of Environmental Conservation (ADEC).

1.21 EROSION AND SEDIMENT CONTROL

A. Plan and execute construction by methods to control surface drainage from cuts and fills from borrow and waste disposal areas. Prevent erosion and sedimentation.

B. Minimize surface area of bare soil exposed at one time.

C. Provide temporary measures including fiber matrix covering, berms, dikes, drains, and other devices to prevent erosion and sedimentation.

D. Construct fill and waste areas by selective placement to avoid erosive surface silts and clays.

E. Periodically inspect earthwork to detect evidence of erosion and sedimentation. Promptly apply corrective measures.

F. Best management practices shall be used for erosion control where ground disturbance occurs.

G. Provide, implement and comply with Storm Water Pollution Prevention Plan (SWPPP) in accordance with State of Alaska Department of Environmental Conservation (ADEC) requirements and guidelines. Submit a Notice-of-Intent (NOI) prior to construction.

1.22 POLLUTION CONTROL

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

B. Comply with pollution and environmental control requirements of authorities having jurisdiction.

C. Water Pollution Control:

1. Provide necessary erosion control measures, silt fences, straw bales, and other means as required and as specified in the SWPPP to protect wetlands adjacent to excavations, temporary stockpiles, and fill sites from contamination by sedimentation and spilling.

2. Divert sanitary and non-storm waste flow interfering with construction and requiring diversion to sanitary sewer collection system or treatment facility.

3. Do not cause or permit action to occur which would cause an overflow to an existing waterway.

4. Prior to commencing excavation and construction, obtain Engineer's concurrence with detailed plans showing procedures intended to handle and dispose of wastewater, groundwater, and storm water flow, including dewatering pump discharges.

5. Disposal of wastes into streams or waterways is prohibited. Provide acceptable containers for collection and disposal of waste materials, debris and rubbish.

D. Storage of Fuel and Petroleum Products: Storage of fuel and petroleum products shall not be permitted within 200 feet of a water body (i.e., rivers, streams, lakes, wells, wetlands, or marine waters which provide domestic or public water supplies, support anadramous fish populations, or are adjacent to areas of human settlement or use which are highly susceptible to petroleum contamination) or within the 100-year floodplain, whichever is greater, unless written justification is submitted to and accepted by the agency having jurisdiction. Justification shall clearly describe:

1. Why such placement is unavoidable, and;
2. The precautions that will be taken to prevent uncontained leaks and/or spills.
3. Fuel storage tanks shall be provided with at least one mechanical or operational means to minimize the potential for tank overfilling. Note: Mechanical float devices are not recommended, as they have a high failure rate in the Alaskan environment.
4. Petroleum storage tanks shall be located within a secondary containment structure, or structures, that have the capacity to hold the volume of the largest tank within the containment area, plus enough additional capacity to allow for local precipitation.
5. Secondary containment structure(s) shall be completely impermeable, with ground surfacing and berms, dikes, or retaining walls constructed of impermeable materials, or lined with impermeable materials. This requirement includes the ground under the tanks, in order to prevent the release of spilled or leaked petroleum from the containment area.
6. Each containment structure shall be constructed so that it can be drained of accumulated water through a secure valve with a locking mechanism to prevent unauthorized discharge. Water discharged from the containment area, and runoff discharged from fuel dispensing facilities shall meet the State Water Quality Standards in 18 AAC 70. Any sheen present on the accumulated water shall be removed by using sorbent pads, an oil/water separator, or other effective means prior to discharge.
7. To assist in leak detection, all piping, to the extent practicable, shall be above ground. Examples of possible exceptions are road crossings, containment dike penetrations, and piping in utilidors. Aboveground piping shall be placed on pipe supports that prevent chaffing and corrosion. Underground piping shall be adequately protected against corrosion.

E. Pollution Control Plan:

1. The Contractor shall perform containment, cleanup, and disposal of all construction-related discharges of oil and/or other hazardous substances to the land or water. The Contractor shall prepare and submit to the Engineer a Pollution Control Plan which shall, as a minimum, address the following relative to hazardous substances:
2. Measures the Contractor shall implement in the containment and cleanup of accidental oil or other hazardous substance spills.
3. Detail the quantity and types of supplies that will be on site to facilitate cleanup activities.
4. Discuss the methods the Contractor shall implement in the disposal of waste oil or other hazardous substances generated by construction equipment or activities.
5. The plan shall comply with the requirements of Alaska Administrative Code, Section 18 AAC 75, and Alaska Statute, Title 46.

F. Notifications of Unauthorized Discharges of Oil or Fuel: The Contractor shall immediately notify ADEC by telephone, and immediately afterwards send ADEC a written notice by facsimile, hand delivery, or first class mail, informing ADEC of:

1. Any unauthorized discharges of oil or fuel to water, any discharge of hazardous substances other than oil or fuel, and any discharge or cumulative discharge of oil or fuel greater than 55 gallons solely to land and outside an impermeable containment area.

a. If a discharge, including cumulative discharge, of oil is greater than 10 gallons but less than 55 gallons, or a discharge of oil greater than 55 gallons is made to an impermeable secondary containment area, the Contractor shall report the discharge within 48 hours, and immediately afterwards send ADEC a written notice by facsimile, hand delivery, or first class mail.

b. Any discharge of oil, including a cumulative discharge, solely to land, greater than one gallon and up to 10 gallons, shall be reported in writing on a monthly basis.

2. The posting of information requirements of 18 AAC 75.305 shall be met.

3. Scope and duration of initial response Actions (18 AAC 75.310) and reporting requirements of 18 AAC 75, Article 3 also apply. The Contractor shall supply ADEC with all follow-up incident reports.

4. Notification of a discharge shall be made to the nearest ADEC Area Response Team during working hours: Anchorage (907) 269-7500, fax (907) 269-7648. The ADEC oil spill report number outside normal business hours is (800) 478-9300.

1.23 SPECIAL CONTROLS

A. Tundra Protection Control:

1. The Contractor shall submit Tundra Protection Control Plan to protect and prevent damage to tundra during construction.

B. Recovery and Preservation of Archaeological and Cultural Resources:

1. The Alaska Historic Preservation Act (AS 41.35.200) prohibits the appropriation, excavation, removal, injury, or destruction of any State-owned historic, prehistoric (paleontological) or archaeological site without a permit from the commissioner.

2. The Contractor is advised that construction work within this contract is subject to the provisions of State and Federal laws and regulations pertaining to the preservation of archaeological and cultural resources.

3. In the event that any historic, cultural or archaeological resources are uncovered during the course of construction, all work shall cease until an inspection and evaluation of the site has been made by proper authorities and an archaeologist to insure that archaeological data are properly preserved. The Contractor shall promptly notify Engineer who will in turn notify the proper authorities.

4. All human remains, regardless of age, condition, or extent encountered, shall be regarded as potential archaeological resources, but State notification and response protocols shall be followed before an archaeological investigation is performed.

5. The Contractor shall anticipate reasonable delays while the notification and response protocols are being followed and archaeological investigations are being performed, and shall make allowance for these delays.

C. Protected Birds: Follow USFWS Construction Advisory for Protecting Migratory Birds, and if an eagle's nest is observed within 660 feet of the project area during construction, notify Village Safe Water and USFWS.

D. Owner-provided Permits and Agreements: Copies of applicable permits or agreements obtained by the Owner are included in this project manual and are made part of the Contract requirements. Stipulations relating to this project are summarized below. The Contractor activities shall comply with the following permit requirements:

1. US Army Corps of Engineers (ACOE) Nationwide Permit No. 12 has been issued for the Kwiguk Pass Raw Water Intake work:

a. Work must comply with Nationwide Permit general conditions.

1) The activity may not interfere with the public's right to free navigation on Kwiguk Pass.

2) If future operations by the USACE require the removal, relocation, or other alteration of the structure, or if the structure causes unreasonable obstruction to free navigation in the navigable waters, the City of Emmonak will be required (upon notice by the USACE) to remove, relocate, or alter the structure at no cost to the USACE. The City will not make a claim against the USACE as a result of any such removal, relocation, or alteration.

3) Heavy equipment working in wetlands must be placed on mats, or other measures must be taken to minimize soil disturbance.

4) Appropriate erosion and sediment controls must be used and maintained during construction and exposed soil stabilized at the earliest practicable date on portions of the site where construction activities have temporarily or permanently ceased.

5) Temporary fills must be removed in their entirety and the affected areas returned to pre-construction elevations and revegetated, as appropriate.

6) The intake structure must be properly maintained, including maintenance to ensure public safety and compliance with applicable permit general conditions.

7) In order to comply with the Endangered Species Act, land disturbance and vegetative clearing will not take place between May 5 and July 25.

8) The City of Emmonak is responsible for ensuring their action complies with the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act.

a) If Bald Eagle nests are found within 660 feet of the project, contact USFWS for further direction.

9) If any previously unknown historic, cultural, or archeological remains or artifacts are discovered, the USACE project manager must be notified and construction activities avoided in the area to the maximum extent practicable.

2. Alaska Department of Fish and Game (ADF&G) Fish Habitat Permit has been issued for this work.

1.24 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, and materials before Final Application for Payment inspection.

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

C. Restore existing facilities used during construction to original condition except as identified on the Drawings. Restore permanent facilities used during construction to specified condition.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION

3.1 SWPPP PRE-CONSTRUCTION ACTIVITIES

A. The Contractor shall complete a description of the nature of the construction activities and the intended sequence of the construction activities which disturb soils for major portions of the site. The description of a construction activity should include the following information:

1. Type of activity.
2. Estimated dates of the activity (both start and finish dates).
3. Name of the Contractor or Subcontractor who is to accomplish the activity.

B. Description of the Construction activities and any amendments to the SWPPP shall be written and attached to the Plan.

C. No later than seven days prior to beginning construction activities, the Contractor shall submit a NOI directly to the EPA and ADEC and deliver a copy to the Engineer at the time of submission.

3.2 SWPPP CONSTRUCTION ACTIVITIES

A. The Contractor shall provide a list of Contractors and Subcontractors participating in each construction activity. The list is required to be kept current throughout the duration of the project. Each Contractor or Subcontractor shall be required to sign the Signature Page of this SWPPP document prior to the commencement of professional services.

B. The Contractor shall list the current activities and the names of Contractors or Subcontractors who complete each construction activity.

3.3 SWPPP MAINTENANCE AND INSPECTION

A. The controls identified in the SWPPP for the project site shall be inspected periodically and maintenance shall begin as soon as a deficiency is observed.

B. The Contractor shall provide a qualified person to inspect the disturbed areas of the construction site that have not been stabilized, the areas used for storage of materials that are exposed to precipitation, the structural control measures, and the location where vehicles enter or exit the site.

C. Disturbed areas and areas used for storage of materials that are exposed to precipitation shall be inspected for evidence of, or the potential for, pollutants entering the drainage system. Control measures as identified in the Contractor's Plan shall be observed to ensure that they are effective in preventing impacts to receiving waters.

D. An inspection report shall be written summarizing the scope of the inspection, the name(s) and qualification of personnel making the inspection, the date of inspection, major observations relating to the implementation of the SWPPP, and the actions and modifications taken to correct

insufficiencies identified during the inspection. The report shall identify any incident of non-compliance. If no incidents of non-compliance are observed during the inspection, the report shall contain a certification that the facility is in compliance with the SWPPP and the ADEC General Permit. The inspection report shall be signed by the project superintendent or a duly authorized representative. Any person signing a document for the SWPPP shall add the following certification:

1. "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system design to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of a fine and imprisonment for knowing violations."

E. All inspection reports shall be made and retained as part of the SWPPP. Each inspection report shall be appended by the Contractor to the original SWPPP.

END OF SECTION

SECTION 01 58 13

TEMPORARY PROJECT SIGNAGE

PART 1: GENERAL

1.1 GENERAL

A project sign provided by Contractor is required for the project.

1.2 SUBMITTAL

A. Submit a shop drawing for approval at least 7 days before start of work on site. Shop drawing shall be in color and have all pertinent information filled in.

B. Submit a photograph of sign for the project record installed at project site prior to start of work on site.

PART 2: PRODUCTS

2.1 TEMPORARY CONSTRUCTION SIGN

A. Meet the requirements as shown on the USDA "Temporary Construction Sign for Rural Development Projects" found in the Attachments to the Contract Documents.

B. Sign paint and material shall be durable and weather resistant.

PART 3: EXECUTION

A. Install sign on or adjacent to the project site clearly visible to the public. If the project has multiple sites or is non-continuous then install the sign adjacent to the project office or job trailer. The sign shall be located where it will not be regularly obstructed by equipment or materials storage.

B. The sign may be free standing or secured to a structure such as a fence or job trailer.

C. The sign shall be secured against falling and extreme or unusual weather typical for the project site. Free standing signs shall be weighed or securely anchored.

END OF SECTION

SECTION 01 60 00

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Products.

B. Product delivery requirements.

C. Product storage and handling requirements.

D. Product options.

1.2 PRODUCTS

A. At minimum, comply with specified requirements and reference standards.

B. Specified products define standard of quality, type, function, dimension, appearance, and performance required.

C. Furnish products of qualified manufacturers that are suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise. Confirm that manufacturer's production capacity can provide sufficient product, on time, to meet Project requirements.

D. Do not use materials and equipment removed from existing premises except as specifically permitted by Contract Documents.

E. Furnish interchangeable components from same manufacturer for components being replaced.

1.3 PRODUCT DELIVERY REQUIREMENTS

A. Comply with delivery requirements in Section 01 74 19 - Construction Waste Management and Disposal.

B. Transport and handle products according to manufacturer's instructions.

C. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.

D. Provide equipment and personnel to handle products; use methods to prevent soiling, disfigurement, or damage.

1.4 PRODUCT STORAGE AND HANDLING REQUIREMENTS

A. Store and protect products according to manufacturer's instructions.

B. Store products with seals and labels intact and legible.

C. Store sensitive products in weathertight, climate-controlled enclosures in an environment suitable to product.

D. For exterior storage of fabricated products, place products on sloped supports aboveground.

E. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

F. Store loose granular materials on solid flat surfaces in well-drained area. Prevent mixing with foreign matter.

G. Provide equipment and personnel to store products; use methods to prevent soiling, disfigurement, or damage.

H. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

I. Secure stored materials from damage due to flooding and floating debris from flood events.

1.5 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Products complying with specified reference standards or description.

B. Products Specified by Naming One or More Manufacturers: Products of one of manufacturers named and complying with Specifications; no options or substitutions allowed.

C. Products Specified by Naming One or More Manufacturers with Provision for Substitutions: Submit Request for Substitution for any manufacturer not named, according to Section 01 33 00 - Submittal Procedures.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 70 00

EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Field engineering.

B. Closeout procedures.

C. Starting of systems.

D. Demonstration and instructions.

E. Project record documents.

F. Operation and maintenance data.

G. Operations and Maintenance Manual contents. .

H. Spare parts and maintenance products.

I. Product warranties and product bonds.

J. Maintenance service.

K. Examination.

L. Preparation.

M. Execution.

N. Cutting and patching.

O. Protecting installed construction.

P. Final cleaning.

1.2 FIELD ENGINEERING

A. Prior to beginning Work, establish floor, piping and conduit elevations within existing facility to ensure that new Work will meet proposed elevations in smooth and level alignment and without conflicting with materials designated to remain except where specifically detailed or indicated otherwise.

1.3 CLOSEOUT PROCEDURES

A. Prerequisites to Substantial Completion: Complete following items before requesting Certification of Substantial Completion, either for entire Work or for portions of Work:

1. Submit maintenance manuals, Project record documents, digital images of construction photographs, and other similar final record data in compliance with this Section.
2. Complete facility startup, testing, adjusting, balancing of systems and equipment, demonstrations, and instructions to Owner's operating and maintenance personnel as specified in compliance with this Section.
3. Conduct inspection to establish basis for request that Work is substantially complete. Create comprehensive list (initial punch list) indicating items to be completed or corrected, value of incomplete or nonconforming Work, reason for being incomplete, and date of anticipated completion for each item. Include copy of list with request for Certificate of Substantial Completion.
4. Obtain and submit releases enabling Owner's full, unrestricted use of Project and access to services and utilities.
5. Deliver tools, spare parts, extra stocks of material, and similar physical items to Owner.
6. Discontinue or change over and remove temporary facilities and services from Project Site, along with construction tools, mockups, and similar elements.
7. Perform final cleaning according to this Section.

B. Substantial Completion Inspection:

1. When Contractor considers Work to be substantially complete, submit to Engineer:

    a. Written certificate that Work, or designated portion, is substantially complete.
    b. List of items to be completed or corrected (initial punch list).

2. Within seven days after receipt of request for Substantial Completion, Engineer will make inspection to determine whether Work or designated portion is substantially complete.
3. Should Engineer determine that Work is not substantially complete:

    a. Engineer will promptly notify Contractor in writing, stating reasons for its opinion.
    b. Contractor shall remedy deficiencies in Work and send second written request for Substantial Completion to Engineer.
    c. Engineer will reinspect Work.
    d. Redo and Inspection of Deficient Work: Repeated until Work passes Engineer's inspection.

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

4. When Engineer finds that Work is substantially complete, Engineer will:

a. Prepare Certificate of Substantial Completion on EJCDC C-625 - Certificate of Substantial Completion, accompanied by Contractor's list of items to be completed or corrected as verified and amended by Engineer and Owner (final punch list).
b. Submit Certificate to Owner and Contractor for their written acceptance of responsibilities assigned to them in Certificate.

5. After Work is substantially complete, Contractor shall:

a. Allow Owner full occupancy of Project under provisions stated in Certificate of Substantial Completion.
b. Complete Work listed for completion or correction within time period stipulated.

6. Owner will occupy all of the building as specified in Section 01 10 00 - Summary.

C. Prerequisites for Final Completion: Complete following items before requesting final acceptance and final payment.

1. When Contractor considers Work to be complete, submit written certification that:

a. Contract Documents have been reviewed.
b. Work has been examined for compliance with Contract Documents.
c. Work has been completed according to Contract Documents.
d. Work is completed and ready for final inspection.

2. Submittals: Submit following:

a. Final punch list indicating all items have been completed or corrected.
b. Final payment request with final releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.
c. Specified warranties, workmanship/maintenance bonds, maintenance agreements, and other similar documents.
d. Accounting statement for final changes to Contract Sum.
e. Contractor's affidavit of payment of debts and claims.
f. Contractor affidavit of release of liens.
g. Consent of surety to final payment.

3. Perform final cleaning for Contractor-soiled areas according to this Section.

D. Final Completion Inspection:

1. Within seven days after receipt of request for final inspection, Engineer will make inspection to determine whether Work or designated portion is complete.
2. Should Engineer consider Work to be incomplete or defective:

    a. Engineer will promptly notify Contractor in writing, listing incomplete or defective Work.
    b. Contractor shall remedy stated deficiencies and send second written request to Engineer that Work is complete.
    c. Engineer will re-inspect Work.
    d. Redo and Inspection of Deficient Work: Repeated until Work passes Engineer's inspection.
    e. If some or all of the Work has been determined not to be at a point of Final Completion and will require re-inspection or re-testing by Engineer, the cost of such re-inspection or re-testing, including the cost of time, travel and living expenses, shall be paid by Contractor to Owner. If Contractor does not pay, or the parties are unable to agree as to the amount owed, then Owner may impose a reasonable set-off against payments due to the Contractor.

1.4 STARTING OF SYSTEMS

A. Coordinate schedule for startup of various equipment and systems.

B. Notify Engineer seven days prior to startup of each item.

C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.

D. Verify that tests, meter readings, and electrical characteristics agree with those required by equipment or system manufacturer.

E. Verify that wiring and support components for equipment are complete and tested.

F. Execute startup under supervision of manufacturer's representative or Contractors' personnel according to manufacturer's instructions.

G. When specified in individual Specification Sections, require manufacturer to provide authorized representative who will be present at Site to inspect, check, and approve equipment or system installation prior to startup and will supervise placing equipment or system in operation.

H. Submit a written statement to Engineer for each equipment and system that they have been properly installed and are functioning correctly.

1.5 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of products to Owner's personnel one week prior to date of Substantial Completion.

B. For equipment or systems requiring seasonal operation, perform demonstration for other season two weeks prior to system operation switchover.

C. Use operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.

D. Demonstrate startup, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each item of equipment at agreed time, at equipment location.

E. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

F. Required instruction time for each item of equipment and system is specified in individual Specification Sections.

1.6 PROJECT RECORD DOCUMENTS

A. Maintain on Site one set of the following record documents; record actual revisions to the Work:

1. Drawings.
2. Specifications.
3. Addenda.
4. Change Orders and other modifications to the Contract.
5. Reviewed Shop Drawings, product data, and Samples.
6. Manufacturer's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress, not less than weekly.

E. Specifications: Legibly mark and record, at each product Section, description of actual products installed, including the following:

1. Manufacturer's name and product model and number.
2. Product substitutions or alternates used.
3. Changes made by Addenda and modifications.

F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction as follows:

1. Include Contract modifications such as Addenda, supplementary instructions, change directives, field orders, minor changes in the Work, and change orders.
2. Include locations of concealed elements of the Work.
3. Identify and locate existing buried or concealed items encountered during Project.

4. Measured depths of foundations in relation to finish main floor datum.
5. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
6. Field changes of dimension and detail.
7. Details not on original Drawings.

G. Submit marked-up paper copy documents to Engineer with claim for final Application for Payment.

1.7 OPERATION AND MAINTENANCE DATA

A. Submit in PDF composite electronic indexed file.

B. Submit data bound in 8-1/2 x 11-inch text pages, three D side ring binders with durable plastic covers.

C. Prepare binder cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS," title of Project, and subject matter of binder when multiple binders are required.

D. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.

E. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

F. Contents: Prepare table of contents for each volume, with each product or system description identified, typed on white paper, in three parts as follows:

1. Part 1: Directory, listing names, addresses, and telephone numbers of Engineer, Contractor, Subcontractors, and major equipment suppliers.
2. Part 2: Operation and maintenance instructions arranged by system and parts category. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Include the following:

    a. Significant design criteria.
    b. List of equipment.
    c. Parts list for each component.
    d. Operating instructions.
    e. Maintenance instructions for equipment and systems.
    f. Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
    g. Safety precautions to be taken when operating and maintaining or working near equipment.

3. Part 3: Project documents and certificates, including the following:

a. Shop Drawings and product data.
b. Certificates.
c. Originals of warranties.

1.8 OPERATIONS AND MAINTENANCE MANUAL CONTENTS

A. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Engineer will review draft and return one copy with comments.

B. For equipment or component parts of equipment put into service during construction and operated by Owner, submit documents within ten days after acceptance.

C. Submit one copy of completed volumes before Substantial Completion. Draft copy will be reviewed and returned after Substantial Completion, with Engineer comments. Revise content of document sets as required prior to final submission.

D. Submit two sets of revised final volumes within ten days after final inspection.

E. Submit in PDF composite electronic indexed file of final manual within ten days after final inspection.

F. Building Products, Applied Materials, and Finishes: Include product data, with catalog number, size, composition, and color and texture designations.

G. Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

H. Moisture Protection and Weather Exposed Products: Include product data listing applicable reference standards, chemical composition, and details of installation. Include recommendations for inspections, maintenance, and repair.

I. Each Item of Equipment and Each System: Include description of unit or system and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and model number of replaceable parts.

J. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.

K. Include color-coded wiring diagrams as installed.

L. Operating Procedures: Include startup, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shutdown, and emergency instructions. Include summer, winter, and special operating instructions.

M. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

N. Include servicing and lubrication schedule and list of lubricants required.

O. Include manufacturer's printed operation and maintenance instructions.

P. Include sequence of operation by controls manufacturer.

Q. Include original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

R. Include control diagrams by controls manufacturer as installed.

S. Include Contractor's coordination drawings with color-coded piping diagrams as installed.

T. Include charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

U. Include list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

V. Include reports for testing and balancing as specified in Section 01 40 00 - Quality Requirements, Section 1.6 Testing and Inspection Services.

W. Additional Requirements: As specified in individual product Specification Sections.

X. Include listing in table of contents for design data with tabbed dividers and space for insertion of data.

1.9 SPARE PARTS AND MAINTENANCE PRODUCTS

A. Furnish spare parts, maintenance, and extra products in quantities specified in individual Specification Sections.

B. Deliver to Project Site and place in location as directed by Owner; obtain receipt prior to final payment.

1.10 PRODUCT WARRANTIES AND PRODUCT BONDS

A. Obtain warranties and bonds executed in duplicate by responsible Subcontractors, suppliers, and manufacturers within ten days after completion of applicable item of Work.

B. Execute and assemble transferable warranty documents and bonds from Subcontractors, suppliers, and manufacturers.

C. Verify documents are in proper form, contain full information, and are notarized.

D. Co-execute submittals when required.

E. Include table of contents and assemble in three D side ring binder with durable plastic cover.

F. Submit prior to final Application for Payment.

G. Time of Submittals:

1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within ten days after acceptance.
2. Make other submittals within ten days after date of Substantial Completion, prior to final Application for Payment.
3. For items of Work for which acceptance is delayed beyond Substantial Completion, submit within ten days after acceptance, listing date of acceptance as beginning of warranty or bond period.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Verify that existing substrate is capable of structural support or attachment of new Work being applied or attached.

C. Examine and verify specific conditions described in individual Specification Sections.

D. Verify that utility services are available with correct characteristics and in correct locations.

3.2 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance according to manufacturer's instructions.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer-required or -recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.

3.3 EXECUTION

A. Comply with manufacturer's installation instructions, performing each step in sequence. Maintain one set of manufacturer's installation instructions at Project Site during installation and until completion of construction.

B. When manufacturer's installation instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

C. Verify that field measurements are as indicated on approved Shop Drawings or as instructed by manufacturer.

D. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1. Secure Work true to line and level and within specified tolerances, or if not specified, industry-recognized tolerances.
2. Physically separate products in place, provide electrical insulation, or provide protective coatings to prevent galvanic action or corrosion between dissimilar metals.
3. Exposed Joints: Provide uniform joint width and arrange to obtain best visual effect. Refer questionable visual-effect choices to Engineer for final decision.

E. Allow for expansion of materials and building movement.

F. Climatic Conditions and Project Status: Install each unit of Work under conditions to ensure best possible results in coordination with entire Project.

1. Isolate each unit of Work from incompatible Work as necessary to prevent deterioration.
2. Coordinate enclosure of Work with required inspections and tests to minimize necessity of uncovering Work for those purposes.

G. Mounting Heights: Where not indicated, mount individual units of Work at industry recognized standard mounting heights for particular application indicated.

1. Refer questionable mounting heights choices to Engineer for final decision.
2. Elements Identified as Accessible to Handicapped: Comply with applicable codes and regulations.

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

I. Clean and perform maintenance on installed Work as frequently as necessary through remainder of construction period. Lubricate operable components as recommended by manufacturer.

3.4 CUTTING AND PATCHING

A. Employ skilled and experienced installers to perform cutting and patching.

B. Submit written request in advance of cutting or altering elements affecting:

1. Structural integrity of element.
2. Integrity of weather-exposed or moisture-resistant elements.
3. Efficiency, maintenance, or safety of element.
4. Visual qualities of sight-exposed elements.
5. Work of Owner or separate contractor.

C. Execute cutting, fitting, and patching to complete Work and to:

1. Fit the several parts together, to integrate with other Work.
2. Uncover Work to install or correct ill-timed Work.
3. Remove and replace defective and nonconforming Work.
4. Remove samples of installed Work for testing.
5. Provide openings in elements of Work for penetrations of mechanical and electrical Work.

D. Execute Work by methods to avoid damage to other Work and to provide proper surfaces to receive patching and finishing.

E. Restore Work with new products according to requirements of Contract Documents.

F. Fit Work tight to pipes, sleeves, ducts, conduits, and other penetrations through surfaces.

G. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.

H. At penetrations of fire-rated walls, partitions, ceiling, or floor construction, completely seal voids with fire-rated material to full thickness of penetrated element.

I. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for assembly, refinish entire unit.

J. Identify hazardous substances or conditions exposed during the Work to Engineer for decision or remedy.

3.5 PROTECTING INSTALLED CONSTRUCTION

A. Protect installed Work and provide special protection where specified in individual Specification Sections.

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

C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

D. Use durable sheet materials to protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects.

3.6 FINAL CLEANING

A. Execute final cleaning prior to final Project assessment.

1. Employ experienced personnel or professional cleaning firm.

B. Clean interior and exterior glass and surfaces exposed to view; remove temporary labels, stains, and foreign substances; polish transparent and glossy surfaces.

C. Clean equipment and fixtures to sanitary condition with appropriate cleaning materials.

D. Replace filters of operating equipment.

E. Remove waste and surplus materials, rubbish, and construction facilities from Site.

END OF SECTION

SECTION 01 74 19

CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Construction waste management plan.

B. Related Sections:

1. Section 01 91 00 - Commissioning: General commissioning requirements.

1.2 PLAN REQUIREMENTS

A. Develop and implement construction waste management plan as approved by Engineer.

B. Intent:

1. Reduce amount of construction and demolition debris from requiring landfill disposal.
2. Ensure that construction and demolition debris is properly disposed of in a landfill permitted by the State of Alaska.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures contains requirements for submittals.

B. Construction Waste Management Plan: Submit construction waste management plan describing methods and procedures for implementation and monitoring compliance including the following:

1. Disposition of waste and hazardous waste.
2. On-Site sorting and Site storage methods.
3. Location of State permitted landfill for disposal of waste materials.

C. Submit documentation prior to Substantial Completion substantiating construction waste management plan was maintained and goals were achieved.

1. Trash: Quantity by volume deposited in landfills.

2. Salvaged Material: Quantity by volume with destination for each type of material salvaged for resale, recycling, reuse, or delivery to Owner.

1.4 CONSTRUCTION WASTE MANAGEMENT PLAN

A. Implement construction waste management plan at start of construction.

B. Review construction waste management plan at preconstruction meeting and progress meetings specified in Section 01 31 19 – Project Meetings.

C. Distribute approved construction waste management plan to Subcontractors and others affected by plan requirements.

D. Oversee plan implementation, instruct construction personnel for plan compliance, and document plan results.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION

3.1 CONSTRUCTION WASTE COLLECTION

A. Collect construction waste materials in marked bins or containers and arrange for transportation to permitted landfill.

B. Maintain storage and collection area in orderly arrangement with materials separated to eliminate co-mingling of materials designated for salvage.

C. Store construction waste materials to prevent environmental pollution, fire hazards, hazards to persons and property, and contamination of stored materials.

D. Cover construction waste materials subject to disintegration, evaporation, settling, or runoff to prevent polluting air, water, and soil.

3.2 CONSTRUCTION WASTE DISPOSAL

A. All construction and demolition waste shall be delivered to a landfill permitted by the Alaska Department of Environmental Conservation. Disposal of waste in an unpermitted landfill is illegal.

B. Construction and demolition waste shall only be disposed of in a landfill after permission from the landfill owner has been secured and all applicable fees have been paid.

C. If an acceptable landfill cannot be secured within the City of Emmonak, construction and demolition waste shall be transported to an acceptable landfill in another community for final disposal.

END OF SECTION

SECTION 01 91 00
COMMISSIONING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Commissioning description.
2. Submittals.
3. Qualifications
4. Commissioning services.
5. Commissioning responsibilities.
6. Commissioning meetings.
7. Commissioning reports.
8. Sequencing.
9. Scheduling.
10. Maintenance materials.
11. Test equipment.
12. Verification check and startup procedures.
13. Functional performance test procedures.
14. Function performance test methods.
15. Deficiencies and test approvals.
16. Demonstration.

1.2 COMMISSIONING DESCRIPTION

A. Commissioning: Systematic process of ensuring systems perform interactively according to design intent and Owner's operational needs. Commissioning process encompasses and coordinates system documentation, equipment startup, control system calibration, testing and balancing, performance testing and training, and verification of actual performance. Commissioning shall be performed by Commissioning Authority, employed by the Contractor. All work related to commissioning and by Commissioning Authority shall be considered incidental to the contract and shall not be measured for payment.

B. Commissioning Intent:

1. Verify equipment and systems are installed according to manufacturer's instructions, industry accepted minimum standards, and Contract Documents.
2. Verify equipment and systems receive adequate operational checkout by Contractor.
3. Verify and document proper performance of equipment and systems.
4. Verify complete operation and maintenance documentation is delivered to Owner.
5. Verify Owner's operating and maintenance personnel are adequately trained.

C. Equipment and Systems to be Commissioned:

1. Raw water pump, valves, and electrical controls

D. Commissioning does not relieve Contractor of responsibility to provide finished and fully functioning Project.

E. Commissioning Process Overview and General Order of Commissioning Tasks:

1. Commissioning begins with initial commissioning meeting.
2. Conduct progress commissioning meetings throughout construction to plan, scope, coordinate, and schedule future activities and to resolve problems.
3. Equipment documentation is submitted to Commissioning Authority during normal submittals with detailed startup procedures.
4. Commissioning Authority works with Contractor and equipment and system installers to develop startup plans and startup documentation formats.
5. Commissioning Authority develops specific equipment and system functional performance test procedures.
6. Contractor executes procedures developed by Commissioning Authority.
7. Items of noncompliance in material, installation, or setup are corrected at Contractor's expense, and system is retested.
8. Commissioning Authority reviews operation and maintenance documentation for completeness.
9. Commissioning is completed before Substantial Completion.
10. Commissioning Authority reviews, approves, and coordinates training provided by Contractor and verifies training was completed.
11. Deferred testing is conducted as specified.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures contains requirements for submittals.

B. Qualification Data: Submit the following prior to start of Work:

1. Commissioning Authority: Firm or individual name, address, and telephone number, and name of responsible officer.

1.4 COMMISSIONING SUBMITTALS

A. Commissioning Authority will review and approve submittals for conformance to Contract Documents as related to commissioning process, for primary purpose of aiding development of functional testing procedures and secondary purpose of verifying compliance with equipment Specifications.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements contains requirements for closeout submittals.

B. Operation and Maintenance Data: Submit operation and maintenance manuals as specified in individual equipment and system Specifications.

1. Submittals made to Commissioning Authority do not constitute compliance with operation and maintenance manual documentation.

C. Commissioning Record: Commissioning Authority will submit one copy of commissioning record for inclusion in operation and maintenance manuals. Furnish records in following format, arranged by system, with each part separated by tabbed flyleafs:

1. Commissioning plan.
2. Final commissioning report.
3. Provide the following separated by tabbed flyleafs:

a. Design narrative and criteria, sequences, and approvals.
b. Startup plan and report, approvals, corrections, and blank verification checklists. Separate data for each equipment type with colored separators.
c. Completed, functional tests, trending and analysis, approvals and corrections, training plan, record and approvals, blank functional test forms, and recommended re-commissioning schedule.

D. Final Commissioning Report: Commissioning Authority will submit one copy of final commissioning report including the following:

1. Executive summary with list and roles of participants, brief Project description, overview of commissioning and testing scope, and general description of testing and verification methods.
2. List outstanding deficiencies referenced to specific functional test, inspection, trend log, or other record where deficiency is documented.

3. Include brief description of verification method used as well as observations and conclusions from testing for each commissioned piece of equipment and system.

1.6 QUALITY ASSURANCE

A. Perform Work according to references listed in Subsection 1.2 – References of this Section.

1.7 QUALIFICATIONS

A. Commissioning Authority: Individual employed by the Contractor or subcontracted firm specializing in performing Work of this Section with documented experience of commissioning at least 3 projects similar to the Emmonak River Intake. Multiple individuals with specific experience commissioning the various systems may operate under the direction of the Commissioning Authority.

1. Individuals performing commissioning duties under Commissioning Authority must be experienced in operation and troubleshooting of the system being commissioned. At a minimum experience in operation and troubleshooting of mechanical, electrical systems, and HVAC systems is required.
2. Excellent verbal and written communication skills, highly organized, and able to work with both management and installers.

1.8 COMMISSIONING SERVICES

A. The Contractor shall employ and pay for services of Commissioning Authority acceptable to Owner to perform specified commissioning.

1.9 COMMISSIONING RESPONSIBILITIES

A. Responsibilities indicated for Owner, Engineer, and Commissioning Authority are provided only to clarify commissioning process.

B. Engineer Responsibilities:

1. Perform Site observation of each system before system startup.
2. Furnish design narratives and sequence documentation requested by Commissioning Authority.
3. Clarify operation and control of commissioned equipment when Specifications, control drawings, or equipment documentation is not sufficient for writing detailed testing procedures.
4. Coordinate resolution of design issues affecting system performance identified during commissioning.

5. Coordinate resolution of system deficiencies identified during commissioning, according to Contract Documents.
6. Prepare and submit final design intent documentation reflecting installed conditions for inclusion in operation and maintenance manuals.
7. Review and approve operation and maintenance manuals.
8. Review verification checklists for major pieces of equipment.
9. Review functional test procedure forms for major pieces of equipment.

C. Commissioning Authority Responsibilities:

1. Basic Responsibilities:

   a. Coordinate, direct, and approve commissioning Work.
   b. Develop and coordinate execution of commissioning plan. Revise commissioning plan to suit Project conditions.
   c. Schedule commissioning Work with Contractor for inclusion in Progress Schedule.
   d. Plan and conduct commissioning meetings.
   e. Request and review commissioning submittals required to perform commissioning tasks.
   f. Develop verification check and startup plan in cooperation with Contractor and equipment and system installers.
   g. Write functional performance test procedures in cooperation with Contractor and equipment and system installers.
   h. Review test and balance execution plan.
   i. Attend Project progress meetings as required. Review meeting minutes. Resolve potential conflicts with commissioning activities.
   j. Observe equipment and system installations.
   k. Document that equipment and systems are installed and perform according to design intent and Contract Documents.
   l. Notify Engineer of deficiencies.
   m. Coordinate and supervise required seasonal or deferred testing and deficiency corrections.
   n. Oversee and approve content and adequacy of Owner's personnel training.
   o. Review and approve operation and maintenance manuals.
   p. Compile commissioning record and testing data manual.
   q. Provide final commissioning report.

2. Detailed Responsibilities:

   a. Witness and document each piping, electrical, and HVAC system testing, cleaning, and flushing. Include documentation in operation and maintenance manuals.
   b. Approve verification tests and checklist completion by reviewing verification checklist reports, Site observation, and spot checking.
   c. Approve system startup by reviewing startup reports and Site observation.
   d. Oversee functional testing of control system. Approve control system for use for test and balance operations.
   e. Analyze functional performance trend logs and monitor data to verify performance.

f. Coordinate, witness, and approve manual functional performance tests performed by equipment and system installers.

1) Coordinate retesting until satisfactory performance is achieved.
2) Perform actual functional testing on equipment as specified in Section 26 08 00 Commissioning of Electrical Systems.

g. Maintain deficiency and resolution log and separate testing record. Submit progress reports and test results with recommended actions to Owner.
h. Review equipment warranties to ensure Owner's responsibilities are defined.
i. Return to Site minimum of two months before expiration of warranty period.

1) Review with Owner's personnel the current equipment and system operation and condition of outstanding issues related to original and seasonal commissioning.
2) Interview Owner's personnel to identify problems or concerns regarding equipment and system operation.
3) Make suggestions for improvements and for recording changes in operation and maintenance manuals.
4) Identify deficiencies covered by warranty or original construction contract.
5) Assist Owner's personnel to develop reports, documents, and requests for services to remedy outstanding problems.

3. Commissioning Authority may not:

a. Release, revoke, alter, or enlarge on requirements of Contract Documents.
b. Approve or accept any portion of the Work.
c. Assume duties of Engineer.

D. Owner Responsibilities:

1. Arrange for Owner's personnel to attend commissioning activities and training sessions according to commissioning plan.
2. Approve commissioning Work completion.
3. Ensure seasonal or deferred testing and deficiency issues are addressed.

E. Contractor Responsibilities:

1. Include requirements for commissioning submittal data, operation and maintenance data, commissioning tasks and training in each purchase order and subcontract for equipment and systems indicated to be commissioned.
2. Facilitate coordination of commissioning Work by Commissioning Authority.
3. Attend commissioning meetings.
4. Cooperate with Commissioning Authority, and provide access to the Work and to manufacturers' facilities.
5. Require equipment and system installers to execute test to review and provide comments on functional test procedures.

6. Require manufacturers to review commissioning test procedures for equipment installed by manufacturer.
7. Furnish proprietary test equipment required by manufacturers to complete equipment and system tests.
8. Provide temporary facilities as specified in Section 01 50 00 - Temporary Facilities and Controls for Commissioning Authority's exclusive use for documentation and instrument storage and preparation of reports.
9. Furnish qualified personnel to assist in completing commissioning.
10. Furnish manufacturer's qualified field representatives as specified in Section 01 40 00 - Quality Requirements and individual Specification Sections to assist in completing commissioning.
11. Ensure equipment and system installers execute commissioning responsibilities according to Contract Documents and Progress Schedule.
12. Coordinate Owner's personnel training.
13. Prepare operation and maintenance manuals specified in Section 01 70 00 - Execution and Closeout Requirements. Update original sequences of operation reflecting actual installation.
14. Ensure equipment and system installers execute seasonal and deferred functional performance testing, witnessed by Commissioning Authority.
15. Ensure equipment and system installers correct deficiencies and make necessary adjustments to operation and maintenance manuals and record documents for issues identified in seasonal testing.

1.10 COMMISSIONING MEETINGS

A. Section 01 31 19 – Project Meetings contains requirements for progress meetings.

B. Commissioning Authority will make arrangements for meetings, prepare agenda with copies for participants, and preside at meetings.

C. Initial Commissioning Meeting:

1. Commissioning Authority will schedule meeting within 30 days after start of construction.
2. Attendance Required: Commissioning Authority, Owner, Engineer, Contractor, Subcontractors, and testing, adjusting, and balancing personnel. Require attendance by installers of the following equipment and systems indicated to be commissioned, including:

    a. Mechanical equipment and systems.
    b. Electrical equipment and systems.

3. Agenda:

    a. Designation of personnel representing parties for commissioning activities.
    b. Review commissioning process and responsibilities.

c. Review commissioning plan development procedures.
d. Review required commissioning submittals.
e. Present initial commissioning schedule.

D. Progress Commissioning Meetings:

1. Commissioning Authority will schedule meetings throughout progress of the Work at regular intervals.

a. Before commissioning of individual systems: meetings shall be scheduled weekly for the two weeks immediately preceding commissioning.

2. Attendance Required: As specified for initial commissioning meeting.

3. Agenda:

a. Coordination of commissioning activities.
b. Commissioning deficiency resolution.
c. Commissioning schedule.
d. Planning for future commissioning activities.

E. Commissioning Authority will record meeting minutes and distribute copies within five days after meeting to participants and those affected by decisions made.

1.11 COMMISSIONING REPORTS

A. Commissioning Authority Reports: Submit reports regularly to Owner, Engineer, and Contractor. Include the following.

1. Progress reports.
2. Scheduling changes.
3. Observation reports of specific commissioning activities.
4. Testing progress and approvals.
5. Deficiencies and deficiency resolution reports.

B. Commissioning Authority Functional Performance Test Procedures: Develop test procedures including forms with following information. Include completed documentation in operation and maintenance manuals.

1. System and equipment or component names.
2. Equipment location and identification number.
3. Unique test identification number and reference to unique verification checklist and startup documentation identification numbers for piece of equipment.
4. Date.

5. Project name.
6. Participating parties.
7. Copy of Specification Section describing test requirements.
8. Copy of specific sequence of operations or other specified parameters being verified.
9. Formulas used in calculations.
10. Required pre-test field measurements.
11. Instructions for setting up test.
12. Special cautions, alarm limits, and safety concerns.
13. Specific step-by-step procedures to execute test, in clear, sequential, and repeatable format.
14. Acceptance criteria of proper performance with "Yes/No" check box to allow for marking whether or not proper performance of each part of test was achieved.
15. Section for comments.
16. Signatures and date block for Commissioning Authority.

1.12 SEQUENCING

A. Section 01 10 00 - Summary contains requirements for sequencing.

B. Sequence Work to complete commissioning, except for functional testing and Owner's personnel training, before Substantial Completion.

C. Sequence Work to achieve functional completion before final completion. Complete the following for each piece of equipment and system indicated to be commissioned to achieve functional completion:

1. Complete and sign startup and verification checklist documentation.
2. Submit trend log data.
3. Submit final approved test and balance report.
4. Complete functional testing.
5. Complete training of Owner personnel.
6. Submit approved operation and maintenance data manuals.
7. Correct identified deficiencies or obtain approval by Owner to exclude deficiencies from functional completion.

1.13 SCHEDULING

A. Section 01 31 00 - Administrative Requirements contains requirements for scheduling.

B. Schedule Work to allow adequate time for commissioning activities.

C. Identify commissioning milestones, activities, and durations on Progress Schedule.

1. Identify the following for each piece of equipment and system including:

a. Operation and maintenance manual submittal.
b. Verification check and startup.
c. Functional performance test.
d. Functional completion.
e. Demonstration and training sessions.
f. Commissioning completion.

1.14 MAINTENANCE MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements contains requirements for maintenance materials.

B. Furnish one set of manufacturer's proprietary test equipment, tools, and instruments required to complete commissioning.

1. Deliver test equipment to Owner after completion of functional performance test. Obtain signed receipt.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. Testing Equipment: Calibrated within last year; of sufficient quality and accuracy to test and measure system performance within the following tolerances unless otherwise specified for individual equipment or systems.

1. Temperature Sensors and Digital Thermometers: 0.5 degrees F accuracy and plus or minus 0.1 degrees F resolution.
2. Pressure Sensors: Accuracy of plus or minus 2.0 percent of measured value range.

B. Recalibrate test equipment according to manufacturer's recommended intervals and when dropped or damaged.

1. Affix calibration tags to test equipment or furnish certificates upon request.

C. Equipment Furnished by Contractor and Remaining Property of the Contractor:

1. Standard testing equipment required to perform verification check and startup and required functional performance testing.
2. Two-way radios for personnel performing commissioning.

D. Equipment furnished by Commissioning Authority and remaining property of Commissioning Authority:

1. Data-logging equipment and software.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 31 00 - Administrative Requirements contains requirements for verification of existing conditions before starting Work.

B. Verify equipment and systems are installed according to individual Specification Sections.

C. Verify utility and power connections are complete and services operational.

3.2 VERIFICATION CHECK AND STARTUP PROCEDURES

A. Notify Commissioning Authority and schedule verification check and startup activities with each party required to complete verification check and startup a minimum of two weeks in advance.

B. Allow Commissioning Authority to witness verification check and startup.

1. Primary Equipment: Commissioning Authority will witness procedures for each piece of equipment.
2. Secondary Equipment: Commissioning Authority will witness procedures for each piece of equipment.

C. Verification Check and Startup:

1. Perform verification check and startup according to approved verification check and startup plan.
2. Complete entire plan for each piece of equipment or system indicated to be commissioned.
3. Complete each procedure in sequence performed by party assigned to each procedure.
4. Record completion of each procedure. Indicate results of procedure where required. Sign and date plan by individual performing procedure.
5. Identify items not completed successfully.

6. Sign and date plan indicating completion of entire plan.
7. Submit executed plan to Commissioning Authority within two days of completion.

D. Deficiencies and Approvals:

1. Commissioning Authority will review verification check and startup reports and issue deficiency report or approval.
2. Correct deficiencies and resubmit updated verification check and startup report with statement indicating corrections made for Commissioning Authority approval.
3. Repeat process until verification check and startup report are approved.
4. Costs for incomplete verification check and startup items that later cause deficiencies or delays during functional tests may be charged to party responsible for incomplete item.

3.3 FUNCTIONAL PERFORMANCE TEST PROCEDURES

A. Complete the following before performing functional tests:

1. Verification check and startup.
2. Control system testing with approval by Commissioning Authority for use for test and balance operations.

B. Notify Commissioning Authority of completion of verification check and startup activities.

C. Commissioning Authority will direct, witness, and document results of functional performance tests.

D. Conduct functional performance tests as specified in Section 26 08 00 – Commissioning of Electrical Systems.

E. Demonstrate that each piece of equipment and system is operating according to documented design intent and Contract Documents.

1. Conduct testing proceeding from components, to subsystems, to systems.
2. Bring equipment and systems to condition capable full dynamic operation.
3. Verify performance of individual components and systems.
4. Verify performance of interactions between systems.
5. Identify and correct areas of deficient performance.

F. Operate each piece of equipment and system through each specified mode of operation including seasonal, occupied, unoccupied, warmup, cool-down, partial load, and full load conditions.

1. Verify each sequence in sequences of operation.

2. Test for proper responses to power failure, freezing, overheating, low oil pressure, no flow, equipment failure, and other abnormal conditions.

3.4 FUNCTIONAL PERFORMANCE TEST METHODS

A. Perform testing and verification by using manual testing or by monitoring performance and analyzing results using control system trend log capabilities or by standalone data loggers as specified for each piece of equipment or system.

1. Commissioning Authority may require alternate or additional method other than specified method.
2. Commissioning Authority will determine test method when method is not specified.

B. Simulated Conditions: Simulating conditions, not by overwritten values, is permitted. Timing tests to use real conditions is encouraged wherever practical.

C. Overwritten Values: Overwriting sensor values to simulate conditions may be used with caution and avoided when possible.

D. Simulated Signals: Using signal generator to create simulated signals to test and calibrate transducers automatic temperature controls is generally recommended over using sensors as signal generators with simulated conditions or overwritten values.

E. Altering Setpoints: Rather than overwriting sensor values, and when simulating conditions is difficult, altering setpoints to test specific sequence is acceptable. Reset setpoint after completing test.

F. Indirect Indicators: Using indirect indicators for responses or performance is permitted only after visually and directly verifying and documenting indirect readings through control system representing actual conditions and responses over tested parameter range.

G. Perform each function and test under conditions simulating actual conditions as close as is practically possible.

1. Provide materials, system modifications, and other items or steps necessary to produce flows, pressures, temperatures, and other responses to execute test according to specified conditions.
2. At completion of test, return modified equipment and systems to pretest condition.

3.5 DEFICIENCIES AND TEST APPROVALS

A. Deficiencies:

1. Commissioning Authority will record and report deficiencies to Owner.

2. Minor deficiencies may be corrected during tests at Commissioning Authority's discretion. Deficiency and resolution will be documented on procedure form.
3. Failure to attend scheduled verification check, startup, or functional performance test will be considered deficiency.
4. When deficiency is identified, Commissioning Authority will discuss issue with party executing test.

    a. When party executing test accepts responsibility to correct deficiency:

        1) Commissioning Authority documents deficiency and executing party's response.
        2) Commissioning Authority submits deficiency report to Owner, Contractor, and party executing test.
        3) Party executing test corrects deficiency, signs statement of correction on deficiency form certifying equipment is ready for retesting, and submits form to Commissioning Authority.
        4) Commissioning Authority reschedules test, and test is repeated until satisfactory performance is achieved.

    b. When party executing test disputes deficiency or responsibility for deficiency:

        1) Commissioning Authority documents deficiency and executing party's response.
        2) Commissioning Authority submits deficiency report to Owner, Contractor, party executing test, and party believed to be responsible for deficiency.
        3) Commissioning Authority refers disputes to Engineer for resolution according to Contract Documents.
        4) Commissioning Authority documents resolution process.
        5) When resolution is decided, appropriate party corrects deficiency, signs statement of correction on deficiency form certifying equipment is ready for retesting, and submits form to Commissioning Authority.
        6) Commissioning Authority reschedules test, and test is repeated until satisfactory performance is achieved.

B. Retesting Costs:

1. When verification check and startup or functional performance test deficiency is discovered requiring rescheduling or retesting:

    a. Owner will compensate Commissioning Authority (when not an employee of Contractor), and Engineer for attending and directing additional testing.
    b. Owner will deduct additional testing compensation from final payment due to Contractor.

C. Provide written report to Commissioning Authority before each scheduled commissioning meeting concerning status of each deficiency. Include explanations of disagreements with resolution proposals for each discrepancy.

1. Commissioning Authority will retain original deficiency forms until end of Project.

D. Manufacturing Defects: When two or more identical pieces of equipment or fail to perform to Contract Document requirements due to manufacturing defect, all identical units may be considered defective by Owner.

1. Within one week of notice from Owner, examine all other identical units and record findings. Submit findings to Owner within two weeks of original notice.
2. Within two weeks of original notification, provide signed and dated written explanation of problem, cause of defect, and proposed solutions meeting Contract Document requirements. Include equipment submittals supporting solution.
3. Owner will determine whether replacement or repair of all identical units is required.
4. Provide a minimum of two examples of proposed solution. Owner will review proposed solutions and decide which solution is acceptable.
5. Upon acceptance, replace or repair all identical items, at Contractor's expense. Extend warranty accordingly, when original equipment warranty had begun.
6. Complete repairs or replacements with reasonable speed beginning within one week from when parts can be obtained.

E. Test Approval: Commissioning Authority notes each satisfactorily demonstrated function on functional performance test form.

1. Commissioning Authority recommends acceptance of each test to Owner using standard form.
2. Owner gives final approval for each test using same form, providing signed copy to Commissioning Authority and Contractor.

3.6 DEMONSTRATION

A. Section 01 70 00 - Execution and Closeout Requirements contains requirements for demonstration and training.

B. Demonstrate equipment and systems and train Owner's personnel as specified in individual equipment and system Specifications.

1. Commissioning Authority will interview Owner's personnel to determine special needs and areas where training will be most valuable.
2. Owner and Commissioning Authority will determine type and extent of training for each commissioned piece of equipment and system.
3. Commissioning Authority will communicate training requirements to Contractor for benefit of equipment and system installers and manufacturers with training responsibilities.

C. Commissioning Authority will develop criteria for determining training was satisfactorily completed, including attending some training sessions.

1. Commissioning Authority will make recommendation to Owner regarding approval of training.

D. Initial Equipment Training Session:

1. Engineer will make a presentation of overall system design concept and design concept of each equipment section.

2. Presentation will include review of the following systems using simplified system schematics:
   a. Raw water pump
   b. Building ventilation system

E. For primary equipment training:

1. Require controls contractor to provide short discussion of equipment control as part of training session.

END OF SECTION

DIVISION 02 EXISTING CONDITIONS

DIVISION 02 EXISTING CONDITIONS

SECTION 02 01 00
MAINTENANCE OF EXISTING CONDITIONS

PART 1 - GENERAL

1.1 PUBLIC AND PRIVATE UTILITIES

A. Existing above-ground utilities, including but not limited to power transmission and distribution, telephone, water and sewer piping, fuel piping, glycol heat trace, and private utility service lines, whether shown on the Plans or not, shall be protected, maintained, relocated, rerouted, removed and restored as may be necessary by Contractor in a manner satisfactory to Owners and operators of the utilities.

B. Major underground utilities and appurtenant structures, whether shown on the Plans or not, shall be protected, maintained, relocated, rerouted, removed and restored by the Contractor.

C. Minor underground utility service lines, including but not limited to sanitary sewer services, fuel pipelines, water services, house or yard drains, and electricity or telephone services and driveway culverts shall be protected, maintained, relocated, rerouted, removed and restored by the Contractor with the least possible interference with such services and in no case shall the interference of such service lines be considered for extra compensation under any of the special cases listed above.

D. Public Utilities:
   1. The right is reserved by Owner of public utilities and franchises to enter upon any street, road, right-of-way, or easement for the purpose of maintaining their property and for making necessary repairs or adjustments caused by the Contractor's operations.
   2. The Contractor shall save the Owner harmless of any costs so incurred.

1.2 RESTORATION OF DRAINAGE FACILITIES

A. Where it is necessary for drainage facilities to be removed and replaced, existing culverts may be reinstalled when approved by the agency(s) having jurisdiction.

B. The materials shall be cleaned.

C. When it is necessary to replace existing culverts, the new materials shall be of equal strength and similar design to existing materials, unless otherwise noted.

D. Installation shall be in accordance with the applicable provisions of these specifications.

E. All costs, whether new or existing facilities are installed, shall be considered to be included in the unit prices bid for the various items and no additional payment shall be allowed.

1.3 QUALITY ASSURANCE

A. All work shall be performed in conformance with regulations pertaining to safety established by the applicable Federal, state, or local agencies, and as may be specified elsewhere in these specifications.

B. Underground Facilities:
   1. It is recommended that the Contractor make arrangements with the applicable utility company or department to aid in the location and maintenance of existing utilities.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION – NOT USED

END OF SECTION

SECTION 02 22 00
EXISTING CONDITIONS ASSESSMENT

PART 1 - GENERAL

1.1 SITE VISITATION

A. Contractor shall visit the site of work, existing buildings, review any available existing drawings, and all conditions affecting the work of this project before providing a bid proposal.

B. If Contractor desires access to existing buildings shall contact the Owner to arrange appointments. No guarantees are made that appointments to visit all facilities will be available. The Owner reserves the right to provide access to all potential bidders at one time at the Owner's convenience.

PART 2 - VERIFICATION

2.1 CONSTRUCTION

A. Prior to commencement of work, verify all existing conditions, control points, principal lines and elevations, presence of underground utilities, at or related to the site and existing buildings, and also examine all adjacent facilities upon which the work is in any way dependent. In the event of any inconsistency or conflict, between existing conditions and the bidding documents, immediate notice of such inconsistency or conflict shall be given to the Engineer. Do not undertake any phase of the work affected by such inconsistency or conflict, pending the issuance of instructions by the Engineer.

B. Some of the elevations of existing grades, floors, tops of walls, parapets, beams and locations of existing columns, walls, pipe foundations, utility boxes and the like are based on drawings of the existing building furnished by the Owner. It is the intent of the Contract Drawings to integrate new work with existing work and the Contractor shall verify actual conditions.

C. Provide protections necessary to prevent damage to existing buildings, improvements, landscaping and trees, parking, streets, walks, etc. to remain in place. Restore damaged buildings, improvements, etc. to their original conditions as acceptable to the Owner.

PART 3 - EXISTING CONDITIONS

3.1 EXISTING FACILITIES

A. Existing buildings must be kept functioning during the construction period.

B. Existing utilities cannot be disconnected until new ones have been installed and completely tested and approved unless otherwise approved by the Engineer. Existing functioning utilities cannot be interrupted without written approval from the Owner. Give two (2) weeks written notice to the Engineer prior to planned interruption of any existing functioning utilities. Engineer will then schedule with Contractor for date and time of shutdown. Due to the need for continuous operation of the facilities, no guarantee is made that scheduled shutdowns can be accommodated.

C. Notify the Engineer when working in areas where utility lines might be encountered.

END OF SECTION

SECTION 02 32 00
GEOTECHNICAL INVESTIGATIONS

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

A. Section 33 05 23.13: Horizontal Directional Drilling

1.2 SOIL REPORTS

A. Geotechnical information for this HDD project and provided in these Contract Document was obtained from two sources: 1) Geotechnical Exploration and Engineering Recommendations - Emmonak Water and Wastewater Utility Upgrades, Golder Associates, 2013, and 2) Geotechnical Report Alaska Village Electric Cooperative - Bulk Fuel Upgrades Emmonak Alaska, HDL Engineering Consultants 2014.

B. Additional Investigation:
   1. Contractor shall visit the site and acquaint himself with site conditions before submitting a bid, and the submission of a bid will be prima facie evidence that he has done so.
   2. Prior to bidding, Contractor may make his own subsurface investigations to satisfy himself with site and subsurface conditions.

1.3 QUALITY ASSURANCE

A. The Contractor shall readjust work performed that does not meet technical or design requirements.

B. The Contractor shall make no deviations from the Contract Documents without specific and written approval of the Owner.

C. The Contractor shall be responsible for obtaining approval from responsible agency(s) or property owner(s) before performing any exploratory excavations.

END OF SECTION

SECTION 02 41 19
SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolishing designated building equipment and fixtures.
2. Demolishing designated construction.
3. Cutting and alterations for completion of the Work.
4. Removing designated items for disposal, relocation, or Owner's retention.
5. Protecting items designated to be relocated.
6. Removing demolished materials.

1.2 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Demolition Schedule: Indicate overall schedule and interruptions required for utility and building services.

C. Shop Drawings:

1. Indicate demolition and removal sequence.
2. Indicate location of items designated for disposal, relocation, or Owner's retention.
3. Indicate location and construction of temporary work.

1.3 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Accurately record actual locations of capped utilities, concealed utilities discovered during demolition and foundation obstructions.

C. Operation and Maintenance Data: Submit description of system, inspection data, and parts lists.

1.4 QUALITY ASSURANCE

A. Obtain required permits from authorities having jurisdiction.

B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

D. Pre-demolition Conference: Conduct conference at Project site.
   1. Inspect and discuss condition of construction to be demolished.
   2. Review structural load limitations of existing structures.
   3. Review and finalize building demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.
   4. Review and finalized protection requirements.
   5. Review procedures for noise control and dust control.
   6. Review procedures for protection of adjacent piping and equipment.

1.5 SEQUENCING

A. Section 01 10 00 - Summary: Requirements for sequencing.

1.6 SCHEDULING

A. Section 01 32 16 - Construction Progress Schedule: Requirements for scheduling.

B. Cooperate with Owner in scheduling noisy operations and waste removal that may impact Owners operation and temporary outages.

C. Coordinate utility and building service interruptions with Owner.

   1. Do not disable or disrupt life safety systems without three days prior written notice to Owner.
   2. Schedule tie-ins to existing systems to minimize disruption.
   3. Coordinate Work to ensure fire alarms, smoke detectors, emergency lighting, exit signs and other life safety systems remain in full operation in occupied areas.

1.7 PROJECT CONDITIONS

A. Conduct demolition to minimize interference with adjacent building areas.

B. Conduct building demolition so operations of occupied building will not be disrupted.
   1. Provide not less than 72 hours' notice of activities that will affect operation of adjacent occupied areas.

2. Maintain access to existing walkways, exits, and other facilities used by occupants of building.

C. Owner assumes no responsibility for buildings and structures to be demolished.
   1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

D. On-site storage or sale of removed items or materials is not permitted.

E. Cease operations immediately if structure appears to be in danger and notify Engineer. Do not resume operations until directed.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 PREPARATION

A. Notify affected utility companies before starting work and comply with their requirements.

B. Mark location and termination of utilities.

C. Erect and maintain weatherproof closures for exterior openings.

D. Erect and maintain temporary partitions to prevent spread of dust, odors, and noise to permit continued Owner occupancy.

E. Prevent movement of structure; provide temporary bracing and shoring required to ensure safety of existing structure.

F. Provide appropriate temporary signage including signage for exit or building egress.

G. Do not close or obstruct building egress paths.

H. Do not disable or disrupt life safety systems without three days prior written notice to Owner.

3.2 SALVAGE REQUIREMENTS

A. Coordinate with Owner to identify building components and equipment required to be removed and delivered to Owner.

B. Tag components and equipment Owner designates for salvage.

C. Protect designated salvage items from demolition operations until items can be removed.

D. Carefully remove building components and equipment indicated to be salvaged.

E. Disassemble as required to permit removal from building.

F. Package small and loose parts to avoid loss.

G. Mark equipment and packaged parts to permit identification and consolidation of components of each salvaged item.

H. Prepare assembly instructions consistent with disassembled parts. Package assembly instructions in protective envelope and securely attach to each disassembled salvaged item.

I. Deliver salvaged items to Owner. Obtain signed receipt from Owner.

3.3 DEMOLITION

A. Conduct demolition to minimize interference with adjacent building areas.

B. Maintain protected egress from and access to adjacent existing buildings at all times.

C. Cease operations immediately when structure appears to be in danger and notify Engineer.

D. Disconnect and remove designated utilities within demolition areas.

E. Cap and identify abandoned utilities at termination points when utility is not completely removed. Annotate Record Drawings indicating location and type of service for capped utilities remaining after demolition.

F. Demolish in orderly and careful manner. Protect existing improvements and supporting structural members.

G. Carefully remove building components indicated to be reused.

1. Disassemble components as required to permit removal.
2. Package small and loose parts to avoid loss.
3. Mark components and packaged parts to permit reinstallation.
4. Store components, protected from construction operations, until reinstalled.

H. Remove demolished materials from site except where specifically noted otherwise. Do not burn or bury materials on site.

I. Remove materials as Work progresses. Upon completion of Work, leave areas in clean condition.

J. Remove temporary Work.

END OF SECTION

DIVISION 03 CONCRETE

SECTION 03 20 00

CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Reinforcing bars.

B. Related Sections:
   1. Section 03 30 00 - Cast-In-Place Concrete.

1.2 REFERENCES

A. American Concrete Institute:
   1. ACI 301 - Specifications for Structural Concrete.
   2. ACI 318 - Building Code Requirements for Structural Concrete.
   3. ACI SP-66 - ACI Detailing Manual.

B. ASTM International:
   1. ASTM A82/A82M - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
   2. ASTM A184/A184M - Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.
   3. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

C. Concrete Reinforcing Steel Institute:
   1. CRSI - Manual of Standard Practice.
   2. CRSI - Placing Reinforcing Bars.

1.3 SUBMITTALS

A. Shop Drawings: Indicate bar sizes, spacings, locations, and quantities of reinforcing steel.

PART 2 - PRODUCTS

2.1 REINFORCEMENT

A. Reinforcing Steel: Per Structural Drawings.

2.2 FABRICATION

A. Fabricate concrete reinforcement in accordance with CRSI Manual of Practice.

PART 3 - EXECUTION

3.1 PLACEMENT

A. Place, support and secure reinforcement against displacement. Do not deviate from required position beyond specified tolerance.
   1. Do not weld crossing reinforcement bars.

B. Accommodate placement of formed openings.

C. Maintain concrete cover around reinforcement per Structural Drawings.

END OF SECTION

SECTION 03 41 00
PRECAST STRUCTURAL CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes structural precast concrete for:
   1. Building footings
   2. Deck footings

B. Related Sections:

   1. Section 03 20 00 Concrete Reinforcing

1.2 REFERENCES

A. American Concrete Institute:

   1. ACI 301 - Specifications for Structural Concrete.
   2. ACI 318 - Building Code Requirements for Structural Concrete.

B. ASTM International:

   1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
   2. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   3. A185/A185M-07 Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
   4. ASTM A416/A416M - Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete.
   5. ASTM A497/A497M - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
   6. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
   7. ASTM A666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
   8. ASTM A706/A706M - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
   9. ASTM C150 - Standard Specification for Portland Cement.
   10. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

C. American Welding Society:

1. AWS D1.1 - Structural Welding Code - Steel.
2. AWS D1.4 - Structural Welding Code - Reinforcing Steel.

D. Precast/Prestressed Concrete Institute:

1. PCI MNL-116 - Manual for Quality Control for Plants and Production of Structural Precast Concrete Products.
2. PCI MNL-120 - PCI Design Handbook - Precast and Prestressed Concrete.
3. PCI MNL-123 - Design and Typical Details of Connections for Precast and Prestressed Concrete.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings:

1. Indicate layout, unit locations, fabrication details, reinforcement, connection details, support items, dimensions, openings, and relationship to adjacent materials.

C. Product Data: Indicate standard component configurations, design loads, deflections, cambers, and bearing requirements.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with requirements of PCI MNL-116, PCI MNL-123, PCI MNL-120.

1.5 QUALIFICATIONS

A. Fabricator: Company specializing in performing Work of this section with minimum three years experience.

B. Design precast concrete members under direct supervision of Professional Engineer experienced in design of this Work and licensed in the State of Alaska.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Handle precast members in position consistent with their shape and design. Lift and support only from support points.

C. Lifting or Handling Devices: Capable of supporting member in positions anticipated during manufacture, storage, transportation, and erection.

D. Protect members to prevent staining, chipping, or spalling of concrete.

E. Mark each member with date of production and final position in structure.

1.7 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Coordinate the Work of framing components not pre-tensioned but associated with the Work of this section.

C. Coordinate cutting required openings 10 inches and smaller.

PART 2 - PRODUCTS

2.1 FABRICATORS

A. Fabricators:

1. Clark Pacific
2. Altus Group
3. Other approved fabricator

2.2 MATERIALS

A. Cement: Portland, conforming to ASTM C150 Type I.

B. Aggregate, Sand, Water, Admixtures: Determined by precast fabricator, as appropriate to design requirements and PCI MNL-116.

C. 4,000 psi concrete

2.3 REINFORCEMENT

1. Section 03 20 00 Concrete Reinforcing

2.4 ACCESSORIES

A. Connecting and Supporting Devices: See Section 05 50 00 – Metal Fabrications

2.5 FABRICATION

A. Fabrication procedure to conform to PCI MNL-116 and ACI 318.

B. Maintain plant records and quality control program during production of precast members. Make records available upon request.

C. Ensure reinforcing steel, anchors, inserts, plates, angles, and other cast-in items are embedded and located as indicated on shop drawings.

D. Weld steel fabrications in accordance with AWS D1.1. Weld reinforcing steel in accordance with AWS D1.4. Do not tack weld reinforcing.

2.6 FINISHES

A. Finish exposed-to-view finish surfaces of precast concrete members uniform in color and appearance.

B. Cure members under identical conditions to develop required concrete quality, and minimize appearance blemishes including non-uniformity, staining, or surface cracking.

C. Finish members to PCI MNL-116 Standard grade.

2.7 FABRICATION TOLERANCES

A. Conform to PCI MNL-116

2.8 OL AND TESTS

A. Section 01 40 00 - Quality Requirements: Testing, inspection and analysis requirements.

B. Test and analyze concrete in accordance with ACI 318.

C. Take one concrete test cylinders for every 5 cu yds of concrete placed in accordance with ASTM C31.

D. Take one slump tests for every set of test cylinders in accordance with ASTM C143.

E. Take one air entrainment test for each set of exterior concrete test cylinders taken.

F. When fabricator is approved by authority having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.

1. Specified shop tests are not required for Work performed by approved fabricator.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify site conditions are ready to receive work and field measurements are as Drawings.

3.2 PREPARATION

A. Prepare support equipment for erection procedure, temporary bracing, and induced loads during erection.

3.3 ERECTION

A. Erect members without damage to structural capacity, shape, or finish. Replace or repair damaged members.

B. Align and maintain uniform horizontal and vertical joints, as erection progresses.

C. Maintain temporary bracing in place until final support is provided. Protect members from staining.

D. Provide temporary lateral support to prevent bowing, twisting, or warping of members.

E. Adjust differential camber between precast members to tolerance before final attachment.

F. Set vertical units dry, without grout, attaining joint dimension with lead or plastic spacers.

G. Weld reinforcing steel in accordance with AWS D1.4. Do not tack weld reinforcing.

H. Secure units in place. Perform welding in accordance with AWS D1.1.

3.4 ERECTION TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Erect members level and plumb within allowable tolerances.

C. Conform to PCI MNL-116.

D. When members cannot be adjusted to conform to design or tolerance criteria, cease work and advise Architect/Engineer. Execute modifications as directed by Architect/Engineer.

3.5 FIELD QUALITY CONTROL

A. Welding: Inspect welds in accordance with AWS D1.1.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed construction.

B. Protect members from damage caused by field welding or erection operations.

C. Use non-combustible shields during welding operations to protect adjacent Work.

3.7 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Clean weld marks, dirt, or blemishes from surface of exposed members.

END OF SECTION

DIVISION 05 METALS

SECTION 05 50 00

METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Shop fabricated steel skid system
2. Shop fabricated steel items including miscellaneous metal fabrications.
3. Shop fabricated steel stairs, handrails, and grating.
4. Miscellaneous metal fabrications and fasteners.
5. Hot dipped galvanized metal fabrication such as access stairs, guardrails, and handrails.
6. Other hot dipped galvanized metal fabrications where specified or indicated.

B. Related Sections:

1. Section 03 41 00 – Precast Structural Concrete
2. Section 06 10 00 - Rough Carpentry
3. Section 08 11 00 - Steel Door and Frame

1.2 SUBMITTALS

A. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.

1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

B. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.

C. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.3 REFERENCES

A. ASTM International:
   1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
   2. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   3. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   4. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
   5. ASTM A992/A992M - Standard Specification for Structural Steel Shapes.

B. American Welding Society:
   1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
   2. AWS D1.1 - Structural Welding Code - Steel.
   3. AWS D1.6 - Structural Welding Code - Stainless Steel.

C. SSPC: The Society for Protective Coatings:
   1. SSPC - Steel Structures Painting Manual.
   2. SSPC SP 1 - Solvent Cleaning.
   3. SSPC SP 10 - Near-White Blast Cleaning.
   4. SSPC Paint 15 - Steel Joist Shop Paint.
   5. SSPC Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Fabricator must be a firm experienced in producing metal fabrications similar to those indicated for this project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

B. Welding: Qualify procedures and personnel according to the following:

   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

   2. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.5 HANDRAIL DESIGN REQUIREMENTS

A. Design handrail, guardrail, and attachments to resist forces as required by International Building Code. Apply loads non-simultaneously to produce maximum stresses.
   1. Guard Top Rail and Handrail Concentrated Load: 200 pounds applied at any point in any direction.
   2. Guard Top Rail Uniform Load: 50 pounds per linear foot applied in any direction.
   3. Intermediate Rails, Panels, and Baluster Concentrated Load: 50 pounds applied to 1 sf area.

PART 2 - PRODUCTS

2.1 METALS

A. Steel Wide Flange Shapes: ASTM A992.

B. Miscellaneous Steel Sections and Plate: ASTM A36/A36M.

C. Steel Tubing: ASTM A500, Grade B cold-formed structural tubing.

D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black and hot-dip galvanized finish, as indicated.

E. Bolts, Nuts, and Washers: ASTM A325 (ASTM A325M), Type 1, galvanized to ASTM A153/A153M where connecting galvanized components.

F. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

G. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

H. Touch-Up of Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

I. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

2.2 FABRICATION

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

B. Fabricate items with joints tightly fitted and secured.

C. Continuously seal joined members by continuous welds.

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

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

2.3 FABRICATED ITEMS

A. Stairs and Landings: Steel members, connections, and fasteners as detailed in Drawings; hot-dipped galvanized finish

B. Handrails: Fabricate handrails of pipe of dimensions indicated. All transitions shall be made using smooth radius fittings. Handrails shall be fabricated continuous, without interruptions, and shall return to terminate at end posts or walls.

C. Grip Strut Grating Panels: Manufactured die stamped type, serrations facing upward, galvanized steel:

1. Profile: 11-3/4" x 1-1/2", 5 diamond pattern.

2. Thickness: 14 gauge.

3. Stair Treads: Provide manufacturer's standard end plate connection.

4. Attachments: Provide manufacturer's standard saddle clips and fasteners.
5. GS Metals Corp. Product Grip Strut Safety Grating with fasteners and saddle clips by manufacturer: Galvanized finish.

D. Wetwell Divider Plates and Angle Clips: As detailed in Drawings; Stainless Steel.

2.4 FINISHES – STEEL

A. Stainless steel
1. No coating required.

B. Handrails, grating and stairs
1. Hot-dipped galvanized, in accordance with ASTM A123/A123M.

C. All other steel
1. Sandblast surfaces to SSPC-SP-10. Prime with one coat of reinforced inorganic zinc primer, Devoe Catha-Coat 302, no substitutes, color green to 3 mils dry film thickness. Cover with two coats of epoxy, Devoe Bar-Rust 236, no substitutes, to 12 mils dry film thickness. First coat color gray, second coat color white. Final coat with one coat of aliphatic urethane enamel, Devoe Dethane 389, no substitutes, color white, to 3 mils dry film thickness.

2.5 FABRICATION TOLERANCES

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

B. Maximum Offset Between Faces: 1/16 inch.

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 EXAMINATION

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

3.2 PREPARATION

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

3.3 INSTALLATION, GENERAL

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. Perform field welding in accordance with AWS D1.1/D1.1M.

D. Grip Strut Grating Attachment: Anchor by bolting through saddle clips.

E. Bolt Size: 5/16" carriage bolts and nuts with diamond connection clip.

F. Quantity: Minimum 2 clips at each end support location.

G. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, concrete screws, and other connectors.

H. Obtain approval from Engineer prior to site cutting or making adjustments not scheduled.

3.4 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

DIVISION 06 WOOD, PLASTICS, & COMPOSITES

SECTION 06 10 00

ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. All framing.

2. Preservative treated wood materials

B. Related Sections:

1. Section 06 16 00 - Sheathing

2. Section 06 17 53 - Shop Fabricated Wood Trusses

C. References:

1. AFP&A – American Wood Council – American Forest and Paper Association
   a. Details for Conventional Wood Frame Construction
2. ASTM International:
   a. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   b. ASTM F1667 - Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.
   c. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

3. AWPA – American Wood Protection Association
   a. AWPA M4 – Standard for the Care of Preservative-Treated Wood Products

4. International Staple, Nail and Tool Association (ISANTA)
   a. ESR-1539

5. International Code Council
   a. International Building Code

6. International Conference of Building Officials
   a. Uniform Building Code

7. PS 20 – American Softwood Lumber Standard; National Institute of Standards and Technology (Department of Commerce); 2005.

8. WWPA G-5 – Western Lumber Grading Rules; Western Wood Products Association; 2011.

1.2 SUBMITTALS

A. Manufacturer's Certificate: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the American Lumber Standards Committee Board of Review.

B. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:

1. Power-driven fasteners.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Dimension Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.

2. Provide dressed lumber, S4S, unless otherwise indicated.

3. Species: Hem or Douglas Fir, unless otherwise indicated.

4. Grade: No. 2 or better.

2.2 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified.

B. Fasteners:
1. High-Humidity and Treated Wood Locations: ASTM A153, hot-dip galvanized steel.
2. Elsewhere: Unfinished steel.

C. Nails and Staples: Comply with ASTM F1667.

D. Bolts: Wood to steel or wood to wood, Structural Bolts, Nuts, and Washers: ASTM A307, medium carbon, galvanized, with matching compatible nuts and washers.

2.3 METAL FRAMING ANCHORS

A. Basis-of-Design Products: Subject to compliance with requirements, provide products indicated on Drawings or comparable products by one of the following:

1. Alpine Engineered Products, Inc.
2. Cleveland Steel Specialty Co.
3. Harlen Metal Products, Inc.
4. KC Metals Products, Inc.
5. Simpson Strong-Tie Co., Inc.
6. Southeastern Metals Manufacturing Co., Inc.
7. USP Structural Connectors.

B. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, which meet or exceed those of basis-of-design products. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

C. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

3.2 INSTALLATION

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

B. Framing Standard: Comply with AF&PA's "Details for Conventional Wood Frame Construction," unless otherwise indicated.

C. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

D. Metal Framing Anchors: Install metal framing to comply with manufacturer's written instructions.

E. Do not splice structural members between supports, unless otherwise indicated.

F. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

G. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. ISANTA ESR-1539 for power-driven fasteners.

2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.

3. Table 23-II-B-1, "Nailing Schedule," and Table 23-II-B-2, "Wood Structural Panel Roof Sheathing Nailing Schedule," in ICBO's Uniform Building Code.

4. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.

5. Table 602.3(1), "Fastener Schedule for Structural Members," and Table 602.3(2), "Alternate Attachments," in ICC's International One- and Two-Family Dwelling Code.

3.3 PROTECTION

A. Do not burn scrap on project site.

B. Do not burn scraps that have been pressure treated.

C. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.

END OF SECTION

SECTION 06 13 00

HEAVY TIMBER

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes preservative-treated heavy structural timber for pipe supports and connection hardware.

B. Related Sections:

1. Section 05 50 00 – Metal Fabrications: Structural steel connectors.
2. Section 06 10 00 – Rough Carpentry: Structural dimension lumber framing.

1.2 REFERENCES

A. American Institute of Timber Construction:

1. AITC 108 - Standard for Heavy Timber Construction.

B. ASTM International:

1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
2. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
4. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength
5. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

C. American Wood-Preservers' Association:

1. AWPA M4 - Standard for the Care of Preservative-Treated Wood Products.
2. AWPA U1 - Use Category System: User Specification for Treated Wood.

D. America Society of Mechanical Engineers

1. ASME B18.6.1 - Wood Screws

E. American Welding Society:

1. AWS D1.1 - Structural Welding Code - Steel.

F. International Code Council

1. International Building Code

G. The Redwood Inspection Service:

1. RIS - Standard Specifications for Grades of California Redwood Lumber.

H. Southern Pine Inspection Bureau:

1. SPIB - Standard Grading Rules for Southern Pine Lumber.

I. U.S. Department of Commerce National Institute of Standards and Technology:

1. DOC PS 1 - Construction and Industrial Plywood.
2. DOC PS 2 - Performance Standard for Wood-Based Structural-Use Panels.
3. DOC PS 20 - American Softwood Lumber Standard.

J. West Coast Lumber Inspection Bureau:

1. WCLIB - Standard Grading Rules for West Coast Lumber.

K. Western Wood Products Association:

1. WWPA G-5 - Western Lumber Grading Rules.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit data on proprietary connection devices. Submit technical data on wood preservative materials.

1.4 QUALITY ASSURANCE

A. Perform welding Work in accordance with AWS D1.1.

B. Lumber Grading Agency: Certified by DOC PS 20.

PART 2 - PRODUCTS

2.1 HEAVY TIMBER FRAMING

A. Lumber Grading Rules: WCLIB or WWPA G-5.

B. Lumber: Beams and Stringers, Douglas Fir Larch species; No. 1 grade (or better for specific components—see Drawings); maximum moisture content of 19 percent.

2.2 FASTENERS AND ANCHORS

A. Fasteners:

1. Bolts shall conform to ASTM A307.
2. Wood Screws, Lag Screws and Lag Bolts shall conform to ANSI/ASME B18.6.1.
3. Nails shall conform to Table 2304.9.1 of the International Building Code (IBC).

2.3 ACCESSORIES

A. Manufactured Connectors: Galvanized steel; manufactured by Simpson Strong-Tie or approved equal.

B. Shop-Fabricated Connectors: Specified in Section 05 50 00.

C. Bolts, Nuts, Washers, Lags, and Screws: Medium carbon steel; galvanized coating; size and type to suit application and resist imposed loads.

D. Zinc Chromate Primer.

2.4 FABRICATION

A. Fabricate components in accordance with AITC 108, with joints neatly fitted, welded and ground smooth. Account for shrinkage of timber in design and arrangement of fasteners for connections.

2.5 FINISHES

A. Timber Surfaces: S4S.

B. Galvanizing: ASTM A123/A123M; hot dip galvanize after fabrication.

C. Galvanizing for Nuts, Bolts and Washers: ASTM A153/A153M.

2.6 WOOD TREATMENT

A. Wood Preservative (pressure treatment for all exterior wood): AWPA U1, Commodity Specification A-Sawn Products or F-Wood Composites using water-borne copper azole, Type C (CA-C) preservative for UC4B use category.

B. Wood Preservative (surface application for cuts and holes in pressure-treated wood): approved copper naphthenate product.

C. Moisture Content after Treatment: Kiln dried (KDAT), maximum 19 percent.

PART 3 - EXECUTION

3.1 ERECTION

A. Set structural timber framing level and plumb, in correct position.

B. Install structural timbers with minimum ½-inch clearance around timbers set into concrete or masonry for air circulation.

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

D. Do not field cut or alter structural members without approval of Architect/Engineer.

E. After erection, touch-up galvanized surfaces with zinc primer.

3.2 SITE-APPLIED WOOD TREATMENT

A. Brush-apply two coats of preservative treatment on wood in contact with cementitious materials, roofing and related metal flashings.

B. Treat site-sawn cuts. Apply preservative to site-sawn cuts in accordance with AWPA M4.

C. Allow preservative to cure prior to erecting members.

3.3 FIELD QUALITY CONTROL

A. Welding: Inspect welds in accordance with AWS D1.1.

END OF SECTION

SECTION 06 16 00

SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof sheathing.
2. Wall sheathing.
3. Floor sheathing.

1.2 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product.

1.3 REFERENCES

A. ASTM International:
1. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
2. ASTM D3498 - Standard Specification for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor System Framing

B. APA – The Engineered Wood Association
1. APA Form No. E30, Engineered Wood Construction Guide

C. U.S. Department of Commerce National Institute of Standards and Technology:
1. DOC PS 1 - Construction and Industrial Plywood.
2. DOC PS 2 - Performance Standard for Wood-Based Structural-Use Panels.
3. DOC PS 20 - American Softwood Lumber Standard.

D. International Code Council
International Building Code

PART 2 - PRODUCTS

2.1 WOOD PANEL PRODUCTS, GENERAL

A. Plywood: DOC PS 1 unless otherwise indicated.

2.2 SHEATHING

A. Plywood Roof Sheathing: Exterior Sheathing.

B. Plywood Wall Sheathing: Exterior Sheathing.

2.3 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A153M

2.4 MISCELLANEOUS MATERIALS

A. Adhesives for Field Gluing Panels to Wood Framing: Formulation complying with ASTM D3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.

2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in the ICC's International Residential Code for One- and Two-Family Dwellings.

3. ICC-ES evaluation report for fastener.

D. Coordinate wall and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

F. Block all diaphragm roof panel edges with 2 x 4 flat blocking.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:

1. Roof Sheathing:

   a. Nail to wood framing in accordance with the drawings.

   b. Space panels 1/8-inch apart at edges and ends.

2. Wall Sheathing:

   a. Nail to wood framing in accordance with the drawings.

   b. Space panels 1/8 inch apart at edges and ends.

3. Floor Sheathing:

   a. Nail to wood framing in accordance with the drawings.

   b. Space panels 1/8 inch apart at edges and ends.

END OF SECTION

SECTION 06 17 53

SHOP-FABRICATED WOOD TRUSSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood roof trusses.

1.2 SUBMITTALS

A. Product Data: For metal-plate connectors, metal truss accessories, and fasteners.

B. Shop Drawings: Show fabrication and installation details for trusses.

1. Show location, pitch, span, camber, configuration, and spacing for each type of truss required.

2. Indicate sizes, stress grades, and species of lumber.

3. Indicate locations of permanent bracing required to prevent buckling of individual truss members due to design loads.

4. Indicate locations, sizes, and materials for permanent bracing required to prevent buckling of individual truss members due to design loads.

5. Indicate type, size, material, finish, design values, orientation, and location of metal connector plates.

6. Show splice details and bearing details.

C. Delegated-Design Submittal: For metal-plate-connected wood trusses indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by a professional engineer registered in the State of Alaska.

D. Informational Submittals:

1. Product Certificates: For metal-plate-connected wood trusses, signed by officer of truss-fabricating firm.

2. Evaluation Reports: For the following, from ICC-ES:

a. Metal-plate connectors.

b. Metal truss accessories.

1.3 REFERENCES

A. American Society of Civil Engineers
   1. ASCE/SEI 7-10 - Minimum Design Loads for Buildings and Other Structures

B. American National Standards Institute:
   1. ANSI/AF&PA National Design Specifications for Wood Construction

C. ASTM International:
   1. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   2. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
   3. ASTM F1667 - Standard Specification for Driven Fasteners: Nails, Spikes, and Staples

D. International Building Council
   1. International Building Code

E. Structural Building Components Associate
   1. SBCA - Building Component Safety Information: Guide to Good Practice for Handling, Installing, Restraining, & Bracing Metal Plate Connected Wood Trusses

F. Truss Plate Institute:
   1. TPI 1 - National Design Standard for Metal Plate Connected Wood Truss Construction.

G. U. S Department of Commerce National Institute of Standards and Technology:
   1. DOC PS 1 - Construction and Industrial Plywood.
   2. DOC PS 2 - Performance Standard for Wood-Based Structural-Use Panels.
   3. DOC PS 20 - American Softwood Lumber Standard.

1.4 QUALITY ASSURANCE

A. Metal Connector-Plate Manufacturer Qualifications: A manufacturer that is a member of TPI and that complies with quality-control procedures in TPI 1 for manufacture of connector plates.

   1. Manufacturer's responsibilities include providing professional engineering services needed to assume engineering responsibility.

   2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

B. Fabricator Qualifications: Shop that participates in a recognized quality-assurance program, complies with quality-control procedures in TPI 1, and involves third-party inspection by an independent testing and inspecting agency acceptable to the Engineer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Trusses shall be designed for the gravity loads, wind and seismic later and uplift loads, and support conditions as indicated on the Drawings and specifications. No duration of load increase in stresses will be allowed for snow loading. Unbalanced snow and drift loading is required. Submit truss designs stamped by an engineer licensed to practice in the State of Alaska. Truss drawings shall indicate all materials of construction.

B. Wood truss design criteria shall be in accordance with the 2012 International Building Code and ASCE/SEI 7-10 “Minimum Design Loads for Buildings and Other Structures,” and in accordance with the general structural notes included in the drawings.

C. Comply with applicable requirements and recommendations of TPI 1, TPI DSB, and SBCA BCSI.

D. Wood Structural Design Standard: Comply with applicable requirements in AF&PA's "National Design Specifications for Wood Construction" and its "Supplement."

2.2 DIMENSION LUMBER

A. Dimension Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated:

1. Factory mark each piece of lumber with grade stamp of grading agency.

2. Provide dressed lumber, S4S, unless otherwise indicated.

3. Species: Hem or Douglass Fir, unless otherwise indicated.

4. Grade No. 2 or better.

2.3 METAL CONNECTOR PLATES

A. Fabricate connector plates to comply with TPI 1.

B. Hot-Dip Galvanized-Steel Sheet: ASTM A653/A653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G60 coating designation; and not less than 0.036 inch thick.

2.4 FASTENERS

A. Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Provide fasteners for use with metal framing anchors that comply with written recommendations of metal framing manufacturer.

2. Where trusses are exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.

B. Nails, Brads, and Staples: ASTM F1667.

2.5 METAL FRAMING ANCHORS AND ACCESSORIES

A. Allowable design loads, as published by manufacturer, shall comply with or exceed those of basis-of-design products. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.

B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 coating designation.

2.6 FABRICATION

A. 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.

B. 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 DELIVERY, STORAGE, AND HANDLING

A. Handle and store trusses to comply with recommendations in SBCA "Building Component Safety Information: Guide to Good Practice for Handling, Installing, Restraining, & Bracing Metal Plate Connected Wood Trusses."

3.2 INSTALLATION

A. Install wood trusses only after supporting construction is in place and is braced and secured.

B. Hoist trusses in place by lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.

C. Install and brace trusses according to TPI recommendations and as indicated.

D. Anchor trusses securely at bearing points; use metal truss tie-downs or floor truss hangers as applicable. Install fasteners through each fastener hole in metal framing anchors according to manufacturer's fastening schedules and written instructions.

E. Securely connect each truss ply required for forming built-up girder trusses.

F. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.

G. Install wood trusses within installation tolerances in TPI 1.

H. Do not alter trusses in field. Do not cut, drill, notch, or remove truss members.

I. Replace wood trusses that are damaged or do not comply with requirements.

END OF SECTION

DIVISION 07 THERMAL AND MOISTURE PROTECTION

SECTION 07 12 00

BUILDING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Thermal insulation

1.2 REFERENCES

A. America Society of
1. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
2. ASTM D1622 - Standard Test Method for Apparent Density of Rigid Cellular Plastics
3. ASTM D1621 - Standard Test Method for Compressive Properties of Rigid Cellular Plastics
4. ASTM D1623 - Standard Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics
5. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials

1.3 SUBMITTALS

A. Product Data: Submit manufacturer’s product data and installation instructions for each material and product used.

1.4 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Spray-Applied Polyurethane Insulation
1. Continuously foamed-in-place
2. Zero ozone depletion potential (ODP)
3. Zero volatile organic compounds (VOC)
4. Closed cell polyurethane

a. ASTM D 1622 - 2.1 pounds per cubic foot nominal density
b. ASTM D1621 - 20.6 psi compressive strength
c. ASTM D 1623 - 45.4 psi tensile and adhesion strength.
d. ASTM E 96 – less than 1 perm of water vapor permeance
e. ASTM C 518 – R-value – 7.4 ft^2h^oF/BTU

5. Demilec Heatlok Soy-200, or equal.
6. Application: Exterior walls, roof and floor.

B. Thermal barrier
1. Color: ice gray
2. Compliant with NFPA 286, AC 456 and UL 1715
3. Minimum 15 minute thermal barrier
4. International Fireproof Technology, Inc – DC315 Intumescent Coating, OAE
5. Application: Exterior walls, roof and floor.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction. Coordinate with work of other sections. Provide full thickness in one layer over entire area, tightly fitting around penetrations.

B. Protect installed insulation.

END OF SECTION

SECTION 07 27 10
AIR AND WATER BARRIERS

PART 1 - GENERAL

1.1 RELATED SECTIONS

A. Section 07 92 00 - Joint Sealants

1.2 REFERENCES

A. The publications listed form a part of this Specification. The publications are referred to in the text by basic designation only. In case of conflict the most stringent shall apply.
   1. ASTM C920 – Specification for Elastomeric Joint Sealants
   2. American Society for Testing and Materials (ASTM) ASTM D828 - Test Method for Tensile Properties of Paper and Paperboard Using Constant-Rate-of-Elongation Apparatus.
   3. ASTMD828 – Test Method for Tensile Properties of Paper and Paperboard.
   4. ASTM D882 - Test Method for Tensile Properties of Thin Plastic Sheeting.
   5. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
   6. ASTM E96 - Test Methods for Water Vapor Transmission of Materials.
   7. ASTM E283 – Test Method for Water Penetration and Air Leakage Through Exterior Windows, Curtain Walls and Doors Underspecified Pressure Differences Across the Specimen.
   8. ASTM E331 – Test Method for Water Penetration of Exterior Windows, Sky lights, Doors and Curtain Walls by Uniform Static Air Pressure Difference.
   9. ASTM E1677 – Specification for Air Retarder Material or System for Low-Rise Framed Building Walls.
   10. ASTM E2178 – Test Method for Air Permeance of Building Materials.
   11. International Building Code (IBC) Chapter 14.
   12. National Fire Protection Association (NFPA) 285 Standard Method of Test for the Evaluation of Flammability Characteristics of Exterior Non-load-bearing Wall Assemblies Containing Combustible Components.

1.3 SUBMITTALS

A. Manufacturer’s literature including material, composition, vapor transmission, water resistance, fire hazard ratings, and application instructions, including penetration, lap and edge details.

1.4 ENVIRONMENTAL REQUIREMENTS

A. Do not heat building with air barrier in place until insulation and vapor retarders are completely installed inside.

PART 2 - PRODUCTS

2.1 SHEET AIR AND WATER BARRIER

A. Moisture vapor permeable, five foot minimum width in continuous sheet recommended by manufacturer to resist air and liquid water infiltration through exterior walls while allowing moisture vapor to escape.
   1. Air penetration: .06 cubic feet per minute per square foot maximum at 0.3 H2O/75 Pa per ASTM E-1677, ASTM E-283 or ASTM E2178.
   2. Water resistance; no water penetration when tested for 15 minutes at 15 miles per hour per ASTM E1677, or ASTM E331.
   3. Water drainage: vertical grooves or wrinkle textured surface to allow water drainage.
   4. Moisture vapor transmission rate: more than 25 perms per ASTM E- 96.
   5. Tensile Strength: 25 pounds per inch minimum per ASTM D-882 or ASTM D828.
   6. Flame spread: Class A 25 maximum per ASTM E-84.
   7. Smoke development: Class A 450 density maximum per ASTM E-84.
   8. NFPA 285 Flammibility test compliant with polyiso or mineral wool insulation. IBC I403 Type II Buildings]

B. Acceptable Manufacturers subject to meeting specified requirements:
   1. Dupont “Tyvek Stuccowrap” or “Drain Wrap”– www.tyvekconstruction.com
   2. VaproShield “Wall Shield” or “Wrapshield”– www.vaproshield.com
   3. Henry “Blueskin VP160” – www.henry.com
   4. Dow Corning “Silicone Air Barrier”: www.dowcorning.com

2.2 ACCESSORIES

A. Attach and seal with primers, adhesives, mastics, tapes through wall flashing membrane, opening corners, sealants and fasteners as recommended by air barrier manufacturer and as follows:
   1. Polyethylene or polypropylene tape, with water resistant pressure sensitive adhesive recommended for cold temperature application to plastic sheet and metal: Owens Corning.”Bild-R-Tape”; Proscoc “R- Guard” Mastic or approved.

B. Adhesive: recommended for cold temperature application to plastic and metal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Drawing Details and field conditions to receive work for defects that will adversely affect the completed installation and for deviations beyond allowable tolerances.

B. Substrate surfaces shall be free of sharp projections or holes over which the air barrier sheet can easily be applied without tearing or puncturing.

C. Verify that substrate work by other trades is complete and ready for air barrier.

D. Beginning of installation shall mean acceptance of the existing conditions as capable of producing an acceptable job.

3.2 INSTALLATION

A. Install sheet barrier horizontally. Completed installation shall be continuous without gaps, holes or tears in accord with air barrier manufacturer's instructions for conditions of use and these specifications.

B. Layout air barrier to provide single sheet where possible with a minimum number of joints. Allow enough fullness or pleats at corners and offsets so that finish material installation does not tear air barrier.

C. Lap sheet air barrier joint seams four inches minimum, adhere, mechanically fasten or tape to backing and seal continuously with tape. Lap top layer over bottom to shed water. Lap air barrier over flashings to allow water to escape.

D. Penetrations: Seal air barrier continuously around all structural, mechanical, electrical and other penetrations with tape and sealant. Tape extra separate sheet of air barrier over as necessary.

E. Attachment: Tape, primer, adhesives, screws, staples as recommended by manufacturer. Seal holes caused by staples with tape.

F. Seal air barrier to door and window frames. Lap and tape air barrier over window and door header flashing to shed water. Underlay and tape air barrier under window sill flushing to shed water.

G. Lap air barriers onto membrane roofing and apply sealant bed.

H. Repair: All punctures and tears by patching with extra lapping material twelve inches minimum and sheet taping, just prior to final cover up.

3.3 AIR BARRIER SCHEDULE

A. Install barrier on outside of sheathing.

END OF SECTION

SECTION 07 41 13

FORMED METAL ROOF PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal roof panels.

2. Flashing and trim integral to roof panels.

3. Clips, anchoring devices, fasteners, and accessories for installation of panel system.

1.2 REFERENCES

A. American Society of Civil Engineers
1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures

B. ASTM International:

1. ASTM A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

2. ASTM A 792 - Standard Specification for Steel Sheet, Aluminum-Zinc Alloy Coated Steel by the Hot-Dip Process.

3. ASTM A 924 - General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
4. ASTM E 72 - Standard Test Methods of Conducting Strength Tests of Panels for Building Construction

C. Factory Mutual
1. FM 4471 – Approval Standard - Class 1 Panel Roofs

D. Underwriters Laboratories

1. UL 580 - Uplift Resistance of Roof Assemblies.

2. UL 1897 - Uplift Test for Roof Covering Systems.

1.3 SUBMITTALS

A. Product Data: Submit product literature and data sheets for each material used.

B. Manufacturer's surface preparation and installation instructions.

C. Calculations demonstrating attachment complies with ASCE 7.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in installation of the products specified for projects of similar size and scope with minimum five years documented experience.

1.5 WARRANTY

A. Manufacturer's Warranty: Manufacturer's two year limited warranty that panels are free from defects in materials and workmanship, beginning from the date of shipment of panels, but excluding coil coatings (paint finishes) covered under a separate warranty. Warranty does not include interior painted surface of panels.

B. Submit exterior paint manufacturer's written twenty year limited warranty on paint finish for adhesion to the substrate and a thirty year limited warranty on chalk and color fade.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural and Wind Load Tests:

1. Design load/deflection criteria verified from tests per ASTM E 72 "Chamber Method" using a 20 psf (0.96 kPa) simulated wind load with a deflection limit of L/240.

2. FM Approval Standard 4471: Meets windstorm Class 1A 90 and hailstorm Class 1-SH classifications.

3. Underwriters Laboratory (UL) Uplift Tests for Roof Assemblies: UL Class 90 rated in accordance with UL 580 and shall withstand static uplift load of 140 psf when tested on 7-foot purlin spacing and 166 psf when tested on 5 foot purlin spacing.

2.2 MANUFACTURERS

A. Acceptable Manufacturer: AEP Span, A Division of ASC Profiles Inc. - A BlueScope Steel Company, 2110 Enterprise Boulevard, West Sacramento, CA 95691, 800-726-2727, 916-372-0933 (Corporate Office) 907-227-1607 (Alaska Office) or approved equal.

2.3 MATERIALS

A. Standing Seam Metal Roof Panels: AEP Span-lok hp, or approved equal.

1. Prefinished Galvalume® or Zincalume® sheet, ASTM AZ50 made of 55% aluminum, 1.6% silicon and the balance zinc as described in ASTM specification A792.

2. Fabricate panels with sufficient thickness to meet specified UL 90 wind uplift requirements.

3. Fabricated panel with integral continuous overlapping seams suitable for continuous locking or crimping by mechanical means during installation.

4. Seam Height: 2” high ribs @ 16” centers.

5. Provide pre-installed, high grade, hot-melt elastomeric sealant or butyl mastic, within the confines of panel’s female leg, designed to seal against adjacent male panel leg.

6. Thickness: 24 gauge (0.0232 in).

B. Panel Finish:

1. Exterior Finish: Cool Dura Tech 5000

C. Flashing and Trim: Brake-formed sheet metal in the same thickness and finish to match the panels.

D. Fasteners: Clips, anchoring devices, fasteners, and accessories for installation of panel system as recommended by panel manufacturer for the system specified.

E. Sealant: Sealant as recommended by panel manufacturer.

F. Panel Width: 12-inch

G. Panel Thickness: 1-inch

H. Underlayment Materials:

1. Self-Adhering, High Temperature Sheet: Minimum 30 to 40 mils thick: Grace Ice and Water Shield, or approved equal.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

A. Store products in accordance with Manufacturer's written instructions. Store under cover in manufacturer's unopened packaging with labels intact until ready for installation.

B. Store products off the ground, with panels sloped for drainage and covered to protect factory finishes from damage.

C. Do not overload roof structure with stored materials. Do not permit material storage or traffic on completed roof surfaces.

3.2 EXAMINATION

A. Examine structural members before beginning installation to ensure that all supporting members are straight, level, plumb and satisfactory for panel installation.

B. Panel Support Tolerances:
   1. Overall rake to rake tolerances plus or minus 2 inches or plus or minus 1 inch at each rake.
   2. Overall eave to ridge tolerance plus or minus 1 inch or plus or minus 1/2 inch at the eave, end lap and ridge.
   3. Vertical deviation from the nominal roof plane of plus or minus 1/8 inch in any 5-foot length, plus or minus 1/4 inch in any 20-foot length and plus or minus 1/2 inch over the entire roof area.

C. Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, reglets are in place, and nailing strips located.

D. Correct defective conditions before beginning work.

E. If substrate is the responsibility of another installer, notify Engineer of unsatisfactory preparation before proceeding.

3.3 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.

3.4 INSTALLATION GENERAL

A. Install in accordance with manufacturer's instructions and recommendations including approved shop drawings, installation guidebook and manufacturer's handbook of construction details.

B. Anchor securely in place using clips and fasteners spaced in accordance with manufacturer’s recommendations for design wind load criteria.

C. Form panel shape as indicated on Drawings, accurate in size, square, and free from distortion or defects.

D. Install flashing and trim true and in proper alignment.

E. Protective film on trim shall be removed before exposure to sunlight.

F. Install sealants where indicated to clean dry surfaces only without skips or voids, to ensure weather tight.

3.5 CLEANING

A. Replace damaged panels and other components of work, which cannot be repaired by finish touch-up or similar minor repair.

B. Wipe finished surfaces clean of any filings caused by drilling or cutting to prevent rust staining.

3.6 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 07 42 13

FORMED METAL WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal wall panels.

2. Flashing and trim integral to wall panels.

3. Fasteners and accessories for installation of panel system.

1.2 REFERENCES

A. American Society of Civil Engineers
1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures

B. ASTM International:

1. ASTM A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

2. ASTM A 792 - Standard Specification for Steel Sheet, Aluminum-Zinc Alloy Coated Steel by the Hot-Dip Process.

3. ASTM A 924 - General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
4. ASTM E 72 - Standard Test Methods of Conducting Strength Tests of Panels for Building Construction

C. Factory Mutual
1. FM 4471 – Approval Standard - Class 1 Panel Roofs

D. Underwriters Laboratories

1. UL 580 - Uplift Resistance of Roof Assemblies.

2. UL 1897 - Uplift Test for Roof Covering Systems.

1.3 SUBMITTALS

A. Product Data: Submit product literature and data sheets for each material used.

B. Shop Drawings
   1. Show panel layout, trim installation, and panel attachment.

C. Site Conditions
   1. Provide completed site condition form for the specified finish to suit project conditions.

D. Manufacturer's surface preparation and installation instructions.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in installation of the products specified for projects of similar size and scope with minimum five years documented experience

1.5 WARRANTY

A. Manufacturer's Warranty: Manufacturer's two year limited warranty that panels are free from defects in materials and workmanship, beginning from the date of shipment of panels, but excluding coil coatings (paint finishes) covered under a separate warranty. Warranty does not include interior painted surface of panels.

B. Submit exterior paint manufacturer's written twenty year limited warranty on paint finish for adhesion to the substrate and a thirty year limited warranty on chalk and color fade.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIERMENTS

A. Structural and Wind Load Tests:
   1. Design load/deflection criteria verified from tests per ASTM E 72 "Chamber Method" using a 20 psf (0.96 kPa) simulated wind load with a deflection limit of L/240.
   2. FM Approval Standard 4471: Meets windstorm Class 1A 90 and hailstorm Class 1-SH classifications.
   3. Underwriters Laboratory (UL) Uplift Tests for Roof Assemblies: UL Class 90 rated in accordance with UL 580 and shall withstand static uplift load of 140 psf when tested on 7-foot purlin spacing and 166 psf when tested on 5 foot purlin spacing.

2.2 MANUFACTURERS

A. Acceptable Manufacturer: AEP Span, A Division of ASC Profiles Inc. - A BlueScope Steel Company, 2110 Enterprise Boulevard, West Sacramento, CA 95691, 800-726-2727, 916-372-0933 (Corporate Office) 907-227-1607 (Alaska Office) or approved equal.

2.3 MATERIALS

A. Metal Wall Panels: AEP Super-Span, or approved equal.

1. Prefinished Galvalume® or Zincalume® sheet, ASTM AZ50 made of 55% aluminum, 1.6% silicon and the balance zinc as described in ASTM specification A792.
2. Fabricate panels with sufficient thickness to meet specified UL 90 wind uplift requirements.
3. Fabricated panel with integral continuous overlapping seams.
4. Seam Height: 1-1/4-inch high.
5. Provide pre-installed, high grade, hot-melt elastomeric sealant or butyl mastic, within the confines of panel's female leg, designed to seal against adjacent male panel leg.
6. Thickness: 24 gauge (0.0232 inch).

B. Panel Finish:
1. Exterior Finish: Exterior Finish: One coat 70 percent polyvinylidene fluoride, nominal 0.7 mil (0.02 mm) thick, over 0.2 mil (0.005 mm) primer.

C. Flashing and Trim: Brake-formed sheet metal in the same thickness and finish to match the panels.

D. Fasteners: Fasteners and accessories for installation of panel system as recommended by panel manufacturer for the system specified.

E. Sealant: Sealant as recommended by panel manufacturer.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

A. Store products in accordance with Manufacturer's written instructions. Store under cover in manufacturer's unopened packaging with labels intact until ready for installation.

B. Store products off the ground, with panels sloped for drainage and covered to protect factory finishes from damage.

3.2 EXAMINATION

A. Examine structural members before beginning installation to ensure that all supporting members are straight, level, plumb and satisfactory for panel installation.

B. Panel Support Tolerances:
1. Overall rake to rake tolerances plus or minus 2 inches or plus or minus 1 inch at each rake.
2. Vertical deviation from the nominal wall plane of plus or minus 1/8 inch in any 5 foot length, plus or minus 1/4 inch in any 20 foot length and plus or minus 1/2 inch over the entire wall area.

C. Verify wall openings, curbs, pipes, sleeves, ducts, or vents through wall are solidly set, reglets are in place, and nailing strips located.

D. Correct defective conditions before beginning work.

E. If substrate is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.3 INSTALLATION GENERAL

A. Install in accordance with manufacturer's instructions and recommendations including approved shop drawings, installation guidebook and manufacturer's handbook of construction details.

B. Anchor securely in place using fasteners spaced in accordance with manufacturer's recommendations for design wind load criteria.

C. Form panel shape as indicated on Drawings, accurate in size, square, and free from distortion or defects.

D. Install flashing and trim true and in proper alignment.

E. Protective film on trim shall be removed before exposure to sunlight.

F. Install sealants where indicated to clean dry surfaces only without skips or voids, to ensure weather tight

3.4 CLEANING

A. Replace damaged panels and other components of work, which cannot be repaired by finish touch-up or similar minor repair.

B. Wipe finished surfaces clean of any filings caused by drilling or cutting to prevent rust staining.

3.5 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 07 92 00

JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Silicone joint sealants.

2. Urethane joint sealants.

1.2 REFERENCES

A. ASTM International:
1. ASTM C920 - Standard Specification for Elastomeric Joint Sealants

1.3 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product including product literature and Manufacturer's surface preparation and installation instructions.

B. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.

2. Joint-sealant manufacturer and product name.

3. Joint-sealant color.

1.4 QUALITY ASSURANCE

A. Installers: Use only skilled workmen specially trained in the techniques of sealing and familiar with the published recommendations of the manufacturers of the sealants being used.

B. Verify that sealants are compatible with the substrates and accessory materials provided under other Sections. Notify Engineer of evidence of incompatibility.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. Joint Sealants:

1. Manufacturers: Where no product is listed, subject to compliance with requirements, provide products from one of the following manufacturers:
   a. BSAF.
   b. Dow.
   c. Pecora Corporation.
   d. Sika Corporation, Construction Products Division.
   e. Tremco Incorporated.

C. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

A. Silicone, S, NS, 100/50, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Use NT.

B. Silicone, S, NS, 50, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.

C. Silicone, S, NS, 35, NT: Single-component, nonsag, plus 35 percent and minus 35 percent movement capability. nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 35, Use NT.

2.3 URETHANE JOINT SEALANTS

A. Polyurethane-based sealant, Sika Sikaflex 1A, or approved equal, meeting Fed. Spec. TT-S-00230C, Type II, Class A.

2.4 ACCESSORY MATERIALS

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

B. Primer: Non-staining type, recommended by sealant manufacturer to suit application.

C. Preformed Compressible and Non-Compressible back-up materials.

1. Polyethylene, Urethane, Neoprene or Vinyl extruded closed cell foam backer rod. Over size backer rod by 30 to 50%.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this Section may properly commence. Notify the Authority in writing of conditions detrimental to the proper and timely completion of the Work.

B. Verify joint dimensions and conditions are acceptable to receive the work of this Section.

C. Beginning of installation means acceptance.

3.2 PREPARATION

A. Clean and prepare joints in accordance with manufacturer's instructions. Remove any loose materials and other foreign matter, which might impair adhesion of sealant.

B. Apply masking tightly around joints to protect adjacent surfaces from excess sealant.

C. Prime as required by manufacturer for proper bond to substrate materials.

D. Prepare joint to achieve proper sealant width/depth ratios as indicated. Install backer rod where required to achieve correct joint profile.

3.3 INSTALLATION OF JOINT SEALANTS

A. Install sealant in strict accordance with manufacturer's instructions.

B. Sealant beads shall have a section as detailed in the Drawings.

C. Apply sealant within recommended temperature ranges. Consult manufacturer when sealant cannot be applied within recommended temperature ranges.

D. Tool joints concave, unless indicated otherwise. Finish free of air pockets, foreign embedded matter, ridges and sags.

3.4 CLEANUP

A. Clean adjacent surfaces free of excess sealant as the work progresses. Use cleaning agents recommended by the sealant manufacturer.

B. Upon completion, remove and dispose of masking.

END OF SECTION

DIVISION 08 OPENINGS

SECTION 08 11 00

METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Flush Steel Doors.

B. Steel frames.

1.2 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry

B. Section 07 12 00 - Building Insulation

C. Section 07 42 13 – Formed Metal Wall Panels

D. Section 08 71 00 - Door Hardware

E. Section 13 12 00 – Pumphouse Building, Stairs and Landing

1.3 REFERENCES

A. ANSI/NFPA 80 - Standard for Fire Doors and Windows.

B. ANSI/DHI A 115.IG - Installation Guide for Doors and Hardware.

C. ANSI/BHMA A 156 - Specifications for Hardware Preparations in Standard Steel Doors and Frames.

D. ANSI/BHMA A156.7 - Hinge Template Dimensions.

E. ANSI A 250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors and Hardware Reinforcing.

F. ANSI/SDI A 250.8 - SDI-100 Recommended Specifications for Standard Steel Doors and Frames.

G. ANSI A 250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.

H. ANSI A 250.11 - Recommended Erection Instructions for Steel Frames.

I. ASTM A 366/A 366M - Standard Specification for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality.

J. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

K. ASTM A 924 - Specification for General Requirements for Steel Sheet, Metallic Coated by the Hot Dip Process.

L. ASTM A 1008/1008M - 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.

M. ASTM E 90 - Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.

N. ASTM E 152 - Standard Methods of Fire Tests of Door Assemblies.

O. ASTM E 413 - Classification for Rating Sound Insulation.

P. SDI-111 - Recommended Standard Details for Steel Doors & Frames.

Q. NAAMM/HHMA-820 TN01 - Grouting Hollow Metal Frames

R. NAAMM/HHMA-820 TN03 - Guidelines for Glazing of Hollow Metal Transom, Sidelight and Windows

S. NAAMM/HMMA-840 - Guide Specification for Installation and Storage of Hollow Metal Doors and Frames.

T. ANSI/UL 10C - Standard for Safety for Positive Pressure Fire Tests of Door Assemblies.

U. NFPA 252 - Standard Method of Fire Tests of Door Assemblies.

V. Federal Emergency Management Agency (FEMA) 361 Guidelines.

W. UL - Building Materials Directory; Underwriters Laboratories Inc.

1.4 SUBMITTALS

A. Product Data: Manufacturer's standard details and catalog data indicating compliance with referenced standards, and manufacturer's installation instructions.

B. Certificates:
1. Manufacturer's certification that products comply with referenced standards.
2. Evidence of manufacturer's membership in the Steel Door Institute.

C. Shop Drawings: Door, frame, and hardware schedule. Show types, quantities, dimensions, specified performance, and design criteria, materials and similar data for each opening required.

D. Indicate frame configuration, anchor types and spacing, location of cutouts for hardware, reinforcement, to ensure doors and frames are properly prepared and coordinated to receive hardware.

E. Indicate door elevations, internal reinforcement, closure method, and cutouts for glass lights and louvers

1.5 QUALITY ASSURANCE

A. Supplier: A direct account of the manufacturer who has on permanent staff, an Architectural Hardware Consultant (AHC), a Certified Door Consultant (CDC) or an Architectural Openings Consultant (AOC), who will be available to consult with the Engineer and Contractor regarding matters affecting the door and frame openings.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Handle, store and protect products in accordance with the manufacturers printed instructions and ANSI/SDI A250.10 and NAAMM/HMMA 840.

B. Store doors vertically in a dry area, under a proper vented cover. Place on 4 inch (102 mm) high wood sills to prevent rust or damage. Provide 1/4-inch (6 mm) space between doors to promote air circulation.

C. Store frames in an upright position with heads uppermost under cover. Place on 4 inch (102 mm) high wood sills to prevent rust and damage. Store assembled frames five units maximum in a stack with 2 inch (51 mm) space between frames to promote air circulation.

D. Do not use non-vented plastic or canvas shelters to prevent rust or damage.

E. Should wrappers become wet, remove immediately.

1.7 COORDINATION

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

B. Coordinate Work with frame opening construction, door and hardware installation.

C. Sequence installation to accommodate required door hardware.

D. Verify field dimensions for factory assembled frames prior to fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Steelcraft, Div. of IR Security Technologies or Dominion Building Products, Elkhart, Indiana or approved equal. Provide all steel doors and frames from a single manufacturer.

2.2 DOORS

A. General: Construct exterior/interior doors to the following designs and gages:

B. Exterior Doors: Zinc-Iron Alloy-Coated Galvannealed steel, ASTM A 653, Class A60:

C. Thickness: 16 gage (1.3 mm).

D. Include Galvannealed components and internal reinforcements with Galvannealed doors.

E. Close and seal tops of exterior swing-out doors to eliminate moisture penetration. Galvannealed steel top caps are permitted.

F. Solid polyurethane core.

G. Include Galvannealed components and internal reinforcements.

H. Hardware Reinforcements:
   1. Hinge reinforcements for full mortise hinges: minimum 7 gage (4.7 mm).
   2. Lock reinforcements: minimum 16 gage (1.3 mm).
   3. Closer reinforcements: minimum 14 gage (1.7 mm) steel, 20-inch (508 mm) long.

I. Galvannealed doors: include Galvannealed hardware reinforcements.

J. Projection welded hinge and lock reinforcements to the edge of the door.

K. Provided adequate reinforcements for other hardware as required.

2.3 DOOR FRAMES

A. General: Construct exterior metal door frames to the following designs and gages;

B. Exterior Frames: Zinc-Iron Alloy-Coated Galvannealed steel, ASTM A 653, Class A60. Thickness: 16 gage (1.3 mm).

C. Accessories: Glazing Bead: Formed steel sheet; screw-attached.

2.4 ACCESSORIES

A. Anchors: Manufacturer's standard framing anchors, specified in manufacturer's printed installation instructions for project conditions.

B. Door Bottom: In accordance with Door Schedule on Drawings.

2.5 FABRICATION

A. Factory-welded frames: Head and jamb intersecting corners mitered at 45 degrees, with back welded joints ground smooth.

B. Continuous face weld the joint between the head and jamb faces along their length either internally or externally. Grind, prime paint, and finish smooth face joints with no visible face seams.

C. Externally weld, grind, prime paint, and finish smooth face joints at meeting mullions or between mullions and other frame members per a current copy of ANSI/SDI A250.8.

D. Provide temporary steel spreaders (welded to the jambs at each rabbet of door openings) on welded frames during shipment. Remove temporary steel spreaders prior to installation of the frame.

E. Provide cutouts and reinforcements required for electrical and security components specified elsewhere in this specification.

2.6 FINISHES

A. Finish: factory chemically clean and phosphate treat for paint adhesion all door surfaces and each side of frames. Factory prime paint with rust inhibiting prime pain in accordance with SPC or HMMA recommendations and for compatibility with finish paint. Exposed surfaces to be smooth and free of scratches and paint runs. Finish paint door and frame with semi-gloss enamel in one of manufacturer’s standard colors.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that project conditions are acceptable before beginning installation of frames. Verify that completed openings to receive knock-down wrap-around frames are of correct size and thickness.

B. Do not begin installation until conditions have been properly prepared.

C. Correct unacceptable conditions before proceeding with installation.

3.2 INSTALLATION

A. Install doors and frames in accordance with manufacturer's printed installation instructions and with Steel Door Institute's recommended erection instructions for steel frames ANSI A250.11 and NAAMM/HMMA 840.

B. Remove temporary steel spreaders prior to installation of frames.

C. Set frames accurately in position; plumb, align and brace until permanent anchors are set. After wall construction is complete, remove temporary wood spreaders.

D. Field splice only at approved locations indicated on the shop drawings.

E. Weld, grind, and finish as required to conceal evidence of splicing on exposed faces.

F. Glaze and seal exterior transom, sidelight and window frames in accordance with HMMA-820 TN03.

G. Apply hardware in accordance with hardware manufacturers' instructions and Section 08710 – Door Hardware. Install hardware with only factory-provided fasteners. Install silencers. Adjust door installation to provide uniform clearance at head and jambs, to achieve maximum operational effectiveness and appearance.

3.3 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 site in a clean condition.

C. Finish Coat Touch-Up: Immediately after erection, sand smooth rusted or damaged areas of finish coat and apply coating to match.

3.4 PROTECTION

A. Protect installed products and finished surfaces from damage during construction.

END OF SECTION

SECTION 08 71 00

DOOR HARDWARE

PART 1 - PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Door locks.

B. Door handles and trim.

1.2 RELATED SECTIONS

A. Section 06100 - Rough Carpentry

B. Section 08110 - Metal Doors and Frames

1.3 REFERENCES

A. ANSI A117.1 - American National Standard for Accessible and Useable Buildings and Facilities.

B. ANSI A156.2 - American National Standard for Bored and Preassembled Locks & Latches

C. ANSI A156.3 - American National Standard for Exit Devices

D. ANSI A156.4 - American National Standard for Door Controls - Closers.

E. ANSI A156.5 - American National Standard for Auxiliary Locks and Associated Products.

F. ANSI A156.13 - American National Standard for Mortise Locks and Latches Series 1000.

G. Underwriters Laboratories (UL). - Fire Resistance Directory.

1.4 SUBMITTALS

A. 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.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: All equipment specified in this section will be provided by a single manufacturer with a minimum of ten (10) years' experience manufacturing door hardware.

B. Installer Qualifications: All products listed in this section are to be installed by a single installer with a minimum of five (5) years demonstrated experience in installing products of the same type and scope as specified.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

1.7 WARRANTY

A. At project closeout, provide to the Owner or Owner's Representative an executed copy of the manufacturer's Limited Warranty against Manufacturing Defects.

B. Duration: ten (10 years).

1.8 EXTRA MATERIALS

A. Provide to the Owner two sets of keys for each lock.

1.9 KEY CONFIGURATIONS

A. Provide same-keyed locks for all doors indicated in the Door Schedule on the Drawings to have a locking mechanism.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Provide and Install all door hardware in accordance with the Door Hardware schedules shown on the Plans.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to 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 in accordance with manufacturer's instructions.

3.4 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

DIVISION 13 SPECIAL FACILITY COMPONENTS

SECTION 13 12 00

PUMPS HOUSE BUILDING, STAIRS & LANDING

PART 1 - GENERAL

1.1 SCOPE

A. Design, fabrication, transportation, and installation of a pre-engineering building including the following components:
   1. Structural Steel skid frame.
   2. Structural Framing and sheathing
   3. Exterior wall system including insulation and siding panels, panel attachments, sealants, mastics, trim and flashings.
   4. Roof system including insulation, roofing, sealants, mastics, trim and flashings.
   5. Interior Finish.
   6. Stairs, handrails and landing.

B. Design drawings prepared by professionals licensed in the State of Alaska.

C. Wall accessories including the following:
   1. Doors
   2. Piping penetration

1.2 RELATED REQUIREMENTS

A. Section 05 50 00 – Metal Fabrications

B. Section 06 10 00 - Rough Carpentry

C. Section 06 16 00 - Sheathing

D. Section 06 17 53 – Shop Fabricated Wood Trusses

E. Section 07 12 00 - Building Insulation

F. Section 07 41 13 – Formed Metal Roof Panels

G. Section 07 42 13 – Formed Metal Wall Panels

H. Section 07 92 00 – Joint Sealants

I. Section 08 11 00 - Steel Doors and Frames

J. Section 08 71 00 - Door Hardware

1.3 REFERENCES

A. AISC – Steel Construction Manual

B. American Plywood Association Specifications & Publications including but not limited to: Fire – Rated Systems; FRP plywood; Nailed Structural – Use Panel & Lumber Beams; Panel Design Specification, supplements: #2 – Design & Fabrication of Plywood-Lumber Beams, #3 – Design & Fabrication of Plywood Stressed-Skin Panels.

C. ASTM A 36/ASTM A36M - Standard Specification for Carbon Structural Steel.

D. ASTM A 307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.

E. ASTM A 325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

F. ASTM A 500 - Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

G. ASTM A 607 - Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Columbium or Vanadium, or Both, Hot-Rolled and Cold-Rolled.

H. ASTM A 653/A 653M - Standard Specification for Steel Sheets, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

I. ASTM A 792/A 792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

J. ASTM A 1011 - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low Alloy with Improved Formability.

K. ASTM D 635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position.

L. ASTM D 1929 - Standard Test Method for Ignition Properties of Plastics.

M. ASTM D 2843 - Standard Test Method for Smoke from the Burning or Decomposition of Plastics.

N. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

O. ASTM E 1592 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference.

P. AWS D1.1 - Structural Welding Code; American Welding Society

R. SDI 100 - Recommended Specifications for Standard Steel Doors and Frames; Steel Door Institute.

S. UL 580 - Tests for Wind Uplift Resistance of Roof Assemblies; Underwriters Laboratories Inc.

T. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc.

1.4 SYSTEM DESCRIPTION

A. General:
1. Provide pre-engineered Pump House Building, Stairs & Landing that can be transported and positioned in Emmonak over the wet well and positioned on precast concrete footings.
2. Design structural systems according to professionally recognized methods and standards and legally adopted building codes.
3. Design under the supervision and stamped by a registered professional engineer licensed in Alaska.

B. Design Requirements:
1. Wind Loading: 150 mph, 3 second gust. Roof system tested and certified to meet Underwriters Laboratories UL 90 wind uplift rating and ASCE7-16 criteria.
2. Module size: A 22’ x 15’-2” Transportable unit as delineated on Drawings
3. Roof pitch: Approximately 1.5:12, refer Building Sections for dimensions.
4. Roof Snow Load: Ground Snow Load, Pf = 70 psf.
5. Collateral Loads: 15 psf and special equipment gravity and lateral loads
6. Seismic Loading: As delineated by the current International Building Code.
7. Floor Load:
   a. Live Load: 125 psf, light storage and as required to support tanks and other mechanical equipment loading.
8. Dead loads, including the weight of all indicated permanent construction:
   a. Elements required for support of lights and light battens, hanging fixtures, mechanical equipment, piping, ceiling hanger wires, and all other items required to provide a complete building and not specifically indicated on the drawings.

1.5 SUBMITTALS

A. Provide design criteria, shop drawings sealed by a licensed professional engineer registered in the State of Alaska.

B. Quality Control Reports.

1.6 WARRANTY

A. Manufacturer shall warranty installed system for the periods described herein, starting from Date of Substantial Completion against all the conditions indicated below. When notified in writing

from Owner, manufacturer/installer shall, promptly and without inconvenience and cost to Owner, correct said deficiencies.

1. Materials and Workmanship Warranty: 3 years.
2. Finish Warranty:
   a. Finish coating shall not change color or fade in excess of 5 NBS units as determined by ASTM D2244.
      1) Panel finish: 10 years.
3. Performance Warranty: Furnish written warranty, stating the roofing system and flashing under this Section will be maintained in watertight condition and defects resulting from the following items will be corrected without cost to Owner for a period of 10 years.
   a. Faulty workmanship.
   b. Defective materials including sealants and fasteners.
   c. Water infiltration.

PART 2 - PRODUCTS

2.1 STRUCTURAL STEEL FRAMING

A. Skid Support: Structural steel skid system as delineated on the drawings.

2.2 FRAMING

A. Plywood sheathed stud walls as delineated on the drawings and wood floor joist and rafters as delineated on the drawings.

2.3 ROOF COVERING SYSTEM

A. Formed Metal Roof Panels (07 41 13.16)

2.4 WALL SIDING SYSTEM

A. Form metal wall panels (07 42 13)

2.5 INSULATION

A. Sprayed Urethane Insulation as delineated in Section 07 21 00 Building Insulation.

2.6 EXTERIOR WALL ACCESSORIES

A. Service Door: See Section 08 11 00 – Metal Doors and Frames.

2.7 FABRICATION

A. Fabricate pre-engineered building within a 60-mile radius of Anchorage, Alaska to facilitate the Owner's quality control inspections; or provide at no cost to the Engineer and Owner, room, board, air, and ground transportation for 4 man-trips from Anchorage, Alaska to the fabrication site. Inspection trips shall allow for one day at the fabrication site, plus travel time.

B. Fabricator shall provide one-week advanced notice for rough-in framing (prior to concealment) and at 98% completion (prior to shipment) inspections. Owner may provide two other random fabrication site inspections, if needed.

C. Steel Fabrication: Fabricate according to manufacturer's standard practice.
   1. Fabricate structural members made of welded plate sections by jointing the flanges and webs by continuous automatic submerged arc welding process.
   2. Welding operators and processes: Qualified in accordance with AWS D1.1.
   3. Field connections: Prepare members for bolted field connection by making punched, drilled, or reamed holes in the shop.

D. Email daily photographs of fabrication progress to the Owner.

2.8 FINISH

A. See Section 05 50 00 – Metal Fabrications for finish requirements.

PART 3 - PART 3 – EXECUTION

3.1 SCOPE OF EXECUTION

A. Contractor shall furnish and package pre-engineered building.

B. Contractor shall store pre-engineered building for a duration of up to 6 months at the monthly rate established in the bid schedule.

C. At a time indicated by the Owner, the building shall be relinquished to another contractor who will be responsible for shipment of the building to Emmonak.

D. Shipment of building to Emmonak and placement on foundations is Not-in-Contract.

3.2 GENERAL

A. Fabricate and assemble pre-engineered building from Engineer-approved shop drawings.

B. Secure, weatherproof, and protect the unit from vandalism and damage during transportation.

3.3 EXAMINATION

A. Verification of Conditions: Examine areas and conditions under which Work is to be performed and identify conditions detrimental to proper and or timely completion.
   1. Verify foundations are properly installed, to correct dimensions and within acceptable tolerances.

3.4 PREPARATION

A. Skid Construction: Construct in compliance with AISC Specification.

B. Construct Floor, Walls and Roof in conformance to the approved shop drawings.

3.5 INSTALLATION OF WALL SIDING AND ROOFING SYSTEM

A. Install in compliance with manufacturer's instructions.

B. Exercise care when cutting prefinished material to ensure cuttings do not remain on finish surface.

C. Fasten cladding system to structural supports, aligned level and plumb.

D. Locate end laps over supports. End lap panels according to manufacturer's recommendations. Place side laps over bearing.

E. Provide expansion joints where indicated.

F. Install sealant and gaskets to prevent weather penetration.

G. Install system free of rattles, noise due to thermal movement, and wind whistles.

H. Install door frames, service doors, overhead doors, window and glass, and gutter system in compliance with manufacturer's instructions.

I. Seal wall and roof accessories watertight and weathertight with sealant in compliance with building manufacturer's standard procedures.

J. Tolerances:
   1. Framing Members: 1/4 inch (6 mm) from level; 1/8 inch (3 mm) from plumb.
   2. Racking: 1/8 inch (3 mm) from true position. Provide shoring to maintain position prior to cladding installation.

3.6 FIELD QUALITY CONTROL

A. Testing by Contractor:
   1. High Strength Bolted Connections: Specification for Structural Joints Using ASTM A325 with minimum testing of bolted connections per the arbitration inspection procedure.

2. Welded Connections: AWS. Visual inspection of 100 percent of welds. Ultrasonic inspection of 50 percent of full and partial penetration welds. A rejection rate greater than 5 percent will increase the inspection to 100 percent.
3. Provide copies of test reports to Engineer.

3.7 Testing by Owner

A. General Testing: For materials and installed tolerances.

END OF SECTION

DIVISION 23 HEATING, VENTILATING AND AIR CONDITIONING

SECTION 23 05 00
COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SUBMITTALS

A. Submit by specification section complete and all at one time; partial submittals will not be considered. Submittals shall be in booklet or electronic form.

1. Booklet Form: The data shall be arranged and indexed under basic categories. A typewritten index shall be included with dividers and identifying tabs between sections and references to sections of specifications.
2. Electronic Form: The data shall be provided in PDF format. The data shall be arranged and indexed under basic categories. All data must be bookmarked by section and clearly marked.

B. Catalog sheets shall be complete and the item or model to be used shall be clearly marked, and identified as to which item in the specifications or on the drawings is being submitted and with drawing fixture number where applicable.

C. Only submit on items specifically required by each specification section. If a submittal has not been requested, it will be returned to the Contractor and will not be reviewed.

1.2 QUALITY ASSURANCE

A. Perform Work in accordance with State of Alaska standards and as amended by the local authority having jurisdiction.

B. Perform work with skilled craftsman specializing in said work. Install all materials in a neat and orderly, and secure fashion as required by specifications and commonly recognized standards of good workmanship.

1.3 SUBSTITUTIONS

A. In accordance with the General Conditions and the General Requirements in Division 01, Substitution and Product Options, all substitute items must fit in the available space, and be of equal or better quality including efficiency performance, size, and weight, and must be compatible with existing equipment.

B. The owner shall be the final authority on acceptability of substitutions.

1.4 DIMENSIONS

A. Before ordering any material or doing any work, the Contractor shall verify all dimensions, including elevations, and shall be responsible for the correctness of the same. No extra charge or compensation will be allowed on account of differences between actual dimensions and measurements indicated on the drawings.

B. Any differences, which may be found, shall be submitted to the Engineer for consideration before proceeding with the work.

1.5 MANUFACTURER'S DIRECTIONS

A. All manufactured articles shall be applied, installed and handled as recommended by the manufacturer, unless specifically called out otherwise in the plans. Advise the owner of any such conflicts before installation.

1.6 PERMITS, FEES, ETC.

A. The Contractor under each section of these specifications shall arrange for a permit from the local authority. The Contractor shall pay for any inspection fees or other fees and charges required by ordinance, law, codes and these specifications.

1.7 TESTING

A. The Contractor under each section shall, at his own expenses, perform the various tests as specified and required by the owner and as required by applicable code, the State, and local authorities.

B. The Contractor shall furnish all fuel and materials necessary for making tests.

1.8 TERMINOLOGY

A. Whenever the words "furnish", "provide", "furnish and install", "provide and install", and/or similar phrases occur, it is the intent that the materials and equipment described be furnished, installed and connected under this Division of the Specifications, complete for operation unless specifically noted to the contrary.

B. Where a material is described in detail, listed by catalog number or otherwise called for, it shall be the Contractor's responsibility to furnish and install the material.

C. The use of the word "shall" conveys a mandatory condition to the contract.

D. "This section" refers to the section in which the statement occurs.

E. "The project" includes all work in progress during the construction period.

F. In describing the various items of equipment, in general, each item will be described singularly, even though there may be a multiplicity of identical or similar items.

1.9 SCHEDULE OF WORK

A. The work must be expedited and close coordination will be required in executing the work. The various trades shall perform their portion of the work at such times as directed so as to meeting scheduled completion dates, and to avoid delaying any other trade.

B. The owner will set up completion dates. Each contractor shall cooperate in establishing these times and locations and shall process his work so as to ensure the proper execution of it.

1.10 COOPERATION AND CLEANING UP

A. The contractor for the work under each section of the specifications shall coordinate his work with the work described in all other sections of the specifications to the end that, as a whole, the job shall be a finished one of its kind, and shall carry on his work in such a manner that none of the work under any section of these specifications shall be handicapped, hindered or delayed at any time.

B. At all times during the progress of the work, the Contractor shall keep the premises clean and free of unnecessary materials and debris. The Contractor shall, on direction at any time from the owner, clear any designated areas or area of materials and debris. On completion of any portion of the work, the Contractor shall remove from the premises all tools and machinery and all debris occasioned by the work, leaving the premises free of all obstructions and hindrances.

1.11 WARRANTY

A. Warranty shall be in accordance with Division 01.

B. Unless a longer warranty is called for within project specifications, all work, materials and equipment items shall be guaranteed for a period of one year after acceptance by the Owner. All defects in labor and materials occurring during this period, as determined by the Architect or Engineer, shall be repaired and/or replaced to the complete satisfaction of the Architect/Engineer.

1.12 COMPLETION REQUIREMENTS

A. In accordance with the General Conditions and the General Requirements in Division 01, Project Closeout; before acceptance and final payment, the Contractor shall furnish:

B. Accurate project record drawings showing all changes from the original plans made during installation of the work.

C. All manufacturers' guarantees.

D. Warranties.

E. Operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide all equipment and materials required for a complete system.

B. All equipment and materials supplied under this Contract are new unless specifically indicated as existing, Where additional or replacement items are required, provide like items by the same manufacturer to the maximum extent practical.

C. Install all material and equipment in accordance with manufacturer's installation instructions and recommendations unless specifically indicated.

2.2 ELECTRICAL MOTORS

A. Furnish electric motors designed for the specific application and duty applied, and to deliver rated horsepower without exceeding temperature ratings when operated on power systems with a combined variation in voltage and frequency not more than + 10% of rated voltage. Motors for pumps and fans shall be selected to be non-overloading.

B. Verify from the drawings and specifications the available electrical supply characteristics and furnish equipment that will perform satisfactorily under the conditions shown and specified.

C. Size motors for 1.15 service factor.

D. Fractional horsepower motors to have self-resetting thermal overload switch.

E. Provide Premium Efficiency, motors for all three phase motors one horsepower and larger. Standard efficiency motors will not be acceptable.

2.3 RESTRICTED MATERIALS

A. No materials containing asbestos in any form shall be allowed.

B. No solder or flux containing lead shall be used on this project.

PART 3 - EXECUTION

3.1 DRAWINGS

A. The mechanical drawings are generally diagrammatic and do not necessarily show all features of the required work. Complete details of the building, which affect the mechanical installation, may not be shown. For additional details, see Architectural, and Electrical Drawings. Coordinate work under this section with that of all related trades.

B. Contractor to field verify all dimensions and conditions prior to start of construction. Immediately contact the Engineer for clarification of questionable items or apparent conflicts.

3.2 INSTALLATION

A. All work shall comply with the latest adopted applicable codes and ordinances including, but not limited to, the NFPA, IMC, IFC, UPC, IFGC and IBC Standards; all local and state amendments to all codes and standards.

B. Obtain and pay for all inspection fees, connection charges and permits as a part of the Contract.

C. Compliance with codes and ordinances shall be at the Contractor's expense.

3.3 MEASUREMENTS

A. Verify all measurements on the job site.

B. Check all piping, ducts, etc. to clear openings.

3.4 OPERATING INSTRUCTIONS

A. Before the facility is turned over to the Owner, instruct the Owner or Owner's personnel in the operation, care and maintenance of all mechanical systems and equipment.

B. The Operation and Maintenance Manuals shall be utilized for the basis of the instruction. Provide a minimum of four hours of onsite instruction to the owner designated personnel.

3.5 OPERATING AND MAINTENANCE MANUALS

A. Submit maintenance manuals to the Engineer covering all equipment, fixtures, devices, etc. installed by the Contractor. Submit prior to substantial completion. A separate chapter is required for each section of the specifications with subchapters for each class of equipment or system.

B. The operation and maintenance manuals shall be bound in a loose leaf three ring binder with reinforced holes in the sheets so as to prevent lost pages. The manual shall contain, but not limited to, the following types of information:

1. Cover sheet with name, address, telephone number of Contractor, General Contractor and major equipment suppliers.
2. A table of contents for each chapter listing each major item with a page or mark number. Each page of the manual is to be numbered.
3. Catalog cuts of all equipment, fixtures, etc. installed (Marked to identify the specific items used). Equipment identification is to be the same as shown on nameplates, i.e. B-1, BP-1, etc.
4. Manufacturer's maintenance and overhaul instruction booklets including exploded views.
5. Manufacturer’s required spare parts list for all equipment with replaceable parts.
6. Identification numbers of all parts and nearest sources for obtaining parts and services.
7. Reduced scale drawings of the control system and a verbal description of how these controls operate.
8. A copy of the final test and balance report.
9. A copy of valve schedule and reduced scale drawings showing valve locations.

C. Operating Sequence Narrative: To be typewritten and in outline form. In each chapter, describe procedures necessary to operate equipment covered by chapter. Include procedures for start-up, shut down, and emergency operation. Provide a description of all adjustments necessary or optional.

D. Maintenance Instructions: In each chapter describe maintenance procedures for equipment covered by the chapter. Include manufacturer’s recommended preventive/periodic maintenance form that includes all of the equipment provided with the maintenance manual. This shall be a standalone document, which can be used independent of the rest of the operations and maintenance manual. The form shall list each piece of equipment and how often maintenance is required (daily, weekly, monthly, annually). Opposite each task shall be squares for check-off for a full year (initials) to verify that the tasks are being done. Maintenance instructions shall include instructions for minor repairs that could be reasonably performed by persons qualified to operate the equipment and perform day-to-day maintenance.

E. Include instruction in the use of the completed and approved Operations and Maintenance Manual as part of the required training for Owner Personnel.

END OF SECTION

SECTION 23 07 00

HVAC INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. HVAC equipment insulation, jackets and accessories.
2. HVAC ductwork insulation, jackets, and accessories.

B. Related Sections:

1. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for pipe hangers, supports, and firestopping for placement by this section.

1.2 REFERENCES

A. ASTM International:

1. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
2. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
3. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
4. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
5. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
6. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
7. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
8. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
9. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
10. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
11. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
12. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

13. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
14. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
15. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
16. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.
17. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
18. ASTM D4637 - Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane.
19. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
20. ASTM E162 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.

B. Sheet Metal and Air Conditioning Contractors':

1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

1.3 SUBMITTALS

A. Division 01 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit product description, thermal characteristics and list of materials and thickness for each service, and location.

C. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.

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

1.4 QUALITY ASSURANCE

A. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.

B. Factory fabricated fitting covers manufactured in accordance with ASTM C450.

C. Duct insulation, Coverings, and Linings: Maximum 25/50 flame spread/smoke developed index, when tested in accordance with ASTM E84, using specimen procedures and mounting procedures of ASTM E 2231.

D. Perform Work in accordance with State of Alaska standard and as amended by the local Authority Having Jurisdiction.

1.5 QUALIFICATIONS

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

B. Applicator: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Division 01 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

C. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Division 01 - Product Requirements: Environmental conditions affecting products on site.

B. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.

C. Maintain temperature before, during, and after installation for minimum period of 24 hours.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.9 WARRANTY

A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 - PRODUCTS

2.1 DUCTWORK INSULATION

A. TYPE D-1: ASTM C1290, Type III, flexible glass fiber, commercial grade with factory applied reinforced aluminum foil jacket meeting ASTM C1136, Type II.

1. Thermal Conductivity: 0.27 at 75 degrees F.
2. Maximum Operating Temperature: 250 degrees F.
3. Density: 1.5 pound per cubic foot.

B. TYPE D-2: ASTM C612, Type IA or IB, rigid glass fiber, with factory applied all service facing meeting ASTM C1136, Type II.

1. Thermal Conductivity: 0.23 at 75 degrees F.
2. Density: 3.0 pound per cubic foot.

2.2 DUCTWORK INSULATION JACKETS

A. Aluminum Duct Jacket:

1. ASTM B209.
2. Thickness: 0.016 inch thick sheet.
3. Finish: Corrugated or textured.
4. Joining: Longitudinal slip joints and 2 inch laps.
5. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.

B. Vapor Retarder Jacket:

1. Kraft paper with glass fiber yarn and bonded to aluminized film 0.0032 inch vinyl.
2. Water Vapor Permeance: ASTM E96/E96M; 0.02 perms.
3. Secure with pressure sensitive tape.

2.3 DUCTWORK INSULATION ACCESSORIES

A. Vapor Retarder Tape:

1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

B. Vapor Retarder Lap Adhesive: Compatible with insulation.

C. Adhesive: Waterproof, ASTM E162 fire-retardant type.

D. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

E. Impale Anchors: Galvanized steel, 12 gage self-adhesive pad.

F. Adhesives: Compatible with insulation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Division 01 - Administrative Requirements: Coordination and project conditions.

B. Verify equipment and ductwork has been tested before applying insulation materials.

C. Verify surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION - DUCTWORK SYSTEMS

A. Duct dimensions indicated on Drawings are finished inside dimensions.

B. Insulated ductwork conveying air above ambient temperature:

1. Provide with or without standard vapor retarder jacket.
2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

C. External Glass Fiber Duct Insulation:

1. Secure insulation with vapor retarder with wires and seal jacket joints with vapor retarder adhesive or tape to match jacket.
2. Secure insulation without vapor retarder with staples, tape, or wires.
3. Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift ductwork off trapeze hangers and insert spacers.
4. Seal vapor retarder penetrations by mechanical fasteners with vapor retarder adhesive.
5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

D. External Elastomeric Duct Insulation:

1. Adhere to clean oil-free surfaces with full coverage of adhesive.
2. Seal seams and butt joints with manufacturer’s recommended adhesive.
3. When application requires multiple layers, apply with joints staggered.
4. Insulate standing metal duct seams with insulation of like material and thickness as adjacent duct surface. Apply adhesive at joints with flat duct surfaces.

5. Lift ductwork off trapeze hangers and insert spacers.

E. Prepare duct insulation for finish painting.

3.3 SCHEDULES

A. Ductwork Insulation Schedule:

DUCTWORK SYSTEM	INSULATION TYPE	INSULATION THICKNESS inches
Outside Air Intake	D-2	2.0
Exhaust Ducts Within 5 feet of Exterior Openings [Thickness indicated is installed thickness]	D-1 or D-2	2.0

END OF SECTION

SECTION 23 07 00

MECHANICAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Plumbing piping, insulation, jackets, and accessories.
   2. HVAC ductwork insulation, jackets, and accessories.

1.2 REFERENCES

A. ASTM International:
   1. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
   2. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
   3. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
   4. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
   5. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
   6. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
   7. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
   8. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
   9. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.
   10. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
   11. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
   12. ASTM E162 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.

B. Sheet Metal and Air Conditioning Contractors':

   1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

1.3 SUBMITTALS

A. Division 01 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit product description, thermal characteristics and list of materials and thickness for each service, and location.

C. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.

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

1.4 QUALITY ASSURANCE

A. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.

B. Factory fabricated fitting covers manufactured in accordance with ASTM C450.

C. Duct insulation, Coverings, and Linings: Maximum 25/50 flame spread/smoke developed index, when tested in accordance with ASTM E84, using specimen procedures and mounting procedures of ASTM E 2231.

D. Perform Work in accordance with State of Alaska standard and as amended by the local Authority Having Jurisdiction.

1.5 QUALIFICATIONS

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

B. Applicator: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Division 01 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

C. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Division 01 - Product Requirements: Environmental conditions affecting products on site.

B. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.

C. Maintain temperature before, during, and after installation for minimum period of 24 hours.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.9 WARRANTY

A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 - PRODUCTS

2.1 PIPE INSULATION

A. TYPE P-1: ASTM C547, molded glass fiber pipe insulation.

1. Thermal Conductivity: 0.23 at 75 degrees F.
2. Operating Temperature Range: 0 to 850 degrees F.
3. Vapor Barrier Jacket: ASTM C1136, Type I, factory applied reinforced foil kraft with self-sealing adhesive joints.
4. Jacket Temperature Limit: minus 20 to 150 degrees F.

2.2 PIPE INSULATION JACKETS

A. Vapor Retarder Jacket:

1. ASTM C921 white Kraft paper with glass fiber yarn, bonded to aluminized film.
2. Water Vapor Permeance: ASTM E96; 0.02 perms.

B. Aluminum Pipe Jacket:

1. ASTM B209.
2. Thickness: 0.020 inch thick sheet.
3. Finish: Corrugated or textured.
4. Joining: Longitudinal slip joints and 2 inch laps.

C. PVC Plastic Pipe Jacket:

1. Product Description: ASTM D1785 One piece molded type fitting covers and sheet material, off-white color.
2. Thickness: 10 mil.
3. Connections: Pressure sensitive color matching vinyl tape.

2.3 PIPE INSULATION ACCESSORIES

A. Vapor Retarder Lap Adhesive: Compatible with insulation.

B. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

C. Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement: ASTM C449.

D. Insulating Cement: ASTM C195; hydraulic setting on mineral wool.

E. Adhesives: Compatible with insulation.

2.4 DUCTWORK INSULATION

A. TYPE D-1: ASTM C1290, Type III, flexible glass fiber, commercial grade with factory applied reinforced aluminum foil jacket meeting ASTM C1136, Type II.

1. Thermal Conductivity: 0.27 at 75 degrees F.
2. Maximum Operating Temperature: 250 degrees F.
3. Density: 1.5 pound per cubic foot.

B. TYPE D-2: ASTM C612, Type IA or IB, rigid glass fiber, with factory applied all service facing meeting ASTM C1136, Type II.

1. Thermal Conductivity: 0.23 at 75 degrees F.
2. Density: 3.0 pound per cubic foot.

2.5 DUCTWORK INSULATION JACKETS

A. Aluminum Duct Jacket:

1. ASTM B209.
2. Thickness: 0.016 inch thick sheet.
3. Finish: Corrugated or textured.
4. Joining: Longitudinal slip joints and 2 inch laps.
5. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.

B. Vapor Retarder Jacket:

1. Kraft paper with glass fiber yarn and bonded to aluminized film 0.0032 inch vinyl.
2. Water Vapor Permeance: ASTM E96; 0.02 perms.
3. Secure with pressure sensitive tape.

2.6 DUCTWORK INSULATION ACCESSORIES

A. Vapor Retarder Tape:

1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

B. Vapor Retarder Lap Adhesive: Compatible with insulation.

C. Adhesive: Waterproof, ASTM E162 fire-retardant type.

D. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

E. Impale Anchors: Galvanized steel, 12 gage self-adhesive pad.

F. Adhesives: Compatible with insulation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Division 01 - Administrative Requirements: Coordination and project conditions.

B. Verify equipment and ductwork has been tested before applying insulation materials.

C. Verify surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION – PIPING SYSTEMS

A. Piping Exposed to View in Finished Spaces: Locate insulation and cover seams in least visible locations.

B. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions.

C. Piping Systems Conveying Fluids Below Ambient Temperature:

1. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.
2. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
3. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor retarder adhesive or PVC fitting covers.

3.3 INSTALLATION - DUCTWORK SYSTEMS

A. Duct dimensions indicated on Drawings are finished inside dimensions.

B. Insulated ductwork conveying air above ambient temperature:

1. Provide with or without standard vapor retarder jacket.
2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

C. External Glass Fiber Duct Insulation:

1. Secure insulation with vapor retarder with wires and seal jacket joints with vapor retarder adhesive or tape to match jacket.
2. Secure insulation without vapor retarder with staples, tape, or wires.
3. Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift ductwork off trapeze hangers and insert spacers.
4. Seal vapor retarder penetrations by mechanical fasteners with vapor retarder adhesive.
5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

D. External Elastomeric Duct Insulation:

1. Adhere to clean oil-free surfaces with full coverage of adhesive.
2. Seal seams and butt joints with manufacturer’s recommended adhesive.
3. When application requires multiple layers, apply with joints staggered.
4. Insulate standing metal duct seams with insulation of like material and thickness as adjacent duct surface. Apply adhesive at joints with flat duct surfaces.
5. Lift ductwork off trapeze hangers and insert spacers.

E. Prepare duct insulation for finish painting.

3.4 SCHEDULES

A. Piping Insulation Schedule:

PIPING SYSTEM	INSULATION TYPE	PIPE SIZE	INSULATION THICKNESS inches
Vent Through Roof	P-1	All Sizes	1.0
Pipe Exposed to Freezing	P-1	All Sizes	1.0

B. Ductwork Insulation Schedule:

DUCTWORK SYSTEM	INSULATION TYPE	INSULATION THICKNESS inches
Outside Air Intake	D-2	2.0
Exhaust Ducts Within 5 feet of Exterior Openings [Thickness indicated is installed thickness]	D-1 or D-2	2.0

END OF SECTION

SECTION 23 31 00
HVAC DUCTS AND ACCESORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Duct Materials.
2. Ductwork fabrication.
3. Duct Accessories.

1.2 REFERENCES

A. ASTM International:

1. ASTM A90 - Standard Test Method for Weight Mass of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
2. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

B. Sheet Metal and Air Conditioning Contractors:

1. SMACNA - HVAC Air Duct Leakage Test Manual.
2. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

C. Underwriters Laboratories Inc.:

1. UL 181 - Factory-Made Air Ducts and Connectors.

1.3 PERFORMANCE REQUIREMENTS

A. Variation of duct configuration or sizes other than those of equivalent or lower loss coefficient is not permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

1.4 SUBMITTALS

A. Division 01 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit data for duct materials.

1.5 CLOSEOUT SUBMITTALS

A. Division 01 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with SMACNA - HVAC Duct Construction Standards - Metal and flexible.

1.7 QUALIFICATIONS

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

B. Installer: Company specializing in performing Work of this section with minimum three years experience.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Do not install duct sealant when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures during and after installation of duct sealant.

1.9 FIELD MEASUREMENTS

A. Before ordering or fabricating any material or doing any work, the Contractor shall verify all dimensions, including elevations, and shall be responsible for the correctness of the same. No extra charge or compensation will be allowed on account of differences between actual dimensions and measurements indicated on the drawings.

B. Any differences, which may be found, shall be submitted to the Engineer for consideration before proceeding with the work.

1.10 WARRANTY

A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 - PRODUCTS

2.1 DUCT MATERIALS

A. Galvanized Steel Ducts: ASTM A653 galvanized steel sheet, lock-forming quality, having G90 zinc coating of in conformance with ASTM A90.

B. Fasteners: Rivets, bolts, or sheet metal screws.

C. Hanger Rod: ASTM A36 steel, threaded both ends, threaded one end, or continuously threaded.

2.2 DUCTWORK FABRICATION

A. Fabricate and support rectangular ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible and as indicated on Drawings. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

B. Fabricate and support round ducts with longitudinal seams in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible (Round Duct Construction Standards), and as indicated on Drawings. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

C. Construct T's, bends, and elbows with minimum radius 1-1/2 times centerline duct width.

D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

E. Seal joints between duct sections and duct seams with welds, gaskets, mastic adhesives, mastic plus embedded fabric systems, or tape.

1. Sealants, Mastics and Tapes: Conform to UL 181A. Provide products bearing appropriate UL 181A markings.
2. Do not provide sealing products not bearing UL approval markings.

2.3 DUCT ACCESSORIES

A. Control Dampers- Dampers shall be premium ultra-low leak and located as indicated on the schedule and plans. Blade arrangement (parallel or opposed) shall be provided as indicated on the schedule and drawings. Outside air dampers shall be insulated Ruskin CDTI-50 double-skin airfoil design or equivalent for minimal air leakage and pressure drop. Leakage rate shall not exceed 3 CFM/square foot at one inch water gauge complying with ASHRAE 90.1 maximum damper leakage. All leakage testing and pressure ratings shall be based on AMCA Standard 500-D. Provide with 120VAC, 1 phase, direct coupled, fail open, spring return, Belimo LF-Series or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Division 01 - Administrative Requirements: Coordination and project conditions.

B. Verify sizes of equipment connections before fabricating transitions.

3.2 INSTALLATION

A. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

B. During construction, install temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

C. Install duct hangers and supports in accordance with SMACNA.

D. Use double nuts and lock washers on threaded rod supports.

E. Install control dampers and actuators per manufacturer installations instructions.

F. Install Work in accordance with State of Alaska Standards.

G. Exhaust Outlet Locations:

1. Minimum Distance from Property Lines: 3 feet.
2. Minimum Distance from Building Openings: 3 feet.
3. Minimum Distance from Outside Air Intakes: 10 feet.

3.3 SCHEDULES

A. Ductwork Material Schedule:

AIR SYSTEM	MATERIAL
Exhaust / Intake	Steel

B. Ductwork Pressure Class Schedule:

AIR SYSTEM	PRESSURE CLASS
Exhaust / Intake	1 inch wg regardless of velocity.

END OF SECTION

SECTION 23 34 00

HVAC FANS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Centrifugal fan.

B. Related Sections:
   1. Section 23 31 00 - HVAC Ducts: Product requirements for hangers for placement by this section.
   2. Division 26 - Equipment Wiring Connections: Execution and product requirements for connecting equipment specified by this section.

1.2 REFERENCES

A. Air Movement and Control Association International, Inc.:
   1. AMCA 204 - Balance Quality and Vibration Levels for Fans.
   2. AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
   3. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
   4. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

B. Underwriters Laboratories Inc.:
   1. UL 705 - Power Ventilators.

1.3 SUBMITTALS

A. Division 01 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit data on each type of fan and include accessories, shop drawings, fan curves with specified operating point plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions: Submit fan manufacturer’s instructions.

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

1.4 CLOSEOUT SUBMITTALS

A. Division 01 - Execution and Closeout Requirements: Closeout procedures.

1.5 QUALITY ASSURANCE

A. Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.

B. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.

C. UL Compliance: Listed, labeled, designed, manufactured, and tested in accordance with UL 705.

D. Balance Quality: Conform to AMCA 204.

E. Perform Work in accordance with State of Alaska standards.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.

B. Installer: Company specializing in performing Work of this section with minimum three years' experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Division 01 - Product storage and handling requirements.

B. Protect motors, shafts, and bearings from weather and construction dust.

1.8 FIELD MEASUREMENTS

A. Before ordering any material or doing any work, the Contractor shall verify all dimensions, including elevations, and shall be responsible for the correctness of the same. No extra charge or compensation will be allowed on account of differences between actual dimensions and measurements indicated on the drawings.

B. Any differences, which may be found, shall be submitted to the Engineer for consideration before proceeding with the work.

1.9 WARRANTY

A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL FANS

A. Manufacturers:
   1. Greenheck Fan Corporation.
   2. Loren Cook Company.
   3. Substitutions: Division 01 - Product Requirements.

B. General:
   1. Centrifugal Fan Unit: UL listed, direct driven, with galvanized steel housing, resilient mounted motor, gravity backdraft damper in discharge and square duct mounting collars. Fan construction shall include removable access panels. Fan shall bear AMCA rating seals for sound and performance.

C. Accessories:
   1. Back-draft Damper: Multiple blade with offset hinge pin, blades linked.
   2. Hood: Weather shield, to exclude rain and snow.
   3. Fan speed controller.

D. Motors: In accordance with Division 26.

E. Disconnect Switch: Factory mount disconnect switch in control panel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Secure wall fans with stainless steel lag screws to structure.

B. Install safety screen where inlet or outlet is exposed.

C. Install backdraft dampers on discharge of exhaust fans and as indicated on Drawings.

D. Install fan in accordance with manufacturer’s installation instructions. Maintain all required service clearances and access.

3.2 FIELD QUALITY CONTROL

A. All field inspecting, testing, and adjusting shall be in accordance with manufacturer's recommendations.

END OF SECTION

SECTION 23 82 39

ELECTRIC HEATERS

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall provide heating systems, complete and operable, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Work shall be in full accordance with the latest State and local codes and regulations, including the local Plumbing Code, the local Building Code, Fire Code, and all other local codes. Nothing in the Contract Documents shall be construed to permit work in violation of the above codes, rules, and regulations. In the absence of applicable codes, installation and workmanship shall follow the standards set by the American Society of Heating, Refrigeration, and Air Conditioning Engineers.

1.3 CONTRACTOR SUBMITTALS

A. Division 01 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit data on each type of unit heater and include accessories, shop drawings, power, RPM, electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions: Submit manufacturer’s instructions.

1.4 CLOSEOUT SUBMITTALS

A. Division 01 - Execution and Closeout Requirements: Closeout procedures.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years’ experience.

B. Installer: Company specializing in performing Work of this section with minimum three years’ experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Division 01 - Product storage and handling requirements.

B. Protect motors, shafts, and bearings from weather and construction dust.

1.7 WARRANTY

A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 - PRODUCTS

2.1 GENERAL

A. Quality: All units shall be alike in materials, workmanship, and design and shall be of the manufacturer's top of the line, industrial-commercial grade.

B. Supports: Equipment and appurtenances shall be firmly anchored or connected to supporting members. Supports required for the proper installation of the equipment, but not forming an integral part of the building structure, shall be provided by the Contractor, unless otherwise indicated. Mounting brackets shall be supplied by the heater manufacturer.

2.2 CONTROLS

A. Standard Thermostats: Control range shall be adjustable from 35 to 95 degrees F. Finish: Classic beige-and-light gold standard, mounting: mounts directly on vertical NEMA standard (2" x 4") single-gang outlet box, electrical rating: 120 V and 8.0 FLA. CSA Certified, UL listed Honeywell model T451A or approved equal.

2.3 ELECTRIC HEATERS

A. General: Electric unit heaters shall be provided where indicated. Heaters shall be controlled as indicated on drawings. Brackets shall be provided for wall mounting as required. Heaters shall have built-in magnetic contactors and safety devices to meet UL listing, National Electrical Code, and local regulations.

B. Unit Heaters: Unit heaters shall be of the electric, horizontal blower type, with enameled steel cabinet, mounting bracket, adjustable horizontal louvers, heat exchanger shall include industrial grade heating element, heat exchanger and aluminum fan blade to be enclosed, automatic reset overheat protection, thermal protected, permanently lubricated fan and motor, fuses, and contactors. Provide ceiling mounting kit and integral thermostat.

C. Heater voltage shall be as shown on plans.

PART 3 - EXECUTION

3.1 GENERAL

A. Install all unit heaters and controls in accordance with manufacturer's recommendations and contract documents.

B. Checking: The contractor shall test all unit heaters and control systems for proper operation in accordance with manufacturer's recommendations.

END OF SECTION

SECTION 26 00 00
ELECTRICAL METHODS AND MATERIALS

PART 1 - GENERAL

1.1 DESCRIPTION AND RELATED WORK

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

B. This Section applies to all other Division 26 Sections.

1.2 SCOPE

A. Provide labor, products and services required for the complete installation, checkout and startup of all systems shown and specified.

B. Where the work of several crafts is involved, coordinate related work to provide each system in complete and in proper operating order.

C. Cooperate with others involved in the project, with due regard to their work, to promote rapid completion of the entire project.

D. Local Conditions: The Contractor shall thoroughly familiarize himself with the work as well as the local conditions under which the work is to be performed. Schedule work with regard to seasons, weather, climatic conditions and other local conditions which may affect the progress and quality of the work.

E. Utility Coordination: Coordinate work with the electrical utility (Alaska Village Electrical Cooperative) and provide equipment and installation in accordance with the respective utility requirements. Meet with the serving utility and coordinate the installation and location of the services. Provide a written statement of approval from utility.

F. Provide commissioning services as specified in Division 1 and 26 08 00 – Electrical Commissioning.

1.3 CODES AND STANDARDS

A. Codes: Perform work in strict accordance with applicable national, state and local codes; including, but not limited to the latest legally enacted editions of the following specifically noted requirements:
   1. NFPA 70, National Electrical Code - NEC.
   2. ANSI-C2, National Electrical Safety Code - NESC.

3. International Building Code - IBC.
4. International Fire Code - IFC.
5. Underwriters Laboratory (UL) or approved equal.

B. Standards: Reference to the following standards infers that installation, equipment and material shall be within the limits for which it was designed, tested and approved, in conformance with the current publications and standards of the following organizations:
1. American National Standards Institute - ANSI.
2. American Society for Testing and Materials - ASTM.
3. American Society of Heating Refrigerating and Air Conditioning Engineers - ASHRAE(Standard 90-75).
4. Institute of Electrical and Electronics Engineers - IEEE.
5. Insulated Cable Engineers Association - ICEA.
6. National Electrical Manufacturers' Association - NEMA.
7. National Fire Protection Association - NFPA.

1.4 MATERIAL QUALITY CONTROL

A. All components, systems and assemblies (i.e.: Control Panels) shall be Listed or Labeled by and Agency acceptable to the State of Alaska Department of Labor, Mechanical Inspections Division. Acceptable Agencies include (but are not limited to) U/L, ETL, FM, CSA/US.

B. It is the CONTRACTOR’s responsibility to verify listing or labeling of all components for which he is responsible for. Any component, system or assembly installed under this contract that is found not to be listed or bear a label will be either replaced or field listed and any associated cost shall be borne in its entirety by the CONTRACTOR.

1.5 SPECIFICATION TERMINOLOGY

A. "Engineer" is the Owner's Representative as defined in the General Conditions of the Contract.

B. Streamlining: In many instances, the products, reference standards, and other itemized specifications have been listed without verbiage. In these cases, it is implied that the Contractor shall provide the products and perform in accordance with the references listed.

C. "Provide" means furnish all products, labor, subcontracts, and appurtenances required and install to a complete and properly operating, finished condition.

D. "Furnish" means to purchase material as shown and specified, and cart the material to an approved location at the site or elsewhere as noted or agreed to be installed by supporting crafts.

E. "Install" means to set in place and connect, ready for use and in complete and properly operating finished condition, material that has been furnished.

F. "Rough-in and connect" means provide an appropriate system connection such as conduit with junction boxes, wiring, switches, disconnects, etc., and wiring connections. Equipment furnished is received, uncrated, assembled, and set in place under the Division in which it is specified.

G. "Accessible" means arranged so that an appropriately dressed man, 6 feet-2 inches tall, weighing 250 pounds, may approach the area in question with the tools and products necessary for the work intended and may then position himself to properly and safely perform the task to be accomplished, without disassembly or damage to the surrounding installation.

H. "Serviceable" means arranged so that the component or product in question may be properly removed, and replaced without disassembly, destruction or damage to the surrounding installation.

I. "Product" is a generic term, which includes materials, equipment, fixtures and any physical item used on the project.

J. "Basis of Design" refers to products around which the design was prepared. Some or all of the particular characteristics of Basis of Design products may be critical to the fit or performance of the completed installation. Such characteristics are often subtle. Where substitutions are made to products that are the Basis of Design, the Contractor is alerted that nominally acceptable substitutions may produce undesirable side effects such as switchboards that no longer fit the space due to increased product dimensions. The Contractor is responsible for resolving all impacts of substitutions. Approval of a substitution request does not relieve the Contractor of complying with the design intent and all Codes.

K. "As Specified" denotes a product, system, or installation that:
   1. Includes all of the salient characteristics identified in the Drawings and Specifications;
   2. Meets all of the requirements of the "Basis of Design"; and
   3. Is produced by a manufacturer listed as acceptable on the Drawings or in the Specifications.

L. "Substitution" is a product, system or installation that is not by a listed manufacturer or does not conform to all salient characteristics identified in the Contract Documents, but which the Contractor warrants meets all specific requirements listed in the Contract Documents.

M. "System Drawing" is a diagrammatic engineered drawing that shows the interconnection and relationship between products to demonstrate how the products interact to accomplish the function intended. Examples of system drawings include control and instrumentation diagrams, and wiring diagrams. Some drawings, such as dimensioned and complete Fire Suppression Drawings may be both System Drawings and Shop Drawings.

N. "Shop Drawings" are dimensioned working construction drawings drawn to scale to show an entire area of work in sufficient detail to demonstrate service and maintenance clearances and complete coordination of all trades.

O. Reference to a specific manufacturer’s product (even as “Basis of Design”) does not necessarily establish acceptability of that product without regard to compliance with all other provisions of these specifications.

1.6 DRAWINGS SPECIFICATIONS AND SYMBOLS

A. The Drawings and specifications are complementary. Do not scale the Drawings. Locations of devices, fixtures, and equipment are approximate unless dimensioned.

B. The Drawings are partly diagrammatic and do not show precise routing of conduits or exact location of all products, and may not show in minute detail all features of the installation; however, provide all systems complete and in proper operating order.

C. Drawing symbols used for basic materials, equipment and methods are commonly used by the industry. Special items are identified by a supplementary list of graphical illustrations, or called for on the Drawings or in the specifications.

1.7 PRODUCT AND SYSTEM SUBMITTALS

A. Submittals: Provide submittals for products and systems described in Division 26 and shown on the Drawings to demonstrate compliance with the requirements of the project. Unless specified otherwise in Division 1, submit data not later than 60 days after award of contract or, in any case, to allow sufficient time for review without delaying construction. Furnish equipment submittals in the manner described elsewhere in these specifications. In addition, include data for review, and organize data, as noted below:
   1. Specification reference and/or drawing reference for which literature is submitted for review with an index, following specification format, and item by item identification.
   2. Manufacturer's name and address, and supplier's name, address and telephone number.
   3. Catalog designation or model number.
   4. Rough-in data and dimensions.
   5. Operation characteristics.
   6. Wiring diagrams for the specific system.
   7. Coordination data to check protective devices.
   8. Information required to verify compliance with the short-circuit withstand and interrupting ratings, as shown on the Drawings or further stated in these Specifications.
   9. Certification that all data shown on the Drawings or further stated in these Specifications concerning available short-circuit currents has been confirmed with the serving Electric Utility.
   10. Working construction drawings (shop drawings).
   11. A customized listing of the characteristics identified in the Contract Documents. Indicate whether each item is submitted as "Basis of Design", "As Specified" or "Proposed Substitution". Clearly indicate on product data sheets the data which show the product meets the requirements. Indicate all deviations and mark out all non-applicable items.
   12. ALL PROPOSED SUBSTITUTIONS, DEVIATIONS, MODIFICATIONS, OR CHANGESOF ANY TYPE WHATSOEVER FROM THE PRODUCTS OR SYSTEMS SPECIFIED SHALL BE CLEARLY ITEMIZED IN THE SUBMITTAL INDEX. Submittal approval will not include such deviations unless they are specifically itemized and approved. Where deviations of substitute product or system performance have not been specifically noted in the submittal by the Contractor and accepted by the Engineer, provision of a

complete and satisfactory working installation of equal quality to system specified is the sole responsibility of the Contractor. Unapproved deviations discovered in the field shall be corrected as directed by the Engineer.

13. DELETE ALL SUPERFLUOUS INFORMATION FROM SUBMITTAL DATA SUCH AS MODEL NUMBERS AND OPTIONS FOR EQUIPMENT CONTAINED ON MANUFACTURER'S DATA SHEETS BUT NOT USED ON THIS PROJECT.
14. Submittals not completely marked as indicated above, in the opinion of the Engineer, will be rejected without review.

B. Electronic Submittals:
   1. Submittals may be in electronic (PDF) format.
      a. Electronic submittals shall follow the organization and formatting required for paper submittals.
         1) Provide electronic bookmarks within the PDF document in place of tabs and sub-tabs.
         2) If individual PDF files are provided for each product or shop drawing sheet, organize files into folders and name files and folders to correspond with applicable specification sections or drawing titles.
      b. If submittal is a scanned document, run the optical character recognition OCR function to ensure the document is searchable and can be copied and pasted.
      c. Electronic submittals may be transmitted via Email, disk or download from a projector construction Website.

C. Coordination:
   1. The Contractor shall create and maintain a master submittal log for all items submitted in Division 26. Submit master submittal log with first submittal.
   2. Prior to submission for approval, the Contractor shall hold a meeting of all trades to review all shop drawings and submittals. All trades shall cross-check all shop drawings and submittals for conflicts, clearances, physical space allocation and routing, discrepancies, dimensional errors, omissions, contradictions, departures from the Contract requirements, correct electrical/mechanical services and connections, and provisions for commissioning.
   3. The Contractor shall revise, correct, and appropriately annotate all submittals prior to submission for approval.

D. Certificate of Coordination: Include with the Submittals a complete letter in the following format:

   I _____ (Name), of _____(Firm), certify that the meeting of all trades for coordination of shop drawings and submittals as required by Specifications Section 26 00 00 - Electrical General Requirements was held on_____ Date(s). I further certify that, except as noted on the shop drawings and submittals, they are free of conflicts, discrepancies, dimensional errors, omissions, contradictions, and departures from the Contract requirements, and that they provide for proper clearances, physical space allocation and routing, correct electrical/mechanical services and connections, and provisions for commissioning.
   SIGNED: _____ DATE: _____
   TITLE: _____

E. A current copy of all approved submittals and the submittal log shall be kept at the job site.

F. With prior permission from the Engineer, partial submittals will be considered for review provided that they are complete sections, as listed below:
   1. Individual Special Systems (Fire Alarm, Intercom, etc.)
   2. Lighting Fixtures, Lamps and Accessories.
   3. Switchboards, Panels and Transformers.
   4. Transfer Switches
   5. Transformers.
   6. Controls and Instrumentation

G. Mark submittal literature and shop drawings clearly and bind 8-1/2 by 11 inch literature in three-ring hardback loose-leaf binders by individual sets.

H. Submittal review is for general design and arrangement only and does not relieve the Contractor from any of the requirements of the Contract Documents. Submittals will not be checked for quantity, dimension, fit or proper technical design of manufactured equipment.

1.8 SHOP DRAWINGS REQUIRED

A. The Contract Documents are not intended for nor are they suitable for use as shop drawings. Do not use Contract Drawings for direct fabrication or installation of products or equipment; instead, prepare shop drawings for installation and arrangement of work. Submit shop drawings as requested, specified, or otherwise required demonstrating proper planning for installation and arrangement of work to the satisfaction of the Engineer. Lay out drawings to scale and show dimensions where accuracy of location is necessary for coordination or communication purposes. Scale shall be appropriate to clearly show all aspects of installation and equipment arrangement. Show work of all trades, including Architectural, Structural, Mechanical, and Electrical items which are pertinent to proper and accurate coordination and conflict resolution.

B. In cases where one or more equipment items in a mechanical or electrical room or space differ in dimensions or configuration from Basis of Design equipment, the working drawing shall show the entire area. The drawing shall be dimensioned to indicate that required aisle ways and maintenance clearances are being maintained to at least the degree shown on the Contract Drawings.

C. Provide shop drawings for all products, systems, system components, and special supports that are not a standard catalog product and which may be fabricated for the Contractor or by the Contractor. In addition provide shop drawings for:
   1. Electrical and telecommunications rooms and spaces, including all equipment. Demonstrate all required clearances and working spaces are provided.
   2. Routing and interdisciplinary coordination of groups of conduits numbering more than one and over two inch trade size.
   3. Where noted on the drawings.
   4. Where noted in other Divisions 26, 27 and 28 sections.

D. Record Shop Drawings: Provide a copy of the final, corrected, approved shop drawings for the project, updated to show as-built conditions. Drawings shall indicate exact device locations and conduit and wire routing. Prepare drawings using the latest release of AutoCAD and deliver files to the Engineer. Refer to other specification sections for additional system specific requirements.

1.9 PERMITS, TESTS AND INSPECTIONS

A. Schedule, obtain, and pay for permits and fees required by local authorities and by these specifications.

B. Request for Tests: Notify the Engineer a minimum of 72 hours in advance of tests. In the event the Engineer does not witness the test, certify in writing that all specified tests have been made in accordance with the specifications.

C. Deficiencies: Immediately correct deficiencies that are evidenced during the tests and repeat tests until system is approved. Do not cover or conceal electrical installations until satisfactory tests are made and approved.

D. Operating Tests: Upon request from the Engineer, place the entire electrical installation and/or any portion thereof, in operation to demonstrate satisfactory operation.

1.10 IDENTIFICATION

A. Equipment Labels and Nameplates:
   1. Provide rigid engraved labels and nameplates of 1/16 inch thick laminated plastic.
      a. Label and Nameplate Colors:
         1) Normal Equipment: White letters on a black or gray background (engraved labels).
         2) Emergency Equipment: White letters on a red background.
      b. Securely attach labels with threaded fasteners or pop-rivets. (Adhesive attachment not acceptable.)
      c. Temporary markings not permitted on equipment. Repaint trims, housings, etc., where markings cannot be readily removed. Refinish defaced finishes.
      d. No labeling abbreviations will be permitted without prior approval.
   2. Include item designation and branch circuit designation (panel and circuit number) on disconnects, starters, equipment and device nameplates, e.g., “AHU-2, Circuit LA-30”).
   3. Label and Nameplate Locations:
      a. Provide 1 inch minimum height letters on following equipment:
         1) Service disconnect (red background).
      b. Provide 1/2 inch minimum height letters on following equipment:
         1) Secondary feeder breakers in distribution equipment. Designation as required by load served.
         2) Special equipment housed in cabinets, as designated on plans, on outside of door.

3) Panelboards, switchboards, motor control centers, as designated on plans, on outside of door.
4) Service equipment. Provide signage in accordance with NEC Article 110.24(A) indicating maximum available fault current and date of fault current calculation.

c. Provide 1/4-inch minimum height letters on:
1) Disconnects and starters for motors or fixed appliances.
2) Designated electrical equipment.

d. Provide 1/8-inch minimum height, adhesive labels on switches and receptacles where item controlled is not visible from the switch, or as noted on drawings.

e. External Power Sources: Provide 1/8-inch white letters on red background on all starters or controllers that receive power from an external source that is not de-energized by operating the associated disconnecting means.

B. Branch Circuit Panelboard Directories: Provide neatly typed schedule (odd numbered circuits on left side or top, even on right side or bottom) under plastic jacket or protective cover to protect the schedule from damage or dirt. Securely mount on inside face of panelboard door. Define briefly, but accurately, nature of connected load (i.e., Lighting Room 2989, Receptacles Janitor Room, Etc.) as approved. Sequentially numbered schedules shall not be used.

C. One-Line Diagram: Provide approved print for the "As-Built" distribution system. Mount behind protective cover (1/8-inch minimum thickness clear Plexiglas) in substantial frame, inaccessible location at main switchboard.

D. Empty Conduits: Provide tags with typed description of purpose, and location of opposite end, wired to each end of conduits provided for future equipment.

E. Conduits: Mark conduits entering or leaving panelboards with indelible black magic marker with the circuit numbers of the circuits contained inside. Identify Fire Alarm System conduits with red paint in accordance with Section 26 05 34 - Conduit and Fittings.

F. Junction Boxes: Mark the circuit numbers of wiring on junction boxes with sheet steel covers. Mark with indelible black marker. On exposed junction boxes in finished areas mark on inside of cover. Paint Fire Alarm System junction boxes with sheet steel covers red. Mark other Special System junction boxes with sheet steel covers with appropriate system designation, e.g., "Intercom", "Clock", "Telecom", etc. Mark with indelible black marker. On exposed junction boxes in finished areas mark on inside of cover.

G. Code Required Markings and Warnings: Provide placards, markings and identification systems required by Code and/or the Contract Documents, such as (but not limited to):
1. Arc Flash.
2. "Series Rated Systems".
3. Conductor insulation color identification.
4. Special conductor identification and legends.
5. Emergency systems markings.
6. Multiple services placards.

7. Emergency source grounded circuit conductor connected to a grounding electrode at a location remote from the emergency source: Provide a sign at the grounding location identifying all emergency and normal sources connected at that location.
8. Warning messages shall include an appropriate plain language imperative command, such as "DANGER HIGH VOLTAGE - KEEP OUT
9. Available Fault Current: Service equipment shall be legibly marked in the field with the maximum available fault current in accordance with NEC Article 110.24(A). The field marking(s) shall include the date the fault calculation was performed and shall be of sufficient durability to withstand the environment involved." Development of the actual fault current will be a joint effort between Contractor and Engineer. Final values will be provided by the Engineer, however field data may be requested from and provided by Contractor.
10. Where disconnecting means is not within sight of the transformer, provide signage in accordance with NEC Article 450.14 indicating location of remote disconnecting means.

1.11 CLEARANCE STRIPING

A. For electrical equipment located in areas with uncarpeted floors, the clearances dictated by NEC Article 110 shall be indicated by two inches wide colored striping on the floor.

B. Striping shall be of a bright color (typically red or yellow) that contrasts with the floor color, and shall be applied by the most durable process that is commercially available for the particular floor finish. Examples are: epoxy paint on concrete floors, and colored tile segments in composition tile floors. Striping color and method shall be subject to approval by the'Engineer.

C. Where practical, on the floor immediately inside the striping, stencil in two inch block letters the statement: "ELECTRICAL CLEARANCE -- STORAGE ILLEGAL INSIDE THIS ZONE." For floor types where painted stenciling is not feasible or sufficiently durable, this message shall instead be posted with a WALL PLACARD below the equipment of the type specified in this Section, with 1/2-inch lettering. Note the specific clearance requirements on the engraved label. Placard shall be of a size needed to provide the required information. Color shall be black letters and symbols on yellow background.

D. A placard placed at either end of a contiguous row of equipment is acceptable where floor marking is not feasible.

1.12 AS-BUILT DRAWINGS

A. Reference requirements stated elsewhere in these Specifications.

B. In addition to other requirements, mark up a clean set of drawings as the work progresses, to show the dimensioned location and routing of all electrical work which will become permanently concealed. Show routing and location of items cast in concrete or buried underground. Show routing of work in permanently concealed blind spaces within the building. Show complete routing and sizing of any significant revisions to the systems shown.

C. Maintain As-Built Drawings in an up-to-date fashion in conjunction with the actual progress of installation. Accurate progress mark-ups shall be available on-site for examination by the Engineer or his representative at all times.

D. Prepare wiring diagrams for individual special systems as installed. Identify components and show wire and terminal numbers and connections. Include diagrams from the shop drawings and submittals, updated to show as-built condition.

E. Contractor's red lines ("As-Builts"), shall be prepared in accordance with to the standard of care criteria as defined in this sub-section. The Engineer reserves the right to reject any or all such As-Built Drawings if, in our opinion, these criteria have not been met or if the work is not clear. Costs incurred as a result of the Contractor's failure to meet these criteria such as, but not limited to, resubmittals, meetings, site visits and written correspondence, shall be reimbursed by the Contractor as additional services. The acceptable standard of care includes the following:
   1. Full size As-Built Drawings shall be neatly marked-up by the Contractor to show actual installation conditions using the symbols, line types and abbreviations as shown in the contract document's legends and abbreviations. Red shall be used to show items to be added, green for items to be removed and blue for general clarification comments not to be drafted.
   2. Line work shall be drawn using a straight edge and all notes shall be neatly printed and legible. Leaders and sheet notes shall be used where necessary using a similar style to that shown throughout the Drawings.
   3. Under slab and otherwise inaccessible piping, ducting, and other components shall be accurately dimensioned to the nearest one-inch increment. Complete and submit As-Built Drawings that include inaccessible components, such as plumbing and heating piping and electrical conduit on underfloor plans involving slab on grade floor construction, for review prior to pouring of the slab.
   4. Where equipment is furnished having different dimensions then those shown, the Drawings shall be modified to show the dimensions of the equipment provided.
   5. Where equipment is shown in more than one drawing location, (i.e., plan and section), revised equipment arrangement shall be shown in all drawing locations.

F. At completion of project, deliver the As-Built Drawings to the Engineer and obtain written receipt.

1.13 OPERATING INSTRUCTIONS

A. Prior to final acceptance, instruct an authorized representative of the Owner for eight hours on the proper operation and maintenance of electrical systems and equipment provided under this contract. This requirement is for several systems, and is in addition to special training specified in other sections. Make available a qualified technician for each component of the installation for this instruction. Give these operating instructions after the operation and maintenance manuals have been furnished to the Owner. Submit written certification, signed by the Contractor and an authorized representative of the Owner, that this has been completed.

1.14 OPERATION AND MAINTENANCE MANUALS

A. Provide Operation and Maintenance Manuals in the manner described elsewhere in these specifications. In addition, organize manual and include data and narrative as noted below.
   1. Final Manuals shall be provided not later than one week prior to requesting inspection for Substantial Completion.
   2. Submit all 8-1/2 by 11 inch literature and equipment data in hard-back, three-ring, loose leaf binders by individual sets. Cardboard or paper binders are unacceptable.
   3. Provide electronic format (Adobe PDF) files for Operation and Maintenance Manuals.

B. Provide a separate chapter for each section of the electrical specifications with sub-chapters for each class of equipment or system. Provide a table of contents for each chapter, and each major item in each chapter, to indicate the page number of each. Provide a summary of product warranty terms and duration for each piece of equipment. Label all pages to assure correct placement in manual. Identify each piece of equipment with its associated specification description.

C. Operating Sequence Narrative:
   1. In each chapter, describe the procedures necessary for personnel to operate the system and equipment covered in that chapter.
   2. Describe procedures for start-up, operation, emergency operation, and shutdown of each system. If a particular sequence is required, give step-by-step instructions in that order.
   3. Describe all seasonal adjustments that should be accomplished for each system.
   4. Provide the above descriptions in typewritten, simple outline, narrative form.

D. Maintenance Instructions:
   1. Provide complete information for preventive maintenance for each product, including recommended frequency of performance for each preventive maintenance task.
   2. Provide instructions for minor repair or adjustments required for preventive maintenance routines, limited to repairs and adjustments that may be performed without special tools or test equipment and which require no extensive special training or skills.
   3. Provide information of a maintenance nature covering warranty items, etc., that are not discussed in the manufacturers literature or the operating sequence narrative.
   4. Provide complete information data for spare and replacement parts for each product and system. Properly identify each part by part number and manufacturer.

E. Manufacturers' Brochures: Include manufacturers' descriptive literature covering products used in each system, together with illustrations, exploded views and renewal parts lists. Highlight all applicable items and instructions, or mark-out non-applicable items.

F. Shop Drawings: Provide a copy of corrected, approved shop drawings for the project, updated to show as-built condition, either with the manufacturers' brochures or properly identified in a separate subsection.

G. Operation and Maintenance Manuals shall be fully corrected to include review comments prior to final submission to the Owner.

1.15 PROJECT COMPLETION AND DEMONSTRATION

A. Tests: During final inspection, conduct operating tests for approval. Demonstrate installation to operate satisfactorily in accordance with requirements of Contract Documents. Should any portion of installation fail to meet requirements of Contract Documents, repair or replace items failing to meet requirements until items can be demonstrated to comply. Have instruments available for measuring light intensities, voltage, and current values and for the demonstration of continuity, grounds, or open circuit conditions. Furnish personnel to assist in taking measurements and making tests. In the event that systems are not complete and fully operational at the time of final inspection, all costs of any subsequent inspections shall be borne by the Contractor at no additional cost to the Owner.

B. Certificate of Completion: Submit at time of request for final inspection, a complete letter in the following format:

I, (Name), of (Firm), certify that the electrical work is complete in accordance with Contract Plans and Specifications, and authorized change orders (copies of which are attached hereto) and will be ready for final inspection as of (Date). I further certify that the following Specifications requirements have been fulfilled:

1. Megger readings performed, copies of logs attached.
2. Operating manuals completed and instruction of operating personnel performed, (Date) (Signed)Owner's Representative
3. Record document drawings up-to-date, accurate, and ready to deliver to Engineer.
4. Emergency systems tested and fully operational.
5. Alarm System tested and fully operational.
6. Other tests required by Specifications have been performed.
7. Specified Owner training complete.
8. Systems are fully operational. Project is ready for final inspection.
   SIGNED: DATE:
   TITLE:

1.16 WARRANTY

A. Warranty work shall be promptly coordinated and performed at the Contractor's sole expense. Workmanship, labor and materials (without limitation) in this Division shall be warranted for the longer of the following:

1. As called for in the General Conditions of the Contract.
2. For a minimum period of one year from the date of final acceptance.
3. For the extended warranty period specified in a specific Section under this Division.

B. Where a specific product carries a longer warranty as a standard offering of its manufacturer, extended warranty coverage beyond these requirements shall be retained by the Owner. The Owner will have recourse back to the manufacturer only in these cases, when the warranty as specified in A. above has expired.

PART 2 - PRODUCTS

2.1 GENERAL

A. Electrical Material have been called out on the plans and unless specifically noted are all considered to be candidates for OR EQUAL substitution.

2.2 NAMEPLATES

A. Product Description: Engraved three-layer laminated plastic nameplate, black letters on white background.

2.3 WALL PLACARDS

A. Product Description:
   1. 0.080” Aluminum
   2. Single sided
   3. Minimum size: 12”x18”

2.4 WIRE MARKERS

A. Product Description: split sleeve, or tubing type wire markers with circuit or control wire number permanently stamped or printed.

PART 3 - EXECUTION – NOT USED

END OF SECTION

DIVISION 26 ELECTRICAL

SECTION 26 05 03
EQUIPMENT WIRING CONNECTIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes electrical connections to equipment.

B. Related Sections:
   1. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
   2. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
   3. Section 26 00 00 - Electrical Methods and Materials

1.2 REFERENCES

A. National Electrical Manufacturers Association:
   1. NEMA WD 1 - General Requirements for Wiring Devices.
   2. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

1.3 SUBMITTALS

A. Section 26 00 00 - Electrical Methods and Materials

B. Product Data: Submit wiring device manufacturer’s catalog information showing dimensions, configurations, and construction.

C. Manufacturer's installation instructions.

1.4 CLOSEOUT SUBMITTALS

A. Section 26 00 00 - Electrical Methods and Materials

B. Project Record Documents: Record actual locations, sizes, and configurations of equipment connections.

1.5 COORDINATION

A. Section 26 00 00 - Electrical Methods and Materials

B. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.

C. Determine connection locations and requirements.

D. Sequence rough-in of electrical connections to coordinate with installation of equipment.

E. Sequence electrical connections to coordinate with start-up of equipment.

PART 2 - PRODUCTS

2.1 CORD AND PLUGS

A. Manufacturers:
1. Leviton Manufacturing Co., Inc.
2. Pass & Seymour/Legrand (Pass & Seymour).
3. Square D; by Schneider Electric.
4. Hubbell / Kellems Inc.
5. Substitutions: Section 26 00 00 Electrical Materials and Methods.

B. Attachment Plug Construction: Conform to NEMA WD 1.

C. Configuration: NEMA WD 6; match receptacle configuration at outlet furnished for equipment.

D. Cord Construction: Type SOWA multiconductor flexible cords with identified equipment grounding conductor, suitable for use in Arctic locations.

E. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 26 00 00 - Electrical Methods and Materials

B. Verify equipment is ready for electrical connection, for wiring, and to be energized.

3.2 EXISTING WORK

A. Remove exposed abandoned equipment wiring connections.

B. Disconnect abandoned utilization equipment and remove wiring connections. Remove abandoned components when connected raceway is abandoned and removed. Install blank cover for abandoned boxes and enclosures not removed.

C. Extend existing equipment connections using materials and methods compatible with existing electrical installations, or as specified.

3.3 INSTALLATION

A. Make electrical connections.

B. Make conduit connections to equipment using flexible conduit. Use Liquidtight flexible conduit with watertight connectors in damp or wet locations.

C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.

D. Install receptacle outlet to accommodate connection with attachment plug.

E. Install cord and cap for field-supplied attachment plug.

F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.

H. Install terminal block jumpers to complete equipment wiring requirements.

I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

J. Whether shown on the plans or not, provide a Duplex receptacle, GFCI type in a weatherproof enclosure with locking cover that can be closed while in use and conductors and conduit and 15A circuit breaker from nearest 120V source. Locate within 25’ of the electrical service.

3.4 ADJUSTING

A. Section 26 00 00 - Electrical Methods and Materials

B. Cooperate with utilization equipment installers and field service personnel during checkout and starting of equipment to allow testing and balancing and other startup operations. Provide personnel to operate electrical system and checkout wiring connection components and configurations.

END OF SECTION

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes building wire and cable; nonmetallic-sheathed cable; direct burial cable; service entrance cable; armored cable; metal clad cable; and wiring connectors and connections.

B. Related Sections:
   1. Section 26 05 53 - Identification for Electrical Systems: Product requirements for wire identification.
   2. Section 31 23 17 - Trenching: Execution requirements for trenching required by this section.

1.2 REFERENCES

A. International Electrical Testing Association:
   1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

B. National Fire Protection Association:
   1. NFPA 70 - National Electrical Code.
   2. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

C. Underwriters Laboratories, Inc.:
   1. UL 1277 - Standard for Safety for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.

1.3 SYSTEM DESCRIPTION

A. Product Requirements: Provide products as follows:
   1. Solid or Stranded 600V rated conductor for feeders and branch circuits 10 AWG and smaller.
   2. Stranded conductors for control circuits.
   3. Conductor not smaller than 12 AWG for power and lighting circuits.
   4. Conductor not smaller than 16 AWG for control circuits.
   5. Increase wire size in branch circuits to limit voltage drop to a maximum of 3 percent.

B. Wiring Methods: Provide the following wiring methods:
   1. Concealed Dry Interior Locations: Use only building wire, Type THHN/THWN or XHHW insulation, in raceway.

2. Exposed Dry Interior Locations: Use only building wire, Type THHN/THWN or XHHW insulation, in raceway.
3. Above Accessible Ceilings: Use only building wire, Type THHN/THWN o XHHW insulation, in raceway.
4. Wet or Damp Interior Locations: Use only building wire, Type XHHW-2 insulation, in raceway.
5. Exterior Locations: Use only building wire, Type XHHW-2 insulation, in raceway.
6. Underground Locations: Use only building wire, Type XHHW insulation, in raceway.

1.4 SUBMITTALS

A. Section 26 00 00 - Electrical Methods and Materials.

B. Product Data: Submit for building wire and each cable assembly type.

C. Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors.

D. Test Reports: Indicate procedures and values obtained.

1.5 CLOSEOUT SUBMITTALS

A. Section 26 00 00 - Electrical Methods and Materials

B. Project Record Documents: Record actual locations of components and circuits.

1.6 QUALITY ASSURANCE

A. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet (1.5 m) when tested in accordance with NFPA 262.

B. Perform Work in accordance with NEC.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.

1.8 FIELD MEASUREMENTS

A. Verify field measurements are as indicated on Drawings.

1.9 COORDINATION

A. Section 26 00 00 - Electrical Methods and Materials

B. Where wire and cable destination is indicated and routing is not shown, determine routing and lengths required.

C. Wire and cable routing indicated is approximate unless dimensioned.

PART 2 - PRODUCTS

2.1 BUILDING WIRE

A. Manufacturers:
   1. Aetna Insulated Wire, Inc.
   2. General Cable; General Cable Corporation.
   3. Southwire Company.
   4. Substitutions: Section 26 00 00 - Electrical Methods and Materials

B. Product Description: Single conductor insulated wire.

C. Conductor: Copper.

D. Insulation Voltage Rating: 600 volts.

E. Insulation Temperature Rating: 90 degrees C.

F. Insulation THHN/THHWN , XHHW-2

2.2 WIRING CONNECTORS

A. Manufacturers; Split Bolt Connectors:
   1. Burndy; Part of Hubbell Electrical Systems.
   2. ILSCO.
   3. Thomas & Betts Corporation; a member of the ABB Group.
   4. Substitutions: Section 26 00 00 - Electrical Methods and Materials
   5. Manufacturers; Solderless Pressure Connectors:
   6. Burndy; Part of Hubbell Electrical Systems.
   7. ILSCO.
   8. Thomas & Betts Corporation; a member of the ABB Group.
   9. Substitutions: Section 26 00 00 - Electrical Methods and Materials

B. Manufacturers; Spring Wire Connectors:
   1. 3M.

2. NELCO, Inc.
3. Substitutions: Section 26 00 00 - Electrical Methods and Materials

C. Manufacturers; Compression Connectors:
1. 3M.
2. NELCO, Inc.
3. Substitutions: Section 26 00 00 - Electrical Methods and Materials

2.3 TERMINATIONS

A. Terminal Lugs for Wires 6 AWG and Smaller: Solderless, compression type copper.

B. Lugs for Wires 4 AWG and Larger: Color keyed, compression type copper, with insulating sealing collars.

2.4 CABLES

A. Manufacturers
1. USA WIRE
2. Okonte
3. Southwire
4. Substitutions allowed per Section

B. Type MC-HL
1. Conductors: Uncoated soft copper per ASTM B-3.
a. Sizes smaller than #8 are compress stranded per ASTM B-8.
b. Sizes #8 and larger are compact stranded per ASTM B-496.
2. Insulation:
a. X-Olene per ICEA S-95-658/ NEMA WC70 and UL 44,
b. Listed UL 600V Type XHHW-2.
c. Meets MIL-DTL-1377H, section 4.8.4.1.2 cold bend at -66°C and ASTM D746 brittle point at -76°C.
3. Conductor Identification:
a. Control Sizes, #9 AWG and smaller, color coded insulation.
b. Power Sizes, #8 AWG and larger, black with printed words of number and color.
4. Grounding Conductor(s): One or three bare soft copper per ASTM B-3. Stranded in accordance with UL 1581. Meets or exceeds requirements of NEC Table 250.122.
5. Sheath: Close fitting, impervious, continuous, welded, corrugated aluminum C-L-X per UL 1569. Exceeds grounding conductor requirements of NEC Table 250.122.
6. Jacket: Black Okoseal (PVC) per UL1569. Meets ASTM D746 brittle point at -40°C.
7. UL Listed as
a. Type MC-HL cable per E38916 UL
b. Listed for cable tray use, direct burial and sunlight resistant.

8. Provide with fittings Listed for use with MC-HL cable.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 26 00 00 - Electrical Methods and Materials

B. Verify interior of building has been protected from weather.

C. Verify mechanical work likely to damage wire and cable has been completed.

D. Verify raceway installation is complete and supported.

3.2 PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

3.3 EXISTING WORK

A. Remove exposed abandoned wire and cable, including abandoned wire and cable above accessible ceiling finishes. Patch surfaces where removed cables pass through building finishes.

B. Disconnect abandoned circuits and remove circuit wire and cable. Remove abandoned boxes when wire and cable servicing boxes is abandoned and removed. Install blank cover for abandoned boxes not removed.

C. Provide access to existing wiring connections remaining active and requiring access. Modify installation or install access panel.

D. Extend existing circuits using materials and methods compatible with existing electrical installations, or as specified, whichever is more stringent ore when required to meet code.

E. Clean and repair existing wire and cable remaining or wire and cable to be reinstalled.

3.4 INSTALLATION

A. Route wire and cable to meet Project conditions.

B. Neatly train and lace wiring inside boxes, equipment, and panelboards.

C. Identify and color code wire and cable under provisions of Section 26 05 53. Identify each conductor with its circuit number or other designation indicated.

D. Special Techniques--Building Wire in Raceway:
   1. Pull conductors into raceway at same time.
   2. Install building wire 4 AWG and larger with pulling equipment.

E. Special Techniques - Cable:
   1. Protect exposed cable from damage.
   2. Support cables above accessible ceiling, using spring metal clips or metal cable ties to support cables from structure. Do not rest cable on ceiling panels.
   3. Use suitable cable fittings and connectors.

F. Special Techniques - Wiring Connections:
   1. Clean conductor surfaces before installing lugs and connectors.
   2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
   3. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.
   4. Install split bolt connectors for copper conductor splices and taps, 6 AWG and larger.
   5. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
   6. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

G. Install stranded conductors for branch circuits 10 AWG and smaller. Install crimp on fork terminals for device terminations. Do not place bare stranded conductors directly under screws.

H. Install terminal lugs on ends of 600 volt wires unless lugs are furnished on connected device, such as circuit breakers.

I. Size lugs in accordance with manufacturer's recommendations terminating wire sizes. Install 2-hole type lugs to connect wires 4 AWG and larger to copper bus bars.

J. For terminal lugs fastened together such as on motors, transformers, and other apparatus, or when space between studs is small enough that lugs can turn and touch each other, insulate for dielectric strength of 2-1/2 times normal potential of circuit.

3.5 WIRE COLOR

A. General:
   1. For wire sizes 10 AWG and smaller, install wire colors in accordance with the following:
      a. Black and red for single phase circuits at 120/240 volts.
      b. Black, red, and blue for circuits at 120/208 volts single or three phase.
      c. Orange, brown, and yellow for circuits at 277/480 volts single or three phase.

2. For wire sizes 8 AWG and larger, identify wire with colored tape at terminals, splices and boxes. Colors are as follows:
   a. Black and red for single phase circuits at 120/240 volts.
   b. Black, red, and blue for circuits at 120/208 volts single or three phase.
   c. Orange, brown, and yellow for circuits at 277/480 volts single or three phase.

B. Neutral Conductors: White. When two or more neutrals are located in one conduit, individually identify each with proper circuit number. White or Gray where there are two separate voltage systems. Add alternating stripe if three of four systems present. Intent is to provide unique neutral for each

C. Branch Circuit Conductors: Install three or four wire home runs with each phase uniquely color coded.

D. Feeder Circuit Conductors: Uniquely color code each phase.

E. Ground Conductors:
   1. For 6 AWG and smaller: Green.
   2. For 4 AWG and larger: Identify with green tape at both ends and visible points including junction boxes.

3.6 FIELD QUALITY CONTROL

A. Section 26 00 00 - Electrical Methods and Materials

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.3.1.

END OF SECTION

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Rod electrodes.
   2. Active electrodes.
   3. Wire.
   4. Grounding well components.
   5. Mechanical connectors.
   6. Exothermic connections.

B. Related Sections:
   1. Section 03 20 00 - Concrete Reinforcing: Bonding or welding bars when reinforcing steel is used for electrodes.

1.2 REFERENCES

A. Institute of Electrical and Electronics Engineers:
   1. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
   2. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment.

B. International Electrical Testing Association:
   1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

C. National Fire Protection Association:
   1. NFPA 70 - National Electrical Code.
   2. NFPA 99 - Standard for Health Care Facilities.

1.3 SYSTEM DESCRIPTION

A. Existing grounding systems use the following elements as grounding electrodes:
   1. Metal building frame.
   2. Rod electrode.

1.4 SCOPE

A. Provide new grounding system for the new intake structure.

1.5 PERFORMANCE REQUIREMENTS

A. Grounding System Resistance: 5 ohms maximum.

1.6 SUBMITTALS

A. Section 26 00 00 - Electrical Methods and Materials.

B. Product Data: Submit data on grounding electrodes and connections.

C. Manufacturer's Installation Instructions: Submit for active electrodes.

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

1.7 CLOSEOUT SUBMITTALS

A. Section 26 00 00 - Electrical Methods and Materials

B. Project Record Documents: Record actual locations of components and grounding electrodes.

1.8 QUALITY ASSURANCE

A. Provide grounding materials conforming to requirements of NEC, IEEE 142, and UL labeled.

B. Perform Work in accordance with NEC.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 26 00 00 - Electrical Methods and Materials

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

C. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

D. Do not deliver items to project before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

1.10 COORDINATION

A. Section 26 00 00 - Electrical Methods and Materials

B. Complete grounding and bonding of building reinforcing steel prior concrete placement.

PART 2 - PRODUCTS

2.1 ROD ELECTRODES

A. Manufacturers:
   1. ERICO International Corporation.
   2. Harger Lightning & Grounding.

B. Substitutions: Section 26 00 00 - Electrical Methods and Materials

C. Product Description:
   1. Material: Copper-clad steel.
   2. Diameter: 3/4 inch.
   3. Length: 10 feet.

D. Connector: Connector for exothermic welded connection.

2.2 WIRE

A. Material: Stranded copper.

B. Foundation Electrodes: 4 AWG.

C. Grounding Electrode Conductor: Copper conductor insulated.

D. Bonding Conductor: Copper conductor insulated.

2.3 MECHANICAL CONNECTORS

A. Manufacturers:
   1. Burndy; Part of Hubbell Electrical Systems.
   2. ERICO International Corporation.
   3. ILSCO
   4. Substitutions: Section 26 00 00 - Electrical Methods and Materials

B. Description: Bronze connectors, suitable for grounding and bonding applications, in configurations required for particular installation.

2.4 EXOTHERMIC CONNECTIONS

A. Manufacturers:
   1. Burndy; Part of Hubbell Electrical Systems.
   2. ERICO International Corporation.
   3. ILSCO
   4. Substitutions: Section 26 00 00 - Electrical Methods and Materials

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 26 00 00 - Electrical Methods and Materials

B. Verify final backfill and compaction has been completed before driving rod electrodes.

3.2 PREPARATION

A. Remove paint, rust, mill oils, surface contaminants at connection points.

3.3 EXISTING WORK

A. Modify existing grounding system to maintain continuity to accommodate renovations.

B. Extend existing grounding system using materials and methods as specified.

3.4 INSTALLATION

A. Install in accordance with IEEE 142 for power and IEEE 1100 for instrumentation.

B. Install grounding and bonding conductors concealed from view.

C. Bond together metal siding not attached to grounded structure; bond to ground.

D. Bond together each metallic raceway, pipe, duct and other metal object entering non-metallic enclosures.

E. Install isolated grounding conductor for circuits supplying Instrumentation in accordance with IEEE 1100.

F. Equipment Grounding Conductor: Install separate, green insulated copper conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing. Size per largest circuit contained in raceway unless larger size indicated on plans.

G. Connect to building grounding system.

H. Permanently ground entire light and power system in accordance with NEC, including service equipment, distribution panels, lighting panelboards, switch and starter enclosures, motor frames, grounding type receptacles, and other exposed non-current carrying metal parts of electrical equipment.

I. Accomplish grounding of electrical system by using insulated grounding conductor installed with feeders and branch circuit conductors in conduits. Size grounding conductors in accordance with NEC. Install from grounding bus of serving panel to ground bus of served panel, grounding screw of receptacles, lighting fixture housing, light switch outlet boxes or metal enclosures of service equipment. Ground conduits by means of grounding bushings on terminations at panelboards with installed number 12 conductor to grounding bus.

J. Grounding electrical system using continuous metal raceway system enclosing circuit conductors in accordance with NEC.

K. Permanently attach equipment and grounding conductors prior to energizing equipment.

3.5 FIELD QUALITY CONTROL

A. Section 26 00 00 - Electrical Methods and Materials

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Grounding and Bonding: Perform inspections and tests listed in NETA ATS, Section 7.13.

D. Perform ground resistance testing in accordance with IEEE 142.

E. Perform leakage current tests in accordance with NFPA 99.

F. Perform continuity testing in accordance with IEEE 142.

G. When improper grounding is found on receptacles, check receptacles in entire project and correct. Perform retest.

END OF SECTION

SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Conduit supports.
   2. Formed steel channel.
   3. Spring steel clips.
   4. Sleeves.
   5. Mechanical sleeve seals.

1.2 REFERENCES

A. ASTM International:
   1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
   2. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
   3. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
   4. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.

B. FM Global:
   1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.

C. National Fire Protection Association:
   1. NFPA 70 - National Electrical Code.

D. Underwriters Laboratories Inc.:
   1. UL 263 - Fire Tests of Building Construction and Materials.
   2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
   3. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
   4. UL - Fire Resistance Directory.

1.3 SUBMITTALS

A. Section 26 00 00 - Electrical Methods and Materials.

B. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.

C. Product Data:

1. Hangers and Supports: Submit manufacturers catalog data including load capacity.

D. Design Data: Indicate load carrying capacity of trapeze hangers and hangers and supports.

E. Manufacturer's Installation Instructions:
   1. Hangers and Supports: Submit special procedures and assembly of components.

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

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years' experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

C. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

PART 2 - PRODUCTS

2.1 CONDUIT SUPPORTS

A. Manufacturers:
   1. Adalet.
   2. Carlon Electrical Products.
   3. ERICO International Corporation.
   4. Minerallac Company.
   5. MIRO Industries, Inc.
   6. Thomas & Betts Corporation; a member of the ABB Group.
   7. Unistrut; an Atkore International company.

B. Substitutions: Section 26 00 00 - Electrical Methods and Materials

C. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.

D. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.

E. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.

F. Conduit clamps - general purpose: One hole, 2-piece malleable iron for surface mounted conduits.

G. Cable Ties: High strength nylon temperature rated to 185 degrees F. Self locking.

2.2 FORMED STEEL CHANNEL

A. Manufacturers:
   1. Carlon Electrical Products.
   2. ERICO International Corporation.
   3. Thomas & Betts Corporation; a member of the ABB Group.
   4. Unistrut; an Atkore International company.
   5. Substitutions: Section 26 00 00 - Electrical Methods and Materials

B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.3 SPRING STEEL CLIPS

A. Manufacturers:
   1. Adalet.
   2. ERICO International Corporation.
   3. Thomas & Betts Corporation; a member of the ABB Group.
   4. Substitutions: Section 26 00 00 - Electrical Methods and Materials

B. Product Description: Mounting hole and screw closure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 26 00 00 - Electrical Methods and Materials

B. Verify openings are ready to receive sleeves.

3.2 PREPARATION

A. Obtain permission from Architect/Engineer before using powder-actuated anchors.

B. Do not drill or cut structural members.

3.3 INSTALLATION - HANGERS AND SUPPORTS

A. Anchors and Fasteners:
   1. Concrete Structural Elements: Provide expansion anchors, powder actuated anchors.
   2. Steel Structural Elements: Provide beam clamps, spring steel clips, steel ramset fasteners, and welded fasteners.
   3. Concrete Surfaces: Provide self-drilling anchors and expansion anchors.
   4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Provide toggle bolts and hollow wall fasteners.
   5. Solid Masonry Walls: Provide expansion anchors and preset inserts.
   6. Sheet Metal: Provide sheet metal screws.
   7. Wood Elements: Provide wood screws.

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

C. Install conduit and raceway support and spacing in accordance with NEC.

D. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.

E. Install multiple conduit runs on common hangers.

F. Supports:
   1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
   2. Install surface mounted cabinets and panelboards with minimum of four anchors.
   3. In wet and damp locations install steel channel supports to stand cabinets and panelboards 1 inch off wall.
   4. Support vertical conduit at every floor.

3.4 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

A. Construct supports of formed steel channel. Brace and fasten with flanges bolted to structure.

B. Provide floor supports for wall mounted equipment weighing over 50LB.

3.5 INSTALLATION - SLEEVES

A. Exterior watertight entries: Seal with adjustable interlocking rubber links.

B. Conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.

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

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

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

F. Where conduit or raceway penetrates floor, ceiling, or wall, close off space between conduit or raceway and adjacent work with stuffing insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

G. Install stainless steel escutcheons at finished surfaces.

3.6 FIELD QUALITY CONTROL

A. Section 26 00 00 - Electrical Methods and Materials

3.7 CLEANING

A. Section 26 00 00 - Electrical Methods and Materials

3.8 PROTECTION OF FINISHED WORK

A. Section 26 00 00 - Electrical Methods and Materials

B. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 26 05 33
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes conduit and tubing, surface raceways, wireways, outlet boxes, pull and junction boxes, and handholes.

B. Related Sections:
1. Section 26 05 03 - Equipment Wiring Connections.
2. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
3. Section 26 05 29 - Hangers and Supports for Electrical Systems.
4. Section 26 05 53 - Identification for Electrical Systems.
5. Section 26 27 16 - Electrical Cabinets and Enclosures.

1.2 REFERENCES

A. American National Standards Institute:
1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
2. ANSI C80.3 - Specification for Electrical Metallic Tubing, Zinc Coated.
3. ANSI C80.5 - Aluminum Rigid Conduit - (ARC).

B. National Electrical Manufacturers Association:
1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
2. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
3. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
4. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
5. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
6. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
7. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.3 SYSTEM DESCRIPTION

A. Raceway and boxes located as indicated on Drawings, and at other locations as required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway and boxes to complete wiring system.

B. Underground More than 5 feet outside Foundation Wall: Provide plastic coated rigid steel conduit. Provide cast metal boxes or nonmetallic handhole.

C. Underground Within 5 feet from Foundation Wall: Provide plastic coated conduit. Provide cast metal or nonmetallic boxes.

D. In or Under Slab on Grade: Provide rigid steel conduit, intermediate metal conduit. Provide cast or metal boxes.

E. Outdoor Locations, Above Grade: Provide plastic coated rigid steel conduit. Provide cast metal outlet, pull, and junction boxes.

F. In Slab Above Grade: Provide rigid steel conduit , intermediate metal conduit. Provide cast boxes.

G. Wet and Damp Locations: Provide rigid steel conduit, intermediate metal conduit, electrical metallic tubing where allowed by code. Provide cast metal or nonmetallic outlet, junction, and pull boxes. Provide flush mounting outlet box in finished areas.

H. Concealed Dry Locations: Provide electrical metallic tubing. Provide sheet-metal boxes with access. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.

I. Exposed Dry Locations: Provide electrical metallic tubing. Provide sheet-metal boxes. Provide hinged enclosure for large pull boxes.

1.4 DESIGN REQUIREMENTS

A. Minimum Raceway Size: 1/2 inch unless otherwise specified.

1.5 SUBMITTALS

A. Section 26 00 00 - Electrical Methods and Materials.

B. Product Data: Submit for the following:
1. Flexible metal conduit.
2. Liquidtight flexible metal conduit.
3. Nonmetallic conduit.
4. Flexible nonmetallic conduit.
5. Nonmetallic tubing.
6. Raceway fittings.
7. Conduit bodies.
8. Surface raceway.
9. Wireway.
10. Pull and junction boxes.
11. Handholes.

C. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.6 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents:
   1. Record actual routing of conduits larger than 2 inch.
   2. Record actual locations and mounting heights of outlet, pull, and junction boxes.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 26 00 00 - Electrical Methods and Materials.

B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

C. Protect PVC conduit from sunlight.

1.8 COORDINATION

A. Section 26 00 00 - Electrical Methods and Materials

B. Coordinate installation of outlet boxes for equipment connected under Section 26 05 03.

C. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes.

PART 2 - PRODUCTS

2.1 METAL CONDUIT

A. Manufacturers:
   1. Allied Tube & Conduit.
   2. EGS/Appleton Electric.
   3. Republic Conduit.
   4. Thomas & Betts Corporation; a member of the ABB Group.
   5. Western Tube and Conduit Corporation.

6. Wheatland Tube Company.
7. Substitutions: Section 26 00 00 - Electrical Methods and Materials.

B. Rigid Steel Conduit: ANSI C80.1.

C. Rigid Aluminum Conduit: ANSI C80.5.

D. Intermediate Metal Conduit (IMC): Rigid steel.

E. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit.

2.2 PVC COATED METAL CONDUIT

A. Manufacturers:
1. Robroy Industries.
2. Thomas & Betts Corporation; a member of the ABB Group.
3. Substitutions: Section 26 00 00 - Electrical Methods and Materials.

B. Product Description: NEMA RN 1; rigid steel conduit with external PVC coating, 20 mil thick.

C. Fittings and Conduit Bodies: NEMA FB 1; steel fittings with external PVC coating to match conduit.

2.3 FLEXIBLE METAL CONDUIT

A. Manufacturers:
1. AFC Cable Systems, Inc.
2. EGS/Appleton Electric.
3. Southwire Company.
4. Substitutions: Section 26 00 00 - Electrical Methods and Materials.

B. Product Description: Interlocked aluminum construction.

C. Fittings: NEMA FB 1.

2.4 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

A. Manufacturers:
1. Anamet Electrical, Inc.
2. Carlon Electrical Products.
3. EGS/Appleton Electric.
4. Southwire Company
5. Substitutions: Section 26 00 00 - Electrical Methods and Materials.

B. Product Description: Interlocked aluminum construction with PVC jacket.

C. Fittings: NEMA FB 1.

2.5 ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:
   1. Carlon Electrical Products.
   2. Emerson Process Management.
   3. Republic Conduit.
   4. Western Tube and Conduit Corporation.
   5. Wheatland Tube Company..
   6. Substitutions: Section 26 00 00 - Electrical Methods and Materials.

B. Product Description: ANSI C80.3; galvanized tubing.

C. Fittings and Conduit Bodies: NEMA FB 1; steel or malleable iron, compression type.

D. Set screw or indenter type fittings and conduit bodies not permitted.

2.6 NONMETALLIC CONDUIT

A. Manufacturers:
   1. Carlon Electrical Products.
   2. EGS/Appleton Electric.
   3. Hubbell Premise Wiring..
   4. Substitutions: Section 26 00 00 - Electrical Methods and Materials.

B. Product Description: NEMA TC 2; Schedule 40 or 80 PVC as indicated on plans. If not indicated than SCH 80 is to be used.

C. Fittings and Conduit Bodies: NEMA TC 3.

2.7 NONMETALLIC TUBING

A. Manufacturers:
   1. Carlon Electrical Products.
   2. Hubbell Premise Wiring.
   3. Substitutions: Section 26 00 00 - Electrical Methods and Materials.

B. Product Description: NEMA TC 2.

C. Fittings and Conduit Bodies: NEMA TC 3.

2.8 SURFACE METAL RACEWAY –NOT USED

2.9 SURFACE NONMETAL RACEWAY - NOT USED

2.10 WIREWAY

A. Manufacturers:
   1. Carlon Electrical Products.
   2. Cooper B-Line, Inc.; a division of Cooper Industries.
   3. Hammond Mfg. Co. Inc.
   4. Hoffman; a brand of Pentair Equipment Protection.
   5. Panduit Corp.
   6. Square D; by Schneider Electric.
   7. Wiremold / Legrand..
   8. Substitutions: Section 26 00 00 - Electrical Methods and Materials

B. Product Description: Oiltight and dust-tight type wireway.

C. Knockouts: Manufacturer's standard.

D. Size and length as indicated on Drawings. If not shown, provide 6x6 wireway, length as required.

E. Cover: Hinged cover with full gaskets.

F. Connector: Flanged.

G. Fittings: Lay-in type with removable top, bottom, and side; captive screws.

H. Finish: Rust inhibiting primer coating with gray enamel finish.

2.11 OUTLET BOXES

A. Manufacturers:
   1. Allied Moulded Products, Inc.
   2. Carlon Electrical Products.
   3. Emerson Electric Co.
   4. RACO; Hubbell..
   5. Substitutions: Section 26 00 00 - Electrical Methods and Materials.

B. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.

1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch male fixture studs where required.
2. Concrete Ceiling Boxes: Concrete type.

C. Nonmetallic Outlet Boxes: NEMA OS 2.

D. Cast Boxes: NEMA FB 1, Type FD, cast feralloy. Furnish gasketed cover by box manufacturer. Furnish threaded hubs.

E. Wall Plates for Finished Areas: As specified in Section 26 27 26.

F. Wall Plates for Unfinished Areas: Furnish gasketed cover.

2.12 PULL AND JUNCTION BOXES

A. Manufacturers:
1. Emerson Process Management.
2. Hoffman; a brand of Pentair Equipment Protection.
3. Kraloy.
4. RACO; Hubbell..
5. Substitutions: Section 26 00 00 - Electrical Methods and Materials.

B. Sheet Metal Boxes: NEMA OS 1, galvanized steel.

C. Hinged Enclosures: As specified in Section 26 27 16.

D. Surface Mounted Cast Metal Box: NEMA 250, Type 4X; flat-flanged, surface mounted junction box:
1. Material: Galvanized cast iron.
2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

E. Fiberglass Concrete composite Handholes: Die-molded, glass-fiber concrete composite hand holes:
1. Cable Entrance: Pre-cut 6 inch x 6 inch cable entrance at center bottom of each side.
2. Cover: Glass-fiber concrete composite, weatherproof cover with nonskid finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 26 00 00 - Electrical Methods and Materials.

B. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

3.2 EXISTING WORK

A. Remove exposed abandoned raceway. Cut raceway flush with walls and floors, and patch surfaces.

B. Remove concealed abandoned raceway to its source.

C. Disconnect abandoned outlets and remove devices. Remove abandoned outlets when raceway is abandoned and removed. Install blank cover for abandoned outlets not removed.

D. Maintain access to existing boxes and other installations remaining active and requiring access. Modify installation or provide access panel.

E. Extend existing raceway and box installations using materials and methods as specified.

F. Clean and repair existing raceway and boxes to remain or to be reinstalled.

3.3 INSTALLATION

A. Ground and bond raceway and boxes in accordance with Section 26 05 26.

B. Fasten raceway and box supports to structure and finishes in accordance with Section 26 05 29.

C. Identify raceway and boxes in accordance with Section 26 05 53.

D. Arrange raceway and boxes to maintain headroom and present neat appearance.

3.4 INSTALLATION - RACEWAY

A. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.

B. Arrange raceway supports to prevent misalignment during wiring installation.

C. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

D. Group related raceway; support using conduit rack. Construct rack using steel channel specified in Section 26 05 29; provide space on each for 25 percent additional raceways.

E. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports

F. Do not attach raceway to ceiling support wires or other piping systems.

G. Construct wireway supports from steel channel specified in Section 26 05 29.

H. Route exposed raceway parallel and perpendicular to walls.

I. Route conduit in and under slab from point-to-point.

J. Maintain clearance between raceway and piping for maintenance purposes.

K. Maintain 12 inch clearance between raceway and surfaces with temperatures exceeding 104 degrees F.

L. Cut conduit square using saw or pipe cutter; de-burr cut ends.

M. Bring conduit to shoulder of fittings; fasten securely.

N. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.

O. Install conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.

P. Install no more than equivalent of three 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Install factory elbows for bends in metal conduit larger than 2 inch size.

Q. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.

R. Install fittings to accommodate expansion and deflection where raceway crosses, control and expansion joints.

S. Install suitable pull string or cord in each empty raceway except sleeves and nipples.

T. Install suitable caps to protect installed conduit against entrance of dirt and moisture.

U. Close ends and unused openings in wireway.

V. Provide thread lubricant on all threaded connections. **Kopr-Shield** CP8-TB or equal.

3.5 INSTALLATION - BOXES

A. Install wall mounted boxes at elevations to accommodate mounting heights as indicated on Drawings (notes or elevations) unless specified in section for outlet device.

B. Adjust box location up to 10 feet prior to rough-in to accommodate intended purpose.

C. Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.

D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

E. In Accessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.

F. Do not install flush mounting box back-to-back in walls; install with minimum 6 inches separation. Install with minimum 24 inches separation in acoustic rated walls.

G. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

H. Install stamped steel bridges to fasten flush mounting outlet box between studs.

I. Install flush mounting box without damaging wall insulation or reducing its effectiveness.

J. Install adjustable steel channel fasteners for hung ceiling outlet box.

K. Do not fasten boxes to ceiling support wires or other piping systems.

L. Support boxes independently of conduit.

M. Install gang box where more than one device is mounted together. Do not use sectional box.

N. Install gang box with plaster ring for single device outlets.

3.6 INTERFACE WITH OTHER PRODUCTS

A. Install conduit to preserve fire resistance rating of partitions and other elements.

B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket.

C. Locate outlet boxes to allow luminaires positioned as indicated on Drawings.

D. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

3.7 ADJUSTING

A. Section 26 00 00 - Electrical Methods and Materials.

B. Adjust flush-mounting outlets to make front flush with finished wall material.

C. Install knockout closures in unused openings in boxes.

3.8 CLEANING

A. Section 26 00 00 - Electrical Methods and Materials.

B. Clean interior of boxes to remove dust, debris, and other material.

C. Clean exposed surfaces and restore finish.

END OF SECTION

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Nameplates.
   2. Labels.
   3. Wire markers.
   4. Conduit markers.
   5. Stencils.
   6. Underground Warning Tape.
   7. Lockout Devices.

B. Related Sections:
   1. Section 09 90 00 - Painting and Coating: Execution requirements for painting specified by this section.

1.2 SUBMITTALS

A. Section 26 00 00 - Electrical Methods and Materials.

B. Product Data:
   1. Submit manufacturer’s catalog literature for each product required.
   2. Submit electrical identification schedule including list of wording, symbols, letter size, color coding, tag number, location, and function.

C. Samples:
   1. Submit two samples of each type of identification products applicable to project.
   2. Submit two nameplates, 4 x 4 inch in size illustrating materials and engraving quality.

D. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

1.3 CLOSEOUT SUBMITTALS

A. Section 26 00 00 - Electrical Methods and Materials

B. Project Record Documents: Record actual locations of tagged devices; include tag numbers.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with NEC.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Section 26 00 00 - Electrical Methods and Materials

B. Accept identification products on site in original containers. Inspect for damage.

C. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

D. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Section 26 00 00 - Electrical Methods and Materials

B. Install labels or nameplates only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.

PART 2 PRODUCTS

2.1 NAMEPLATES

A. Manufacturers:
   1. Craftmark Pipe Markers.
   2. Kolbi Pipe Marker Co.
   3. Pipemarker.com; Brimar Industries, Inc.
   4. Seton Identification Products.
   5. Substitutions: Section 26 00 00 - Electrical Methods and Materials.

B. Product Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

C. Letter Size:
   1. 1/8 inch high letters for identifying individual equipment and loads.
   2. 1/4 inch high letters for identifying grouped equipment and loads.
   3. 3/8 inch high letters for identifying control panels and panelboards.

D. Minimum nameplate thickness: 1/8 inch.

2.2 WIRE MARKERS

A. Manufacturers:
   1. Brady ID.
   2. Grafoplast Wire Markers.
   3. Ideal Industries, Inc.
   4. 3M Skotchcode.
   5. Dymo Rhino.

6. Substitutions: Section 26 00 00 - Electrical Methods and Materials.

B. Description: Cloth tape , split sleeve , or tubing type wire markers.

C. Legend:
1. Power and Lighting Circuits: Branch circuit or feeder number as indicated on Drawings.
2. Control Circuits: Control wire number as indicated on schematic and interconnection diagrams. shop drawings.

2.3 CONDUIT AND RACEWAY MARKERS

A. Manufacturers:
1. Brady ID.
2. Ideal Industries, Inc.
3. Seton Identification Products.
4. Substitutions: Section 26 00 00 - Electrical Methods and Materials.

B. Description: Nameplate fastened with straps Labels fastened with adhesive.

C. Color:
1. Medium Voltage System: Black lettering on white background.
2. 480 Volt System: Black lettering on white background.
3. 208 Volt System: Black lettering on white background.

D. Legend:
1. Medium Voltage System: HIGH VOLTAGE.
2. 480 Volt System: 480 VOLTS.
3. 208 Volt System: 208 VOLTS.
4. 240 System: 240 volts.
5. Controls: DATA/CONTROL

E. Stencils: With clean cut symbols and letters of following size:
1. Up to 2 inches Outside Diameter of Raceway: 1/2 inch high letters.
2. 2-1/2 to 6 inches Outside Diameter of Raceway: 1 inch high letters.

2.4 LOCKOUT DEVICES

A. Lockout Hasps:
1. Manufacturers:
a. Brady ID.
b. Master Lock Company, LLC.
c. Substitutions: Section 26 00 00 - Electrical Methods and Materials.
2. Reinforced nylon hasp with erasable label surface; size minimum 7-1/4 x 3 inches.

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 EXISTING WORK

A. Install identification on existing equipment to remain in accordance with this section.

B. Install identification on unmarked existing equipment.

C. Replace lost nameplates.

D. Re-stencil existing equipment.

3.3 INSTALLATION

A. Install identifying devices after completion of painting.

B. Nameplate Installation:
   1. Install nameplate parallel to equipment lines.
   2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners, or adhesive.
   3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners or adhesive.
   4. Secure nameplate to equipment front using screws or adhesive.
   5. Secure nameplate to inside surface of door on recessed panelboard in finished locations.
   6. Install nameplates for the following:
      a. Switchboards.
      b. Panelboards.
      c. Transformers.
      d. Service Disconnects.
      e. Control Panels.
      f. Disconnects

C. Label Installation:
   1. Install label parallel to equipment lines.
   2. Install label for identification of individual control device stations, and disconnects.
   3. Install labels for permanent adhesion and seal with clear lacquer.

D. Wire Marker Installation:
   1. Install wire marker for each conductor at panelboard gutters, pull boxes, outlet and junction boxes each load connection.
   2. Mark data cabling at each end. Install additional marking at accessible locations along the cable run.
   3. Install labels at data outlets identifying panel and termination designation per approved shop drawings or as indicated on Drawings.

E. Conduit Marker Installation:
   1. Install conduit marker for each conduit longer than 6 feet.
   2. Conduit Marker Spacing: 20 feet on center.

END OF SECTION

SECTION 26 08 00
COMMISSIONING OF ELECTRICAL AND CONTROL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. The requirements of this section apply to all sections of Divisions 26 and 40

B. Section includes:
   1. Electrical and Control System commissioning description.
   2. Electrical and Control System commissioning responsibilities.

C. Related Sections:
   1. Division 26 and 40 Specifications

1.2 REFERENCES

A. National Electrical Testing Agency.

1.3 COMMISSIONED SYSTEMS

A. Commissioning of a system or systems specified in Divisions 26 and 40 is part of the construction process. Documentation and testing of these systems, as well as training of the Owner's Operation and Maintenance personnel in accordance with the requirements Division 26, is required.

B. Electrical and Controls Systems commissioning process includes the following tasks:
   1. Testing and startup of Electrical and Control equipment and systems.
   2. Equipment and system verification checks.
   3. Assistance in functional performance testing to verify testing and equipment and system performance.
   4. Provide qualified personnel to assist in commissioning tests.
   5. Complete and endorse functional performance test checklists provided by Commissioning Authority to assure equipment and systems are fully operational and ready for functional performance testing.
   6. Provide equipment, materials, and labor necessary to correct deficiencies found during commissioning process to fulfill contract and warranty requirements.
   7. Provide operation and maintenance information and record drawings to Commissioning Authority for review verification and organization, prior to distribution.
   8. Provide assistance to Commissioning Authority to develop, edit, and document system operation descriptions.

9. Provide training for systems specified in this Section with coordination by Commissioning Authority.

C. Equipment and Systems to Be Commissioned:
   1. New Electrical and Control systems that were installed under this Contract.
   2. Existing Electrical and Control systems that were modified, adjusted, upgraded, or affected by the work performed under this Contract.

D. The following is a partial list of equipment that may be included in this Commissioning:
   1. Intake MDP panel
   2. Well pump starter and controls
   3. Infiltration gallery instrumentation
   4. Lighting
   5. Receptacles
   6. Building instrumentation.

1.4 COMMISSIONING SUBMITTALS

A. Draft Forms: Submit draft of system verification form and functional performance test checklist.

B. Test Reports: Indicate data on system verification form for each piece of equipment and system as specified.

C. Field Reports: Indicate deficiencies preventing completion of equipment or system verification checks equipment or system to achieve specified performance.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record revisions to equipment and system documentation necessitated by commissioning.

B. Operation and Maintenance Data: Submit revisions to operation and maintenance manuals when necessary revisions are discovered during commissioning.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with NETA requirements.

B. Maintain one copy of each document on site.

1.7 COMMISSIONING RESPONSIBILITIES

A. Equipment or System Installer Commissioning Responsibilities:

1. Attend commissioning meetings.
2. Ensure controls installer performs assigned commissioning responsibilities as specified below.
3. Ensure calibration agency performs assigned commissioning responsibilities as specified.
4. Provide instructions and demonstrations for Owner's personnel.
5. Ensure subcontractors perform assigned commissioning responsibilities.
6. Ensure participation of equipment manufacturers in appropriate startup, testing, and training activities when required by individual equipment specifications.
7. Develop startup and initial checkout plan using manufacturer’s startup procedures and functional performance checklists for equipment and systems to be commissioned.
8. During verification check and startup process, execute process related portions of checklists for equipment and systems to be commissioned.
9. Perform and document completed startup and system operational checkout procedures, providing copy to Commissioning Authority.
10. Provide manufacturer’s representatives to execute starting of equipment. Ensure representatives are available and present during agreed upon schedules and are in attendance for duration to complete tests, adjustments and problem-solving.
11. Coordinate with equipment manufacturers to determine specific requirements to maintain validity of warranties.
12. Provide personnel to assist Commissioning Authority during equipment or system verification checks and functional performance tests.
13. Prior to functional performance tests, review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during tests.
14. Prior to startup, inspect, check, and verify correct and complete installation of equipment and system components for verification checks included in commissioning plan. When deficient or incomplete work is discovered, ensure corrective action is taken and re-check until equipment or system is ready for startup.
15. Provide factory supervised startup services for equipment and systems specified in Division 26 and 40. Coordinate work with manufacturer and Commissioning Authority.
16. Perform verification checks and startup on equipment and systems as specified.
17. Assist Commissioning Authority in performing functional performance tests on equipment and systems as specified.
18. Perform operation and maintenance training sessions scheduled by Commissioning Authority.
19. Conduct process system orientation and inspection.

B. Controls Installer Commissioning Responsibilities:
   1. Attend commissioning meetings.
   2. Review design for ability of systems to be controlled including the following:
      a. Confirm proper hardware requirements exists to perform functional performance testing.
      b. Confirm proper safeties and interlocks are included in design.
      c. Confirm proper sizing of system control valves and actuators and control valve operation will result capacity control identified in Contract Documents.
      d. Confirm proper sizing of system control dampers and actuators and damper operation will result in proper damper positioning.
      e. Confirm sensors selected are within device ranges.
      f. Review sequences of operation and obtain clarification from Architect/Engineer.

g. Provide written sequences of operation for packaged controlled equipment. Equipment manufacturers' stock sequences may be included, when accompanied by additional narrative to reflect Project conditions.

3. Inspect, check, and confirm proper operation and performance of control hardware and software provided in other Electrical and Controls sections.
4. Submit proposed procedures for performing automatic temperature control system point-to-point checks to Commissioning Authority and Architect/Engineer.
5. Inspect check and confirm correct installation and operation of automatic temperature control system input and output device operation through point-to-point checks.
6. Perform training sessions to instruct Owner's personnel in hardware operation, software operation, programming, and application in accordance with commissioning plan and requirements of Divisions 26 and 40.
7. Demonstrate system performance and operation to Commissioning Authority during functional performance tests including each mode of operation.
8. Provide control system technician to assist during Commissioning Authority verification check and functional performance testing.
9. Provide control system technician to assist testing, adjusting, and balancing agency during performance of testing, adjusting, and balancing work.
10. Assist in performing operation and maintenance training sessions scheduled by Commissioning Authority.

C. Testing, Adjusting, and Calibration Agency Commissioning Responsibilities:
1. Attend commissioning meetings.
2. Participate in verification of testing, adjusting, and calibration report for verification or diagnostic purposes.
3. Assist in performing operation and maintenance training sessions scheduled by Commissioning Authority.

1.8 COMMISSIONING MEETINGS

A. Attend initial commissioning meeting and progress commissioning meetings as required by Commissioning Authority.

1.9 COORDINATION

A. Section 26 00 00 - Electrical Methods and Materials

B. Notify Commissioning Authority minimum of four weeks in advance of the following:
1. Scheduled equipment and system startups.
2. Scheduled automatic temperature control system checkout.
3. Scheduled start of testing, adjusting, and calibration work.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 CONSTRUCTION INSPECTIONS

A. Commissioning of Electrical systems will require inspection of individual elements of the electrical systems construction throughout the construction period. The Contractor shall coordinate with the Commissioning Agent in accordance with Section 01 19 00 and the Commissioning plan to schedule electrical systems 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.

B. 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 Owner and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists.

C. 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.

D. 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.

3.3 CONTRACTORS TESTS

A. Contractor tests as required by other sections of Division 26 and 40 shall be scheduled and documented in accordance. All testing shall be incorporated into the project schedule. 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 prior to 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, to 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 Engineer. The Contractor shall review and comment on the tests prior to 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.

3.5 TRAINING OF OWNER'S PERSONNEL

A. Training of the operation and maintenance personnel is required. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. Contractor shall submit training agendas and trainer resumes in accordance with the requirements of Section 01 19 00. The instruction shall be scheduled in coordination with the Engineer after submission and approval of formal training plans. Refer to Division 26 Sections for additional Contractor training requirements.

END OF SECTION

SECTION 26 24 16
PANEL BOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Distribution and branch circuit panelboards.
   2. Electronic grade branch circuit panelboards.
   3. Load centers.

B. Related Requirements:
   1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
   2. Section 26 05 53 - Identification for Electrical Systems.
   3. Section 26 28 13 - Fuses.

1.2 REFERENCE STANDARDS

A. Institute of Electrical and Electronics Engineers:
   1. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

B. National Electrical Manufacturers Association:
   1. NEMA FU 1 - Low Voltage Cartridge Fuses.
   2. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
   3. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
   4. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
   5. NEMA PB 1 - Panelboards.
   6. NEMA PB 1.1 - General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.

C. International Electrical Testing Association:
   1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

D. National Fire Protection Association:
   1. NFPA 70 - National Electrical Code.

E. Underwriters Laboratories Inc.:
   1. UL 50 - Cabinets and Boxes
   2. UL 67 - Safety for Panelboards.

3. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
4. UL 1283 - Electromagnetic Interference Filters.
5. UL 1449 - Transient Voltage Surge Suppressors.
6. UL 1699 - Arc-Fault Circuit Interrupters.

1.3 SUBMITTALS

A. Section 26 00 00 - Electrical Methods and Materials.

B. Product Data: Submit catalog data showing specified features of standard products.

C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.

D. Source Quality control submittals: Indicate results of factory tests and inspections.

E. Field Quality Control Submittals: Indicate results of Contractor furnished tests and inspections.

1.4 CLOSEOUT SUBMITTALS

A. Section 26 00 00 - Electrical Methods and Materials

B. Project Record Documents: Record actual locations of panelboards and record actual circuiting arrangements.

C. Operation and Maintenance Data: Submit spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Section 26 00 00 - Electrical Methods and Materials

B. Extra Stock Materials:
   1. Furnish two of each panelboard key. Panelboards keyed alike.

1.6 QUALITY ASSURANCE

A. Qualifications
   1. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.

PART 2 - PRODUCTS

2.1 PANELBOARDS

A. Manufacturers:
   1. Square D
   2. General Electric
   3. Eaton
   4. Cutler Hammer
   5. Substitutions: See Section 26 00 00 - Electrical Methods and Materials

B. Description: NEMA PB 1, circuit breaker type panelboard.

C. Operation:
   1. Service Conditions:
      a. Temperature: 50-80 degrees FAltitude: 100 feet above sea level.

   2. Minimum integrated short circuit rating: 22,000 amperes rms symmetrical for 240 / 208 volt panelboards; 14,000 amperes rms symmetrical for 480 volt panelboards, or as indicated on Drawings.

D. Materials
   1. Panelboard Bus: Copper, current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard.
   2. Molded Case Circuit Breakers: UL 489, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Furnish circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.

   3. Circuit Breaker Accessories: Trip units and auxiliary switches as indicated on Drawings.

   4. Enclosure: NEMA PB 1, Type 12 Minimum or as shown on Drawings.

E. Finishes
   1. Manufacturer's standard gray enamel for NEMA 12

   2. Stainless Steel or Aluminum for NEMA 4 or 4X

2.2 SOURCE QUALITY CONTROL

A. Section 26 00 00 - Electrical Methods and Materials

PART 3 - EXECUTION

3.1 DEMOLITION

A. Disconnect abandoned panelboards. Remove abandoned panelboards.

B. For existing panelboards scheduled for relocation, as-built existing installation including circuits served, conductors and breaker ampacity. Unless otherwise noted re-serve all existing loads based on as-built conditions.

C. Maintain access to existing panelboard and load centers remaining active and requiring access. Modify installation or provide access panel.

3.2 INSTALLATION

A. Install panelboards in accordance with NEMA PB 1.1.

B. Install panelboards plumb.

C. Height: 6 feet to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above floor.

D. Install filler plates for unused spaces in panelboards.

E. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes to balance phase loads. Identify each circuit as to its clear, evident and specific purpose of use.

F. Install engraved plastic nameplates in accordance with Section 26 05 53.

G. Ground and bond panelboard enclosure according to Section 26 05 26. Connect equipment ground bars of panels in accordance with NFPA 70.

H. Ensure non electrical components are not installed above or below the footprint of the each panelboard.

I. Verify required clearspace is identified with permanent markings on the floor in front of each panel requiring trouble shooting or maintenance while energized.

3.3 RESTORATION

A. Repair existing panelboards to remain or to be reinstalled.

B. Update panel schedules of existing panels modified under this project.

3.4 FIELD QUALITY CONTROL

A. Section 26 00 00 - Electrical Methods and Materials

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform circuit breaker inspections and tests listed in NETA ATS, Section 7.6.

D. Perform switch inspections and tests listed in NETA ATS, Section 7.5.

3.5 ADJUSTING

A. Section 26 00 00 - Electrical Methods and Materials

B. Measure steady state load currents at each panelboard feeder; rearrange circuits in panelboard to balance phase loads to within 10 percent of each other. Maintain proper phasing for multi-wire branch circuits.

3.6 CLEANING

A. Section 26 00 00 - Electrical Methods and Materials

B. Clean existing panelboards to remain or to be reinstalled.

END OF SECTION

SECTION 26 27 16
ELECTRICAL CABINETS AND ENCLOSURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Hinged cover enclosures.
   2. Cabinets.
   3. Terminal blocks.
   4. Accessories.

B. Related Requirements:
   1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
   2. Section 26 05 29 - Hangers and Supports for Electrical Systems.
   3. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
   4. Section 40 95 13 - Process Control Panels and Hardware

1.2 REFERENCE STANDARDS

A. National Electrical Manufacturers Association:
   1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
   2. NEMA ICS 4 - Industrial Control and Systems: Terminal Blocks.

1.3 SUBMITTALS

A. Section 26 00 00 - Electrical Methods and Materials

B. Product Data: Submit manufacturer's standard data for enclosures, cabinets, and terminal blocks.

C. Manufacturer's Instructions: Submit application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Materials:
   1. Furnish two of each key.

PART 2 - PRODUCTS

2.1 HINGED COVER ENCLOSURES

A. Manufacturers:
   1. Adalet.
   2. Carlon Electrical Products.
   3. Hoffman; a brand of Pentair Equipment Protection.
   4. Leviton Manufacturing Co., Inc.
   5. Wiegmann; Hubbell Inc.
   6. Substitutions: Section 26 00 00 - Electrical Methods and Materials

B. Description: NEMA 250, Type NEMA 12 steel enclosure.
   1. Covers: Continuous hinge, held closed by flush latch operable by screwdriver.
   2. Furnish interior metal panel for mounting terminal blocks and electrical components; finish with white enamel.
   3. Enclosure Finish: Manufacturer's standard enamel.

2.2 CABINETS

A. Manufacturers:
   1. Hammond Mfg. Co. Inc.
   2. Hoffman; a brand of Pentair Equipment Protection
   3. Substitutions: Section 26 00 00 – Electrical Materials and Methods.

B. Description:
   1. Boxes: Galvanized steel.
   2. Box Size: As required.
   3. Backboard: Paint matte white.
   4. Fronts: Steel, surface type with screw cover front door with concealed hinge, and flush lock.
   5. Knockouts: None.

C. Fabrication
   1. Furnish metal barriers to form separate compartments wiring of different systems and voltages.
   2. Furnish accessory feet for free-standing equipment.

D. Finishes:
   1. Finish with gray baked enamel.

2.3 TERMINAL BLOCKS

A. Manufacturers:

1. Allen-Bradley/Rockwell Automation.
2. Cooper Bussmann; a division of Cooper Industries.
3. Square D; by Schneider Electric.
4. Entrelec,
5. Substitutions: Section 26 00 00 – Electrical Materials and Methods.

B. Description:
1. Terminal Blocks: NEMA ICS 4.
2. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.
3. Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, fused, or non-fused as shown, rated 300 volts.
4. Analog Signal Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors for twisted pair plus shield, fused on one leg, rated 300.
5. Furnish ground bus terminal block, with each connector bonded to enclosure.

2.4 PLASTIC RACEWAY

A. Manufacturers:
1. Panduit Corp.
2. Wiremold / Legrand.
3. Substitutions: Section 26 00 00 – Electrical Materials and Methods.

B. Description: Plastic channel with hinged or snap-on cover.

2.5 CORROSION PROTECTION

A. Manufacturers; Emitter:
1. Cortec Corporation..

2. Substitutions: Section 26 00 00 – Electrical Materials and Methods.

3. Description: Foam emitter to provide long term protection against corrosion by airborne contaminants.

a. For each enclosure, furnish quantity as indicated in manufacturers' instructions to protect the enclosure.

B. Manufacturers; Absorber:
1. Cortec Corporation.
2. Substitutions: Section 26 00 00 – Electrical Materials and Methods.

3. Description: Plastic cup with breathable membrane to absorb corrosive gasses from the enclosure.

a. For each enclosure, furnish quantity as indicated in manufacturers' instructions to protect the enclosure.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner in accordance with Section 26 05 29.

B. Install cabinet fronts plumb.

3.2 CLEANING

A. Section 26 00 00 - Electrical Methods and Materials

B. Clean existing cabinets and enclosures to remain or to be reinstalled.

C. Clean electrical parts to remove conductive and harmful materials.

D. Remove dirt and debris from enclosure.

E. Clean finishes and touch up damage.

END OF SECTION

SECTION 26 28 19
ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fusible.
   2. Nonfusible switches.

B. Related Requirements:
   1. Section 26 05 29 - Hangers and Supports for Electrical Systems.
   2. Section 26 05 53 - Identification for Electrical Systems.
   3. Section 26 28 13 - Fuses.

1.2 REFERENCE STANDARDS

A. National Electrical Manufacturers Association:
   1. NEMA FU 1 - Low Voltage Cartridge Fuses.
   2. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

B. International Electrical Testing Association:
   1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

A. Section 26 00 00 - Electrical Methods and Materials

B. Product Data: Submit switch ratings and enclosure dimensions.

1.4 CLOSEOUT SUBMITTALS

A. Section 26 00 00 - Electrical Methods and Materials

B. Project Record Documents: Record actual locations of enclosed switches and ratings of installed fuses.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCH ASSEMBLIES

A. Manufacturers:
   1. Cutler-Hammer.
   2. Eaton Electrical Sector; Eaton Corporation.
   3. Siemens Power Transmission & Distribution, Inc.
   4. Square D; by Schneider Electric.
   5. Substitutions: Section 26 00 00 – Electrical Materials and Methods

B. Description: NEMA KS 1, Type HD, enclosed load interrupter knife switch. Handle lockable in OFF position.

C. Operation:
   1. Switch Ratings
      a. Switch Rating: Horsepower rated for AC or DC as indicated on Drawings.
      b. Short Circuit Current Rating: UL listed for 10,000 rms symmetrical amperes when used with or protected by Class H or K fuses (30-600 ampere).

D. Materials:
   1. Fuse clips: Designed to accommodate NEMA FU 1, Class J fuses.
   2. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel, aluminum or stainless steel as listed below.
      a. Interior Dry Locations: Type 1.
      b. Exterior Locations: Type 4X.
      c. Industrial Locations: Type 12.
      d. Or as shown on Plans.
   3. Furnish switches with entirely copper current carrying parts.

2.2 NONFUSIBLE SWITCH ASSEMBLIES

A. Manufacturers:
   1. Cutler-Hammer.
   2. Eaton Electrical Sector; Eaton Corporation.
   3. Siemens Power Transmission & Distribution, Inc.
   4. Square D; by Schneider Electric.
   5. Substitutions: Section 26 00 00 – Electrical Materials and Methods

B. Description: NEMA KS 1, Type HD enclosed load interrupter knife switch. Handle lockable in OFF position.

C. Operation:
   1. Switch Ratings
      a. Switch Rating: Horsepower rated for AC or DC as indicated on Drawings.
      b. Short Circuit Current Rating: UL listed for 10,000 rms symmetrical amperes when used with or protected by Class H or K fuses (30-600 ampere).
   2. Provide single throw (disconnect) and double throw (transfer) switches as shown on the plans.

D. Materials:
   1. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel, aluminum or stainless steel as listed below.
      a. Interior Dry Locations: Type 1.
      b. Exterior Locations: Type 4X.
      c. Industrial Locations: Type 12.
      d. Or as shown on Plans.

   2. Furnish switches with entirely copper current carrying parts.

PART 3 - EXECUTION

3.1 DEMOLITION

A. Disconnect and remove abandoned enclosed switches.

B. Maintain access to existing enclosed switches and other installations remaining active and requiring access. Modify installation or provide access panel.

3.2 INSTALLATION

A. Install enclosed switches where indicated.

B. Install enclosed switches plumb. Provide supports in accordance with Section 26 05 29.

C. Height: 5 feet to operating handle.

D. Install fuses for fusible disconnect switches. Refer to Plans or Manufacturers recommended size/Class for product requirements.

E. Install engraved plastic nameplates in accordance with Section 26 05 53. Engrave nameplates with the equipment served and the panel and circuit number supplying the switch.

F. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

3.3 FIELD QUALITY CONTROL

A. Section 26 00 00 - Electrical Methods and Materials

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.5.

3.4 CLEANING

A. Section 26 00 00 - Electrical Methods and Materials

B. Clean existing enclosed switches to remain or to be reinstalled.

END OF SECTION

SECTION 26 29 13
ENCLOSED CONTROLLERS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes manual and magnetic motor controllers in individual enclosures.

B. Provide enclosed motor controllers where called out on plans (identified as “MS-x”, “ST” etc).
   1. Provide HP rating as required by the motor served.
   2. Provide voltage rating as shown on plans.

1.2 REFERENCES

A. National Electrical Manufacturers Association:
   1. NEMA FU 1 - Low Voltage Cartridge Fuses.
   2. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
   3. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
   4. NEMA ICS 6 - Industrial Control and Systems: Enclosures.
   5. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

B. International Electrical Testing Association:
   1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

C. Underwriters Laboratories Inc.:
   1. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.

1.3 SUBMITTALS

A. Section 26 00 00 - Electrical Methods and Materials

B. Product Data: Submit catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.

C. Test Reports: Indicate field test and inspection procedures and test results.

1.4 CLOSEOUT SUBMITTALS

A. Section 26 00 00 - Electrical Methods and Materials

B. Project Record Documents: Record actual locations and ratings of enclosed controllers.

C. Operation and Maintenance Data: Submit Replacement parts list for controllers.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.

PART 2 PRODUCTS

2.1 MANUAL MOTOR CONTROLLER

A. Manufacturers:
   1. Cutler Hammer
   2. Square D
   3. Eaton
   4. Substitutions: Section 26 00 00 – Electrical Materials and Methods.

B. Product Description: NEMA ICS 2, AC general-purpose, Class A, manually operated, full-voltage controller with overload element, NO auxiliary contact, and push button or toggle operator.

C. Enclosure: NEMA ICS 6, Type to meet conditions of installation.

2.2 FRACTIONAL-HORSEPOWER MANUAL CONTROLLER

A. Manufacturers:
   1. Cutler Hammer
   2. Square D
   3. Eaton
   4. Substitutions: Section 26 00 00 – Electrical Materials and Methods.

B. Product Description: NEMA ICS 2, AC general-purpose, Class A, manually operated, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, green pilot light, and toggle operator.

C. Enclosure: NEMA ICS 6, Type to meet conditions of installation.

2.3 MOTOR STARTING SWITCH

A. Manufacturers:
   1. Cutler Hammer
   2. Square D
   3. Eaton
   4. Substitutions: Section 26 00 00 – Electrical Materials and Methods.

B. Product Description: NEMA ICS 2, AC general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, without thermal overload unit, with green pilot light and toggle operator.

C. Enclosure: NEMA ICS 6, Type to meet conditions of installation.

2.4 FULL-VOLTAGE NON-REVERSING CONTROLLERS

A. Manufacturers:
   1. Cutler Hammer
   2. Square D
   3. Eaton
   4. Substitutions: Section 26 00 00 – Electrical Materials and Methods.

B. Product Description: NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower.

C. Control Voltage: 120 volts, 60 Hertz.

D. Overload Relay: NEMA ICS 2; bimetal ambient compensated with Form C AUX alarm contacts.

E. Product Features:
   1. Auxiliary Contacts: NEMA ICS 2, 2 each field convertible contacts in addition to seal-in contact.
   2. Cover Mounted Pilot Devices: NEMA ICS 5, duty oiltight type, LED.
   3. Pilot Device Contacts: NEMA ICS 5, Form Z, rated A150.
   4. Pushbuttons: Unguarded type.
   5. Indicating Lights: LED type.
   6. Selector Switches: Rotary type HAND-OFF AUTO.
   7. Where called for on the plans provide:
      a. Relays: NEMA ICS 2, 2PDT.
      b. Control Power Transformers: 120 volt secondary or as indicated on Drawings. Furnish fused primary and secondary, and bond unfused leg of secondary to enclosure.

F. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using thermal magnetic circuit breaker conforming to UL 489, with integral thermal and instantaneous magnetic trip in each pole.

G. Enclosure: NEMA ICS 6, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
   1. Interior Dry Locations: Type 1.
   2. Exterior Locations: Type 4X.
   3. Process Locations: Type 12.

PART 3 EXECUTION

3.1 EXISTING WORK

A. Disconnect and remove abandoned enclosed motor controllers.

B. Maintain access to existing enclosed motor controllers and other installations to remain active and to require access. Modify installation or provide access panel.

C. Clean and repair existing enclosed motor controllers to remain or to be reinstalled.

3.2 INSTALLATION

A. Install enclosed controllers plumb. Provide supports in accordance with Section 26 05 29.

B. Height: 5 feet to operating handle.

C. Select and install overload heater elements in motor controllers to match installed motor characteristics.

D. Install engraved plastic nameplates. Refer to Section 26 05 53 for product requirements and location.

E. Neatly type label and place inside each motor controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating. Place label in clear plastic holder.

3.3 FIELD QUALITY CONTROL

A. Section 26 00 00 - Electrical Methods and Materials

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.16.1.

END OF SECTION

SECTION 26 99 90
ELECTRICAL HEAT TRACE

PART 1 - – GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. Section 26 05 03 - EQUIPMENT WIRING CONNECTIONS

1.2 WORK INCLUDED

A. This section describes specific requirements, products, and methods of execution relating to providing ELECTRICAL HEAT TRACE used on this project.

1.3 QUALITY ASSURANCE

A. Heat Trace shall be listed or labeled.

B. Heat Trace shall be identified as acceptable for use on plastic pipe.

C. Codes, Approvals and Standards - The electric heat-trace system shall conform to this specification. It shall be designed, manufactured, and tested in accordance with the applicable requirements of the latest edition of the following codes and standards.

1. ANSI American National Standards Institute
2. CEC Canadian Electrical Code
3. CSA CSA International
4. FM FM Approvals
5. IEC International Electro-Mechanical Commission
6. IEEE Institute Of Electrical and Electronics Engineers
7. ITS Intertek Testing Services (Intertek ETL SEMKO)
8. NEC U.S. National Electrical Code (NFPA 70)
9. NEMA National Electrical Manufacturers Association
10. NESC National Electrical Safety Code
11. UL Underwriters' Laboratories, Inc.

1.4 SUBMITTALS

A. The following items shall be included in the submittal:

1. Quality Assurance: Verification that product is listed for the intended use (HDPE water line freeze protection in arctic pipe.)
2. "Cut" sheets are an acceptable format if all required data is presented in a readable manner. Where options are identified as available but not provided they shall be marked

out alternately identify only those options intended to be supplied with the component if none, then state so on the submittal.

PART 2 - PRODUCTS

A. The heat trace is existing and the intent is to re-use after partially removing from existing arctic pipe. The existing heat trace may not be salvageable for its full length or be long enough to reach the new intake structure. The following is to be used to extend the existing and matches what is currently installed.

B. Self-Regulating Electrical Heat Trace
   1. All heat-tracing applications with continuous exposure (maintain) temperatures from 150°F (65°C) to 250°F (121°C) or intermittent exposure temperatures from 185°F (85°C) to 420°F (215°C) shall use self-regulating cables.
   2. Self-regulating heating cable shall vary its power output relative to the temperature of the surface of the pipe or the vessel. The cable shall be designed such that it can be crossed over itself and cut to length in the field.
   3. Self-regulating heating cable shall be designed for a useful life of 20 years or more with "power on" continuously, based on the following useful life criteria:
   4. Retention of at least 75 percent of nominal rated power after 20 years of operation at the maximum published continuous exposure (maintain) temperature.
   5. Retention of at least 90 percent of nominal rated power after 1000 hours of operation at the maximum published intermittent exposure temperature. The testing shall conform to UL 746B, IEC 216-1 Part 1.
   6. A warranty against manufacturing defects for a period of 10 years shall be available.
   7. All cables shall be capable of passing a 2.5 kV dielectric test for one minute (ASTM 2633) after undergoing a 0.5 kg-m impact (BS 6351, Part 1, 8.1.10).

C. Freeze-Protection Systems
   1. The heating cable shall consist of two 16 AWG or larger nickel-plated copper bus wires, embedded in a self-regulating polymeric core that controls power output so that the cable can be used directly on plastic or metallic pipes. Cables shall have a temperature identification number (T-rating) of T6 (185°F or 85°C) without use of thermostats.
   2. A ground-fault protection device set at not more than 30 mA, with a nominal 100-ms response time, shall be used to protect each circuit. Breaker is not included in the procurement phase.
   3. The heating cable shall have a tinned copper braid with a resistance less than the heating cable bus wire resistance as determined in type test (ASTM, B193, Sec. 5). The braid shall be protected from chemical attack and mechanical abuse by a flouropolymer outer jacket.
   4. In order to provide rapid heat-up, to conserve energy, and to prevent overheating of fluids and plastic pipe, the heating cable shall have the following minimum self-regulating indices:

Minimum Self-Regulating Indices

Heating cable	S.R. index (W/°F)	S.R. Index (W/°C)

3 W/ft	0.038	0.068
5 W/ft	0.060	0.108
8 W/ft	0.074	0.133
10 W/ft	0.100	0.180

5. The self-regulating index is the rate of change of power output in watts per degree Fahrenheit or watts per degree Celsius, as measured between the temperatures of 50°F (10°C) and 100°F (38°C) and confirmed by the type test and published data sheets.
6. In order to ensure that the self-regulating heating cable does not increase power output when accidentally exposed to high temperatures, resulting in thermal runaway and self-ignition, the cable shall produce less than 0.5 watts per foot (1.64 watts per meter) when energized and heated to 350°F (177°C) for 30 minutes. After this test, if the cable is reen-ergized, it must not have an increasing power output leading to thermal runaway.
7. In order to confirm 2.1C, the self-regulating heating cable shall retain at least 90 percent of its original power output after having been cycled 300 times between 50°F (10°C) and 210°F (99°C), allowing at least six minutes of dwell time at each temperature.
8. Provide each heat cable installation with required power point and end kits rated for the intended environment.
9. Heating cable shall be rated at 8 W/ft, 277V.
10. The heating cable shall be **Raychem LBTV2 - CT** self-regulating heater, with con-tinuous exposure (maintain) capability up to 150°F (65°C) and intermittent exposure capability up to 185°F (85°C), as manufactured by Tyco Thermal Controls or approved equal.

D. Heat Trace accessories
1. Provide NEMA 4X power junction box with internal terminals suitable for running dual heat trace runs from a single circuit.
2. Proved suitable end kit suitable for use in arctic pipe couplings.
3. Accessories shall be **RAYCHEM** to match existing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall consist of Heat Cable, End Kit, Power point and GFCI (Class B) circuit.

3.2 TESTING

A. Factory inspections and tests for self-regulating heater cables shall include but are not limited to the following:
1. Testing shall be done per the latest IEEE Std. 515 test section and applicable manufacturer’s standards.
2. Prior to shipping, all heater cables shall be meggered and results shall be permanently attached to the shipping reel or carton.

3. Upon receipt OWNER will perform megger test to compare and verify heating cable was not damaged during transit.
4. The megger readings upon receipt shall be greater than 20 megohms. Otherwise, the heater cable is not acceptable and shall be replaced.

END OF SECTION

DIVISION 27 COMMUNICATIONS

SECTION 27 05 14.05
RADIO TELEMETRY SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. The Contractor shall furnish and install at the well pump station and water treatment plant a data telemetry system for status and control (SCADA) of the well pump and intake structure.

B. The system shall consist of a field unit serving a remote station via 900 Mhz radio communications in a point to point network.

C. Local Well Pump Control Panel shall be provided at the intake structure.

D. Remote Well Pump Control shall be provided at the Water Treatment Plant.

E. Receive-Transmit Unit (RTU) based panels shall be provided in accordance with the plans and these specifications.

1.2 RELATED SECTIONS

A. Section 40 90 00 – Process Control and Instrumentation

B. Section 40 95 13 – Control Panels

1.3 SUBMITTALS

A. Shop drawings shall be submitted in accordance with Section 01 33 00 – Submittal Procedures.

B. Operation and maintenance manuals shall be submitted in accordance with Section 01 33 00 – Submittal Procedures.

PART 2 - PRODUCTS

2.1 LOCAL AND REMOTE CONTROL PANEL

A. In addition to the manufacturer’s requirements, unit shall be in accordance with the plans.

B. Control panels shall be provided in a NEMA 4X enclosure.

C. Field hardware shall be provided per the plans.

D. The field hardware shall have:
   1. 120V input Power with Conditioning
   2. 12VDC power supply
   3. I/O terminal blocks for all external connections.

E. Control Panel RTU Modules shall provide the following features:
   1. 2 Analog Inputs (4-20mA) 24 bit precision,
   2. 2 Analog Outputs (4-20mA) 16 bit precision,
   3. 2 Digital Inputs,
   4. 2 Relay (N.O.) contact Outputs.
   5. The RTU shall continuously transmit or enable all digital, analog and pulse inputs continuously on an “as occurs basis”.
   6. The RTU shall have on board diagnostic enunciator lights for lost link.
   7. The RTU shall have on board diagnostics that indicate received signal strength of the wireless carrier's signal.
   8. The RTU shall utilize, in the case of a continuously transmitting field unit, a transmission scheme that encrypts the transmitted data utilizing an 128 bit encryption method that meets or exceeds the advanced encryption standard (AES). Additionally, the continually transmitting field units will have an effective, continuous, transfer rate of at least 19,200 baud.
   9. The RTU shall utilize a transmission scheme that individually identifies each transmitted message by sequence number.

F. Control Panels shall be listed as an assembly complying with Underwriter’s Laboratory requirements for remote signaling devices.

G. RTU Manufacturer
   1. Synetcom Digital Incorporated DIN-R-A4D2
   2. No Substitutions.

2.2 ACCESSORIES

A. Antenna:
   1. Fiberglass enclosed Log Periodic per the plans.

B. Hardware – Galvanized

C. COAX – Heliax per MFR recommendations.

D. Mounting: Provide suitable mounting brackets for the following
   1. Antennas shall be mounted on 2” Schedule 80 pipe per the plans.

PART 3 - EXECUTION

3.1 GENERAL

A. The telemetry system shall be manufactured and tested in accordance with the best applicable trade practices and in compliance with state, OSHA, and other governing code requirements including Listing by a State approved third party laboratory..

B. As soon as practicable after award of an NTP, the Telemetry system Vendor shall perform a Radio Survey documenting performance and recommendations. Field investigation to be provided with recommendations for antenna locations.

C. The report shall be provided to the Owner.

3.2 INSTALLATION

A. Installation shall be in accordance with manufacturer's written instructions.

B. Mount antennas as shown on the plans and in accordance with recommendations provided with the Radio Survey.

C. Provide properly grounded lightning/surge protection prior to penetrating structures.

3.3 TEST

A. Demonstrate operation of all channels whether in use for the current controls or not. Provide simulated inputs and means to verify the outputs are in 1:1 correspondence.

B. Provide 4 Hours of instruction of the operation and maintenance of the RTU/IO system. Training could coincide with the installation of the RTU units or a simulated RTU system may be provided for training during the field investigation.

END OF SECTION

DIVISION 31 EARTHWORK

SECTION 31 05 13
SOILS FOR EARTHWORK

PART 1 - GENERAL

1.1 DEFINITIONS

A. Selected Backfill Material: Material available onsite that the Engineer determines to be suitable for a specific use.

1.2 SUBMITTALS

A. Catalog and Manufacturer's data sheets for compaction equipment.

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials:

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. ASTM International:

1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
2. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)).
3. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).

PART 2 - PRODUCTS

2.1 BACKFILL MATERIAL

A. Locally available inorganic silty-sand/sandy-silt, free of roots and frozen or organic materials.

B. Material shall be mined from the City operated borrow source.

C. Material shall be allowed to dry prior to placement. Maximum allowable moisture content prior to placement shall be 10%.

2.2 BEDDING MATERIAL/SURFACE COURSE

A. Crushed stone or crushed gravel consisting of sound, tough, durable pebbles or rock fragments of uniform quality. Free from clay balls, vegetative matter, or other deleterious matters. Meeting the following requirements (DOT E-1 classification):

Property	Value	Test Method
LA Wear, %	45, max	AASHTO T 96
Degradation value	45, min	ASTM 313
Fracture, %	70, min	WAQTC FOP for AASHTO TP 61
Liquid Limit	35, max	WAQTC FOP for AASHTO TP 89
Plastic Index	10, max	WAQTC FOP for AASHTO TP 90
Sodium Sulfate Loss, %	9, max (5 cycles)	AASHTO T 104

Sieve	Gradation
1-1/2 in	-
1 in	100
3/4 in	70-100
3/8 in	50-85
No. 4	35-65
No. 8	20-50
No. 50	15-30
No. 200	8-15

PART 3 - EXECUTION

3.1 PREPARATION

A. Water Control
   1. Promptly remove and dispose of water as necessary to grade and compact backfill and install pipe. Do not lay pipe in standing water.
   2. Remove water in a manner that minimizes soil erosion.
   3. Provide continuous water control until backfill is complete.

B. Remove foreign material and backfill contaminated with foreign material.

3.2 SUBGRADE

A. Firm Subgrade: Grade with hand tools, remove loose and disturbed material, and trim off high areas and ridges left by excavating bucket teeth. Allow space for backfill below pipes.

B. Soft Subgrade: If subgrade is encountered that may require removal to prevent pipe settlement, notify Engineer. Engineer will determine the depth of over-excavation, if any, required.

3.3 BACKFILL

A. Furnish imported bedding material where, in the opinion of the Engineer, excavated material is unsuitable for bedding and backfill.

B. Place material in maximum 6-inch thick lifts.

C. Compact the material using a minimum of three passes with a vibratory plate compactor. Mechanically compact each lift to 95% of maximum density in accordance with ASTM D698.

3.4 MAINTENANCE OF BACKFILL

A. After each excavation is backfilled, maintain the surface of the backfilled trench even with the adjacent ground surface until final surface restoration is completed.

B. Add excavated material where necessary.

3.5 SETTLEMENT OF BACKFILL

A. Settlement of backfill or of fill or facilities constructed over backfill will be considered a result of defective compaction of backfill and shall be corrected at Contractor's expense.

END OF SECTION

SECTION 31 11 00
CLEARING AND GRUBBING

PART 1 - GENERAL

1.1 PROTECTION

A. Streets, roads, adjacent property and other work to remain shall be protected throughout the work.

B. Adjacent vegetation outside of clearing and grubbing limits shall be protected.

1.2 DEFINITIONS

A. Clearing:
   1. Clearing shall consist of the felling, trimming, and cutting of trees into 2 foot long segments and the satisfactory disposal of the trees and other vegetation designated for removal, including down timber, snags, brush and rubbish occurring in areas to be cleared.
   2. Clearing shall also include the removal and disposal of structures that interfere, encroach upon, or otherwise obstruct the work.

B. Grubbing: Grubbing shall consist of the removal and disposal of stumps, roots and matted roots from the designated grubbing areas.

1.3 CLEARING AND GRUBBING LIMITS

A. Clearing and grubbing shall be minimized and restricted to areas necessary for construction.

B. Clearing limits shall be limited to areas within established easements.

C. Excessive clearing and grubbing beyond construction limits or outside of easements shall be repaired to as near pre-construction conditions as possible at the sole expense of the Contractor.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 SURVEY STAKING

A. The Contractor shall set his own offset references for clearing limits.

3.2 TIMEFRAME LIMITATIONS

A. Land disturbance and vegetative clearing activities will not be performed between May 5 and July 25 any given year.

3.3 CLEARING

A. Clearing work shall be confined to the minimum areas necessary for construction. In no case shall clearing extend beyond the limits of existing easements on private property.

B. Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be cut off flush with or below the original ground surface.

C. Debris resulting from said clearing shall be disposed of by the Contractor as described in Paragraph 3.5 and disturbed areas shall be cleaned up in a neat and workmanlike manner.

D. No logs, stumps, rocks, etc., shall be left lying in the right-of-way or on adjacent property without specified written approval by the Owner.

3.4 GRUBBING

A. Grubbing shall be minimized to avoid damage to existing tundra surface but may be performed within all areas designated for clearing as required for construction access.

3.5 DAMAGED VEGETATION

A. Neatly trim torn limbs and trunks or severed roots.

B. Apply suitable wound paint to cuts more than 1-1/2 inches in diameter.

3.6 DISPOSAL

A. Contractor shall comply with all laws and regulations that govern burning and shall secure necessary permits.

B. When burning is permitted, it shall be done under the constant care of competent watchmen such that surrounding property or vegetative cover is not damaged.

C. Materials cleared or grubbed from private property may be claimed by property owner for use. Contractor shall notify property owner of material availability and remove and dispose of all non-claimed material and debris from property.

D. Contractor may sell any non-claimed marketable material.

E. Material and debris not burned, transferred or sold shall be disposed of by Contractor in accordance with Section 024119 Selective Demolition.

END OF SECTION

SECTION 31 23 16
EXCAVATION

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Provide adequate survey control to avoid unauthorized over-excavation.

1.2 WEATER LIMITATIONS

A. Material excavated when frozen or when air temperature is less than 32 degrees F shall not be used as fill or backfill until material completely thaws.

B. Material excavated during inclement weather shall not be used as fill or backfill until after material drains and dries sufficiently for proper compaction.

C. When air temperature is equal to or greater than 32 degrees F the excavation shall be backfilled by the end of a work day and shall not be left open overnight.

1.3 CONTRACTOR'S RESPONSIBILITY

A. Contractor shall install and maintain shoring, sheeting, bracing, and sloping as necessary to support sides of excavations and prevent detrimental settlement and lateral movement of existing facilities, adjacent property, and completed Work.

B. Contractor shall be solely responsible for making all excavations in a safe manner. All excavation work shall be conducted in accordance with OSHA and other applicable governmental regulations and agencies.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

A. Excavate to lines, grades, and dimensions shown and as necessary to accomplish Work.

B. Do not over-excavate without authorization of the Engineer.

3.2 STOCKPILING EXCAVATED MATERIAL

A. Stockpile excavated material that is suitable for use as fill or backfill until material is needed.

B. Material that meets the requirements of Section 31 05 13 may be reused for backfill.

C. Post signs indicating proposed use of material stockpiled. Post signs that are readable from all directions of approach to each stockpile. Signs should be clearly worded and readable by equipment operators from their normal seated position.

D. Confine stockpiles to within easements, rights-of-way, and approved work areas. Do not obstruct road or streets.

E. Do not stockpile excavated material adjacent to trenches and other excavations unless excavation sideslopes and excavation support systems are designed, constructed, and maintained for stockpile loads.

F. Do not stockpile excavated materials near or over existing facilities, adjacent property, or completed Work, if weight of stockpiled material could induce excessive settlement.

3.3 DISPOSAL OF SPOIL

A. Dispose of excavated materials, which are unsuitable or exceed quantity needed for fill or backfill in accordance with Section 024119 Selective Demolition.

B. Dispose of debris resulting from removal of organic matter, trash, refuse and junk as specified in Section 311000, Clearing and Grubbing, for clearing and grubbing debris.

END OF SECTION

SECTION 31 23 19

DEWATERING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Dewatering system.
2. Surface water control system.
3. System operation and maintenance.
4. Water disposal.

B. Related Sections:

1. Section 31 05 13 – Soils for Earthwork.
2. Section 31 23 16 – Excavation.

1.2 DEFINITIONS

A. Dewatering includes the following:

1. Lowering of ground water table and intercepting horizontal water seepage to prevent ground water from entering excavations.
2. Disposing of removed water in compliance with permits.

B. Surface Water and Groundwater Control: Removal of surface water and groundwater within open excavations.

1.3 SYSTEM DESCRIPTION

A. Provide dewatering and surface water control systems to permit Work to be completed on dry and stable subgrade.

B. Furnish standby equipment stored at Project site and ready for immediate use upon failure of dewatering equipment, including pumps and portable generators.

1.4 REFERENCES:

A. Alaska Department of Environmental Conservation (ADEC):

1. AKR100000 - General Permit for Discharges from Large and Small Construction Activities.
2. Alaska Storm Water Guide - December 2011.
3. ADEC User's Manual - Best Management Practices for Gravel/Rock Aggregate Extraction Projects - September 2012.
4. AKG002000 – Excavation Dewatering General Permit

1.5 PERFORMANCE REQUIREMENTS

A. Design dewatering systems to:

1. Permit Work to be completed on dry and stable subgrade.
2. Prevent damage to adjacent properties, buildings, structures, utilities, and facilities from construction operations.
3. Prevent loss of fines, quick condition, or softening of foundation subgrade.
4. Maintain stability of sides and bottoms of excavations.
5. Prevent the pollution of nearby water bodies, including drainages, ponds, lakes and rivers.

B. Design surface water and groundwater control systems to:

1. Collect and remove surface water and seepage entering excavation.

C. Project Conditions: Contractor shall anticipate, provide labor and equipment for, and conduct winter time dewatering operations as may be needed to excavate or construct fills to meet the requirements of the Work.

1.6 ENVIRONMENTAL CONTROLS

A. Dewatering Plan:

1. At least ten days prior to conducting dewatering operations submit an ADEC-approved dewatering plan and operation schedule for dewatering of each excavation for review by the Architect/Engineer.
2. Acceptance of the Contractor’s dewatering plan by the Architect/Engineer shall not relieve the Contractor of the responsibility of exercising reasonable precaution, sound engineering judgment, prudent construction practices, overloading or misuse of existing or new structures, the adequacy and safety of such work, and potential damage or undermining of existing or completed work.

1.7 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Permits:

1. Submit copy of ADEC Dewatering Permit to Architect/Engineer with dewatering plan no later than 10 business days prior to conducting dewatering operations.

C. Shop Drawings:
   1. Dewatering System:
      a. Indicate dewatering system layout, dewatering pump locations, pipe sizes and capacities, surface water and groundwater control devices, valves, and water disposal method and location.
      b. Indicate primary and standby power system location and capacity.
      c. Include detailed description of dewatering and monitoring system installation procedures and maintenance of equipment.
      d. Include description of emergency procedures to follow when problems arise.

D. Product Data: Submit data for each of the following:

   1. Dewatering Pumps: Indicate sizes, capacities, priming method, characteristics.
   2. Pumping equipment for control of surface water within excavation.

E. Field Reports: Test and monitoring reports as specified in Field Quality Control article.

1.8 QUALITY ASSURANCE

A. Comply with State and Federal authorities having jurisdiction for the following:

   1. Water discharge and disposal from pumping operations.

      a. Under no circumstances shall dewatered volumes be discharged into any water body, unless treated in an ADEC-approved manner to produce an effluent that meets State water quality standards or meets discharge permit standards, whichever is most stringent. Testing to verify sufficient effluent water quality shall be provided by the Contractor at no additional cost to the Owner.
      b. Any violations, and therefore any penalties and fines resulting from such violations, regarding disposal of dewatering effluent shall be borne solely by the Contractor.

B. Provide Storm Water Pollution Prevention Plan (SWPPP) in accordance with EPA under National Pollutant Discharge Elimination System (NPDES), for storm water discharge from construction sites.

      a. See Section 312316, Excavation, for SWPPP requirements.

C. Perform Work in accordance with State of Alaska Department of Environmental Conservation (ADEC) Dewatering Permit obtained by Contractor.

D. Maintain one copy of SWPPP document on site.

1.9 SEQUENCING

A. Sequence work to obtain required permits before start of dewatering operations.

B. Sequence work to install and test dewatering and surface water control systems minimum 7 days before starting excavation.

1.10 COORDINATION

A. Section 013100 – Project Management and Coordination: Requirements for coordination.

B. Coordinate work to permit the following construction operations to be completed on dry stable substrate.

1. Excavation specified in Section 312316, Excavation.
2. Stockpile soil as permitted and as specified in Section 310513, Soils for Earthwork.

PART 2 - PRODUCTS

2.1 DEWATERING EQUIPMENT

A. Select dewatering equipment to meet specified performance requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Contractor shall document existing conditions of project site and neighboring area prior to starting work.

B. Conduct additional borings and investigations to supplement subsurface investigations as required to complete dewatering system design.

3.2 PREPARATION

A. Protect existing adjacent buildings, structures, and improvements from damage caused by dewatering operations.

3.3 DEWATERING SYSTEM

A. Install dewatering system in accordance with shop drawings.

B. Locate system components to allow continuous dewatering operations without interfering with installation of permanent Work and existing public rights-of-way, and adjacent buildings, structures, and improvements.

3.4 SURFACE WATER AND GROUNDWATER CONTROL SYSTEM

A. Provide Best Management Practices (BMPs) for controlling drainage from surface water, groundwater and dewatering efforts and mitigating pollution as required in ADEC AKR100000 - *General Permit for Discharges from Large and Small Construction Activities*.

B. Provide ditches, berms, and other devices in the limits of excavation to divert and drain surface water and groundwater from the area being excavated as specified in Section 312316 - Excavation.

C. Control and remove unanticipated seepage into excavation from surface water and groundwater.

D. Divert surface water and groundwater seepage within excavation areas into sumps and pump water into drainage channels and settling basins to minimize water turbidity in accordance with ADEC dewatering permit requirements.

E. Control the rate and effect of dewatering in such a manner as to prevent all objectionable sedimentation, erosion and subsidence.

F. Perform dewatering operation as to:

1. not destroy or weaken the strength of the soil under or alongside the excavation.
2. prevent excavated soil and soil yet to be excavated from becoming saturated with groundwater, gaining excessive water content, or otherwise becoming unsuitable for use in the Work.
3. avoid contamination of surrounding environment.

3.5 SYSTEM OPERATION AND MAINTENANCE

A. Operate dewatering system continuously until excavation and fill construction is complete.

B. Provide 24-hour supervision of dewatering system by personnel skilled in operation, maintenance, and replacement of system components.

C. Conduct daily observation of dewatering system and monitoring system. Make required repairs and perform scheduled maintenance.

D. Fill fuel tanks before tanks reach 25 percent capacity.

E. Start emergency generators at least twice each week to check operating condition.

F. When dewatering system cannot control water within excavation, notify Architect/Engineer and stop excavation work.

1. Supplement or modify dewatering system and provide other remedial measures to control water within excavation.
2. Demonstrate dewatering system operation complies with performance requirements before resuming excavation operations.

G. Modify dewatering and surface water control systems when operation causes or threatens to cause damage to new construction, existing site improvements, adjacent property, or adjacent water wells.

H. Correct unanticipated pressure conditions affecting dewatering system performance.

I. Do not discontinue dewatering operations without Architect/Engineer's approval.

3.6 WATER DISPOSAL

A. Discharge water into drainage channels and settling basins in accordance with ADEC Dewatering Permit and SWPPP.

B. Water shall be disposed of in accordance with the discharge permit and ADEC-approved dewatering plan, and as not to cause injury to public or private property or to cause a nuisance or menace to the public.

C. Contractor's failure to obtain or abide by the stipulations set forth in the ADEC-approved dewatering plan and discharge permits shall give the Owner sufficient justification to suspend all work until deficiencies are corrected to the satisfaction of the Engineer. Such work suspension shall not be eligible for additional compensation in extra payment or Contract time.

D. Construction of temporary facilities to dispose of water shall be incidental to the cost of construction.

3.7 SYSTEM REMOVAL

A. Remove dewatering and surface water control systems after dewatering operations are discontinued.

3.8 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements and Section 017000 - Execution Requirements: Field inspecting.

END OF SECTION

SECTION 31 25 13
EROSION CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Site Stabilization.

B. Related Sections:
   1. Section 31 05 13 - Soils for Earthwork.
   2. Section 31 10 00 - Site Clearing.
   3. Section 31 23 16 - Excavation.
   4. Section 32 90 01 – Landscape Restoration

1.2 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

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

1.3 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with requirements of Section 31 05 13, Section 31 10 00, Section 31 23 16, and Section 32 90 01, as applicable.

B. Perform Work in accordance with SWPPP.

C. Maintain one copy of SWPPP on site.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.

PART 2 - PRODUCTS

2.1 EROSION AND SEDIMENT CONTROL

A. Provide, implement and comply with Storm Water Pollution Prevention Plan (SWPPP) in accordance with State of Alaska Department of Environmental Conservation (ADEC) requirements and guidelines. Submit a Notice-of-Intent (NOI) prior to construction.

B. Plan and execute construction by methods to control surface drainage from cuts and fills from borrow and waste disposal areas. Prevent erosion and sedimentation.

C. Minimize surface area of bare soil exposed at one time.

D. Provide temporary measures including fiber matrix covering, berms, dikes, drains, and other devices to prevent erosion and sedimentation.

E. Construct fill and waste areas by selective placement to avoid erosive surface silts and clays.

F. Periodically inspect earthwork to detect evidence of erosion and sedimentation. Promptly apply corrective measures.

G. Best management practices shall be used for erosion control where ground disturbance occurs.

2.2 PLANTING MATERIALS

A. Seeding and Soil Supplements: as specified in Section 32 90 01, Landscape Restoration.

2.3 EROSION CONTROL FIBER COMPOUND:

A. Fiber compound may be applied by hand, mechanically, hydraulically or aerially as specified by manufacturer.

B. Material shall meet the following requirements:

1.	Cellulose Fiber	> 85%
2.	Corn Fiber	> 10%
3.	Fiber Stabilizing Compound	> 1%
4.	pH	6.5% ± 0.4%
5.	Moisture Content	10% ± 2%
6.	Non-Toxic To Plant and Animals	Yes

C. Product application rate and soil preparation shall conform to manufacturer's requirements for the specific type of soil, slope and weather of the region. Grade and track-walk the areas to be covered in accordance with manufacturer's recommendations.

D. Seed and Fertilizer may be combined with product during application; See Section 32 90 01, Landscape Restoration.

E. Product: EarthGuard Fiber Matrix or Edge pellets, as manufactured by Terra Novo, Inc., or approved equal.

2.4 SOURCE QUALITY CONTROL (AND TESTS)

A. Section 01 40 00 - Quality Requirements: Testing, inspection and analysis requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify subgrade or stabilized soil is acceptable and ready to support devices and imposed loads.

C. Verify gradients and elevations of base or foundation for other work are correct.

3.2 SITE STABILIZATION

A. Incorporate erosion control devices at the earliest practicable time.

B. Construct, stabilize and activate erosion controls before site disturbance within tributary areas of those controls.

C. Stockpile and waste pile heights shall not exceed 8 feet. Slope stockpile sides at 2H:1V or flatter.

D. Stabilize any disturbed area of affected erosion control devices on which activity has ceased and which will remain exposed for more than 20 days.
   1. During non-germinating periods, apply mulch at recommended rates.
   2. Stabilize disturbed areas which are either at finished grade or will not be disturbed within one year in accordance with Section 32 90 01 permanent seeding specifications.

E. Stabilize constructed slopes and embankments, diversion channels and stockpiles immediately:
   1. With exception to the area noted below in 3.2 E.2, all constructed slopes and embankments and temporary stockpile areas, including landfill, dump close-out and borrow areas, shall be stabilized with erosion control fiber compound in accordance with the manufacturer's instructions,
   2. The flat fill area over the existing dump pond need not receive erosion control fiber compound soil stabilization provided that the required grading plan and the SWPPP in association is followed to prevent any transport of silt outside of the pond area.
   3. Other areas disturbed by construction or otherwise needing stabilization may be stabilized with the use of erosion control fiber compound or jute mesh installed in accordance with the manufacturer's instructions.

4. All embankments, stockpiles left in place and disturbed areas shall be seeded in accordance with Section 32 90 01, Landscape Restoration.

3.3 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements and Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

B. Inspect erosion control devices on a weekly basis and after each runoff event. Make necessary repairs to ensure erosion and sediment controls are in good working order.

C. Compaction Testing: As specified in Section 31 05 13 – Soils for Earthwork.

3.4 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.

B. Do not damage surface grading and established vegetation during cleaning operations.

C. Do not permit sediment to erode into construction or site areas or natural waterways.

D. Clean channels when depth of sediment reaches approximately one half channel depth.

3.5 PROTECTION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.

END OF SECTION

DIVISION 32 EXTERIOR IMPROVEMENTS

SECTION 32 32 23

BINWALL RETAINING WALLS

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 applies to construction of Binwall retaining walls.

Related Sections include the following:

1. Section 31 05 13 – Soils for Earthwork
2. Section 31 23 16 - Excavation.

1.3 DEFINITIONS

A. Bin Wall: A system of adjoining closed faced bins bolted together to form a gravity-type retaining wall.

1.4 SUBMITTALS

A. Product Data
B. Shop Drawings showing wall construction and assembly details.
   1. Note: if shop drawings show any deviations from the construction plans such deviations shall be accompanied by appropriate engineering calculations stamped by a professional engineer registered in the state of Alaska.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials under cover and protect from inclement weather and impact hazards. If open deck ocean shipping is anticipated fully shrink wrap to protect against salt spray.

PART 2 - PRODUCTS

2.1 BINWALL, GENERAL

A. General: Galvanized materials conforming to ASTM A 929.

B. Minimum 12 gauge (0.109”) steel

C. All materials to be hot-dip galvanized.

D. Contech Type 2 Bin-Wall, or approved equal

2.2 BINWALL CONNECTORS

A. Vertical Connectors: Steel conforming to ASTM A 123, hot-dip galvanized per ASTM A 123 except coating weight shall be 2 ounces per square foot coating total both sides.

B. Fasteners: 5/8” diameter (min) conforming to ASTM A 307, hot-dip galvanized.

2.3 BINWALL FILL

A. Bin fill material shall be sand fill material per section 31 05 13.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Assembly shall be in conformance with the manufacturer’s recommendations and the project plans and specifications.

B. Torque bolts IAW manufacturer’s recommendations.

3.2 FILL & BACKFILL

A. Bin fill shall be placed in 6” max lifts and shall be compacted to 95% max density.

B. Place bin fill material prior to beginning backfilling wall.

C. Bench soil slopes as necessary in order to allow for safe and efficient backfill placement and compaction.

D. Refer to section 31 23 16 for additional information on excavation, site preparation, embankment construction, compaction, grading, and maintenance.

END OF SECTION

SECTION 32 90 01
LANDSCAPE RESTORATION

PART 1 - GENERAL

1.1 SUBMITTALS

A. Duplicate copies of a statement signed by the vendor certifying that each lot of seed has been tested by a recognized seed testing laboratory within 6 months be-fore the date of delivery on the project.

B. Duplicate copies of certification from grower certifying the grass species.

1.2 JOB CONDITIONS

A. Areas landscaped and/or seeded prior to construction shall be restored to their original condition.

B. Unless otherwise specified, the Contractor shall reseed grassed areas that are disturbed during construction.

C. Grass:
   1. Grass shall be sown in all areas that are excavated or disturbed during construction.
   2. Grass seeding shall follow backfilling operations by not more than 3 weeks.
   3. Weekly seeding shall be required for projects in which all backfilling cannot be completed in 3 weeks.

D. All areas to be planted, seeded or sodded shall be accomplished in accordance with this Section.

E. Except for road shoulders all non-paved areas within the cleared limits and other areas disturbed as a result of the work of this contract shall be graded to match undisturbed existing ground level or final grade as shown on the Plans and seeded in accordance with this Section, unless otherwise indicated or directed by the Engineer.

PART 2 - PRODUCTS

2.1 GRASS SEED

A. Grass seed of the type hereinafter specified shall conform to the standards of State Department of Agriculture.

B. Seed shall be furnished in standard unopened containers on which shall be shown the following information:

1. Common name of seed
2. Lot number
3. Net weight
4. Percentage of purity
5. Percentage of germination (in case of legumes percentage of germination to include hard seed)
6. Percentage of weed seed content and inert material clearly marked for each kind of seed in accordance with applicable state and federal laws.

C. Seed Mix:
1. 'Norcoast' Bering hairgrass 45% by weight
2. 'Arctared' red fescue 35% by weight
3. 'Alyeska' polargrass 20% by weight

2.2 FERTILIZER

A. General:
1. Fertilizer shall be a standard commercial grade of organic or inorganic fertilizer of the kind and quality specified herein.
2. It may be separate or in a mixture containing the percentage of total nitro-gen, available phosphoric acid, and water-soluble potash in the amounts specified.
3. All fertilizers shall be furnished in standard unopened containers with weight, name of plant nutrients, and manufacturer's guaranteed statement of analysis clearly marked all in accordance with state and federal laws.
4. Fertilizer shall be ground to fineness as required for the method of application.

B. Fertilizer for Seeded Areas:
1. Total Nitrogen 20%
2. Available Phosphoric Acid. 20%
3. Water Soluble Potash 10%

PART 3 - EXECUTION

3.1 GRASS SEEDING

A. Seeding shall not be done during windy weather or when the ground is frozen, excessively wet or otherwise untillable.

B. The finish grade of all areas to be planted with grass shall be smooth, without visible depressions or mounds.

C. After establishing the finish grade, all areas shall be hand raked, rolled and again hand raked, removing all rocks, weeds and debris.

D. Commercial fertilizer shall be applied at the rate of 6 pounds per 1,000 square feet.

E. Grass seed shall be seeded over all areas to be put into lawn at the rate of 30 pounds per 1,000 square feet.

F. The exact time for seeding will be determined by actual weather conditions. The normal satisfactory periods for seeding shall be considered as being between May 15 and August 15.

G. Maintenance:
   1. Maintenance shall commence immediately on planting and the lawn area shall be kept damp for 10 days to 2 weeks.
   2. Protect all seeded areas by watering, mowing and replanting as necessary for at least 30 days and as long as necessary to establish a uniform growth of grass, and a minimum of two cuttings.

H. When delays in operations carry the work beyond the most favorable planting season, or when weather conditions are such that satisfactory results are not likely to be obtained for any stage of the seeding operations, the CONTRACTOR will stop the work and it shall be resumed only when the desired results are likely to be obtained or when approved alternates or corrective measures and procedures are adopted.

I. The Contractor shall protect all seeded areas from erosion until final inspection and acceptance has been made; areas damaged by erosion shall be repaired by the CONTRACTOR at his own expense.

3.2 FINAL INSPECTION

A. Final inspection for seeded areas will not be made until 30 days following installation of all seeding and fertilizing as specified.

B. Damage caused by the Contractor to areas which have been seeded shall be repaired and/or replaced by the Contractor at his own expense.

3.3 GUARANTEE

A. Guarantee of planting and seeding shall continue for 1 calendar year from date of final acceptance.

B. Contractor shall reseed all grass dead or dying within the guarantee period.

C. Guarantee shall include both materials and labor. Replacements shall be the same as originally planted.

END OF SECTION

DIVISION 33 UTILITIES

SECTION 33 05 23.13

HORIZONTAL DIRECTIONAL DRILLING

PART 1 - GENERAL

1.1 DESCRIPTION

A. WORK in this Section shall consist of furnishing all labor, equipment, and materials necessary to install the high-density polyethylene (HDPE) pipeline by horizontal directional drilling (HDD). This WORK shall include all services, equipment, materials and labor for the complete and proper installation, testing, restoration of underground utilities and environmental protection and restoration.

B. Work in this Section also includes the purchase of an underwater video inspection camera, lighted marker buoy and underwater pipe locator equipment.

C. Related Requirements:

1. Section 31 25 13 Erosion Controls
2. Section 33 05 33 Polyethylene Utility Pipe

1.2 GENERAL REQUIREMENTS

A. The Contractor shall install the pipeline to the horizontal and vertical alignment shown on the Plans and shall complete all associated WORK described in this Section.

B. The Contractor is responsible for knowledge of all permits as well as local, state, and federal codes, standards, or statutes related to the WORK he performs. The Contractor shall install the system in compliance with such regulations and shall notify the ENGINEER immediately of any discrepancies.

C. Work shall conform to applicable requirements of the ADF&G permit.

1.3 SUBMITTALS

A. Submit the following in accordance with the requirements of Section 01 33 00- Submittal Procedures, providing sufficient detail to allow the ENGINEER to judge whether the proposed equipment, materials, and procedures meet the Contract requirements. Review and acceptance of the Contractor's Submittals by the ENGINEER shall not be construed in any way as relieving the Contractor of its responsibilities under this Contract.

1. Horizontal Directional Drilling Work Plan: Submit a general work Plan outlining the procedure and schedule used to execute the project. The Plan should be complete with drawings and written description identifying details of the proposed method of construction, the sequence of operations to be performed during construction and schedule of all major construction activities and durations, with starting and completion dates. The Contractor shall include sketches depicting the layout and locations of equipment within the rig side work area and pipe side work area, including any proposed drilling fluid containment and recirculation pits. If work is to occur at night Contractor's plan shall include details on how to minimize noise and impact to public and comply with local ordinances.
2. Offshore Work Plan: Provide a written description of offshore work, including:
    a. The proposed equipment to be used offshore.

b. The proposed method of retrieving the drill stem from the river bottom.

c. The plan to secure the product pipe during pullback.

d. The plan to monitor the progress of the pullback near completion, including while the pipe is underwater.

e. The plan to position and sink the river intake.

f. The bore tracking system to be used.

g. The plan to visually mark the borepath on the river surface.

3. Description of Equipment and Materials: Submit detailed descriptions of equipment and materials to be used for the pipeline installation. Material shall include the pipe, fittings, and any other item which is to be an installed component of the project. Descriptions of equipment shall include manufacturers' specifications, calibrations, appropriate drawings, photographs, and descriptions of any modifications since manufacture.

4. Surveying, Equipment and Procedures: Submit records of equipment calibrations and certifications for all equipment used for tracking the drill head.

5. Plans for Disposal of Spoils and Drilling Fluids: Submit plans for disposal of waste materials resulting from the pipeline construction, including drilling fluids, cuttings, waste oil, fuel, discharge water, etc.

6. Contingency Plans for Potential Problems: Submit contingency plans for remediation of potential problems that may be encountered during the drilling operations. The contingency plans shall address the observations that would lead to the discovery of the problem and the methods that would be used to mitigate the problem. Potential problems that shall be addressed include:

   a. Utility strike.

   b. Loss of circulation.

   c. Drill pipe twisted off or broken off in borehole.

   d. Pipe collapses or pipe deformations exceed maximum allowable tolerances.

   e. Over-excavation or creation of voids or cavities: Descriptions of methods, equipment, and materials that would be used for grouting any such areas.

   f. Frac-out and Surface Spill: Containment and cleanup equipment shall be provided by the contractor. Descriptions of methods, equipment and materials that would be used for cleaning up a surface spill.

   g. Tidal influence into work area

   h. Excessive pullback of product pipe into the ground.

7. Safety Plan: Submit a Safety Plan, including the name of the Contractor's Site Safety Representative, emergency telephone numbers for medical facilities, and precautions for handling and disposal of any hazardous or flammable materials. The Safety Plan should include a code of safe practices and an emergency plan in accordance with OSHA requirements.

8. Contractor Qualifications: Submit a description of the qualifications of the HDD project manager and operator as described in this specification.

9. Bore Track Layout Plan: Submit a plan that identifies the design bore location on 20 foot intervals along the bore path. At each 20-foot interval the plan shall include the station number, existing surface elevation, bore path elevation and vertical distance from the existing surface to the bore path.

B. The following shall be submitted as construction progresses and at the completion of construction.

1. Daily Logs and Records: Submit complete, legible, written daily logs and records as called for in Paragraph 1.4 A of this specification and as directed by the ENGINEER, by noon of the following day to which the records correspond.

2. Variations in Plan and Profile: The Contractor shall document any variations between the actual plan and profile of the bore path and the location shown on the plans and specifications herein. The CONTRACTOR shall notify the ENGINEER immediately upon discovery of any deviations.

3. Pressure Test Records: Submit all pressure test records for both the pre-installation and post-installation tests

1.4 QUALITY ASSURANCE

A. Daily Logs and Records: Daily logs and records shall be maintained by the Contractor and shall include drilling lengths, location of drill head, installation loads, inadvertent returns, drilling times required for each pipe joint, any instances of retraction and re-drilling of the pilot bore or segments thereof, and any other relevant observations, including any observed settlement, heave, frac-outs, or surface spills. The position of the drill head shall be tracked and a plot of actual locations of the bore path shall be maintained and updated daily, or more frequently, as directed by the ENGINEER.

B. Advance Notice and Inspections: Provide written notice to the ENGINEER at least two weeks in advance of the planned inception of major drilling activities, including pilot bore launch, pre-reaming, reaming, pipe pullback, and mobilization to Emmonak. The Contractor shall immediately notify the ENGINEER, in writing, when any significant problems are encountered or if ground conditions are considered by the Contractor to be materially and significantly different from those represented within the Contract Documents.

C. Pipe: The pipe shall be certified by the Contractor as meeting all requirements of the specifications. The fabricated pipe shall be pressure-tested by the Contractor prior to pullback and after installation is completed.

D. If the Contractor is using a radio system for communication between the driller and the drill bit locator crew, the Contractor shall provide to the ENGINEER, if requested, one operable radio unit that the ENGINEER can use to monitor the drilling WORK.

1.5 DESIGN CRITERIA

A. The drilling equipment shall be capable of advancing through the geologic conditions to be encountered at the site, as described in the geotechnical information provided and as anticipated by the Contractor. The directional drilling machine shall consist of a hydraulically powered system to rotate, push and pull hollow drill pipe into the ground at a variable angle while delivering a pressurized fluid mixture to a guidable drill (bore) head. Contractor shall also have available to them drill heads and reamers that are designed to advance through boulders and other large rocks.

B. The drilling fluid shall be designed for the geologic conditions to be encountered at the site, as described in the Geotechnical Investigation and as anticipated by the Contractor. Drilling fluid shall be composed of clean water, bentonite and an appropriate additive to maintain a viscosity sufficient to suspend cutting and maintain the integrity of the bore wall.

C. The drilling system shall include a fluid pump and mud reclaimer/separation plant that can achieve the rates of drilling fluid pumping, spoil separation, and slurry cleaning required by the Contractor to achieve planned production rates for the soils described in the Geotechnical Investigation, and as anticipated by the Contractor. The drilling fluid reservoir tank shall be sized for adequate storage of the drilling mud.

D. All spoil and slurry must be contained in trucks, tanks, approved recirculation pits, or other containers at all times. Dumping of spoil or slurry on the ground, discharge into sewers, or discharge into the water bodies shall not be permitted. All drilling mud spoils shall be dewatered with chemical additives and/or through the use of mechanical equipment and disposed of at the Emmonak Landfill.

E. Perform all WORK within work areas, easements or street right of way, if shown on the Plans.

F. The pipeline shall be installed using the radii of curvatures and entry and exit angles shown on the Plans, unless deviations are approved in writing by the ENGINEER.

G. Surface settlement or heave of utilities and other features above the HDD centerlines and within the zone influenced by the HDD construction shall not cause damage. The Contractor shall repair any damage resulting from settlement or heave caused by HDD activities at no additional cost to the OWNER. The Contractor shall grout voids caused by or encountered during drilling.

H. Safety: It shall be the Contractor’s sole responsibility that all work is done in conformance with all applicable federal, state, and local safety requirements. Required safety equipment and procedures shall be employed by the Contractor at all times. All materials and methods of construction shall meet the applicable requirements of the Construction Safety Orders of the State of Alaska Department of Industrial Relations and Division of Occupational Safety and Health.

I. The Contractor shall allow the ENGINEER access to and shall furnish necessary assistance and cooperation to aid the ENGINEER in observations and data and sample collection, including full access to the operator controls prior to, during, and following all HDD operations. This shall include, but not be limited to, providing visual access to real-time operator gauges, and indicators.

1.6 CONTRACTOR EXPERIENCE AND QUALIFICATIONS

A. Construction of HDD work requires that the Contractor have demonstrated experience in constructing pipelines at similar pipe diameters and installation lengths and depths using HDD construction practices. At least four (4) years of recent experience constructing HDD projects is required

B. Demonstrated Experience: Submit the following information for the most recent five HDD projects completed: project name and location; OWNER; name of contact person; contact person's current telephone number; HDD bore diameter, depth, and length; casing/product pipe diameter and material; project manager; HDD driller; and description of all litigation and unresolved claims in conjunction with these contracts.

C. Project Manager: Submit the name(s) and resume(s) of the project manager(s) who will be assigned to the project. The proposed project manager(s) shall have at least four years of appropriate HDD experience. Individual resume(s) shall provide a detailed experience summary including the following: the name of each project; description of project; position held; employer; responsibilities; and a reference and phone number of all HDD construction assignments in the last five years. Submit the name, resume and experience summary of alternate project manager(s) who will be assigned to this project in the event the proposed project manager(s) becomes unavailable. The alternate project manager(s) must satisfy the above experience requirement.

D. HDD Operator: Submit the name(s) and resume(s) of the HDD operator(s) who will be assigned to the project. The proposed HDD operator shall have at least three years of appropriate HDD experience. Experience shall include at least five HDD projects with pipe diameters between 6 and 12 inches and installation lengths of 700 feet or longer. The proposed HDD Operator shall have at least two river crossings of greater than 200 feet in length. The individual resume(s) shall provide a detailed experience summary including the following: the name of each project; project location; OWNER's representative and phone number; description of project; length, depth, and diameter of the HDD installation; diameter of the casing/carrier pipe, geotechnical conditions, and machine type and manufacturer. Submit the name, resume and experience summary of alternate HDD operator(s) who will be assigned to this project in the event the proposed HDD operator(s) becomes unavailable for any of this assignment. The alternate HDD operator(s) must satisfy the above experience requirement.

PART 2 - PRODUCTS

2.1 HIGH DENSITY POLYETHYLENE PIPE AND FITTINGS

A. HDPE pipe shall be SDR 11 and confirm to the requirements of section 33 05 33 Polyethylene Utility Pipe.

2.2 WATER

A. The Contractor shall pump and use raw water from Kwiguk Pass slough or the city water supply for the drilling Work. The Contractor will be responsible for providing a pump suitable for water demand the Contractor deems necessary to perform the Work. The Contractor shall be responsible for transporting, storing, and disposing of any water required.

2.3 DRILLING FLUID

A. Select drilling fluid mixture proportions to ensure continuous circulation, bore stability, reduce drag on the pipe, and completely fill the annular space between the bore and the pipe to control settlement. Management and disposal of drilling fluids shall be the Contractor's responsibility.

2.4 DRILL PIPE

A. Provide high quality drill pipes that have been inspected and determined to be adequate for the project requirements. Bent, cracked, or fatigued drill pipes shall not be used. Threads must be in good condition. The lengths of each drill pipe shall be measured and recorded.

2.5 UNDERWATER INSPECTION CAMERA

A. Provide an underwater camera that will be used by the OWNER for periodic inspection of the water pipe intake. The camera system shall include the following components as supplied by JW Fishers Mfg. Inc. 1953 County Street, East Taunton, Massachusetts 02718:

3. MC-2 Mini Camera
4. External 1500 lumen light
5. Adaptor for pole mounting
6. VRM-2 video recorder and monitor

B. Also provide the following support equipment:

1. Portable generator, Honda EU2000i or similar
2. 120V extension cord, 25 feet long
3. Pole for mounting the camera, 30 feet long minimum when extended.

2.6 LIGHTED BUOY AND ANCHOR

A. Furnish and install a lighted buoy and anchor to mark the water intake location after the intake is in place. See the Drawings for a description of the buoy, light, anchor and connecting rope, chain and fittings.

2.7 SUBSURFACE LOCATOR EQUIPMENT

A. Provide a subsurface utility locator unit that will be used by the OWNER to assist with locating the intake pipe. The locator shall be an AML PRO as manufactured by SubSurface Instruments, Inc. The equipment shall be provided with the durable carrying case, headphones, user guide, battery packs and auxiliary rechargeable lithium battery kit.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide adequate control of surface water and drilling fluids drainage and runoff, and provide silt fences, and wattles to prevent surface water or drilling fluids from entering adjacent storm drains or streams. Erosion and sediment control shall comply with Section 31 25 13-Erosion Controls

B. The Contractor shall not initiate mobilization to Emmonak until all submittals are received, reviewed, and accepted by the ENGINEER.

C. The Contractor shall not begin HDD drilling work until all required permits are obtained.

D. The Contractor shall have onsite the equipment necessary to clean-up and contain an inadvertent surface spill or frac-out.

E. Provide all miscellaneous support equipment needed to perform work on the waters of Kwiguk Pass slough. Miscellaneous support equipment includes but is not limited to: boats, personal flotation devices, anchors, ropes, divers, equipment lighting, pole cameras, probes, sounding tapes, boat hooks, and grappling hooks. All offshore work must comply with federal boating regulations for navigable waters.

3.2 BORE TRACK LAYOUT PLAN

A. Submit a plan that identifies the design bore location on 20 foot intervals along the bore path that is located onshore. At each 20-foot interval the plan shall include the station number, existing ground surface elevation, bore path elevation and vertical distance from the existing ground surface to the bore path.

3.3 PROTECTION OF UNDERGROUND UTILITIES

A. The Contractor shall request marking of buried utilities and shall individually notify all other OWNERs of known or suspected buried utilities to request marking of these utilities. The Contractor shall confirm that all requested locates are made prior to commencing drilling operations. Make all diligent efforts to locate any unmarked or abandoned utilities using all available information, maps, and drawings. The Contractor shall confirm and stake all existing lines, cables, or other underground facilities including crossing utilities and utilities within twenty (20) feet laterally of the designed drilled path.

B. The Contractor shall control drilling practices to prevent damage to existing utilities

C. The Contractor shall be responsible for all losses and repairs occasioned by damage to underground utilities resulting from drilling operations.

3.4 WORK STAGING AREA

A. All Work Staging: Limit staging and work operations to the work areas shown on the plans.

1. Entry Area: The Contractor shall set up a temporary work space. Appropriate precautions and measures shall be employed by the Contractor to prevent erosion, surface drainage, and spillage of drilling fluids or other materials that could adversely impact the environmental quality of the site.

2. Pipe Layout Area: Layout area shall be free of stones, wood, debris and obstructions.

B. Construction Impacts: Maintain the work area in a manner that shall minimize adverse impacts on other public use activities. The Contractor shall proceed with WORK in a safe, orderly manner, while maintaining the work site free of debris and unnecessary equipment and materials

C. Control of Drilling Fluids: Follow all requirements of the Frac-Out and Surface Spill Contingency Plan and control operational pressures, drilling mud weights, drilling speeds, and any other operational factors required to avoid hydrofracture fluid losses into the formation, and control drilling fluid spillage. This includes any spillages, inadvertent fluid, or slurry returns at entry and exit locations or at any intermediate point. All inadvertent returns or spills shall be promptly contained and cleaned up. The Contractor shall maintain on-site mobile spill containment and removal equipment during all drilling, pre-reaming, reaming, and pullback operations and shall be capable of quickly containing and removing spills. The Contractor shall immediately notify ENGINEER of any inadvertent returns or spills and immediately clean up the inadvertent return or spill.

D. Disposal of Drilling Fluids: Drilling fluids shall not be disposed of on-site or discharged to sanitary or storm sewers, wetlands, Kwiguk Pass or creeks. All spoils shall be transported and disposed of at the Emmonak Landfill. Before disposing of the fluids, coordinate with the City of Emmonak in regard to the disposal location and other requirements for placement in the landfill.

E. Combustible Materials: Combustible materials (fuel, oil, lubricants, etc.) shall be stored off-site or in a well-ventilated storage facility removed from the immediate vicinity of the drilling area by at least twenty (20) feet.

F. Removal of Temporary Facilities: At the completion of construction, remove all temporary facilities installed by the Contractor. Unused soil, aggregate, and other materials shall be removed and disposed of at approved sites in accordance with all Federal, State, and Local regulations. Any damage to streets, lawns, common areas, and sidewalks shall be restored to original or better conditions. All disturbed areas shall be restored to their pre-construction condition.

3.5 HORIZONTAL DIRECTIONAL DRILLING

A. Drill Rig Capacity: The capacity of the directional drilling rig used by the Contractor shall be adequate to install the specified pipeline and shall be a minimum a medium sized HDD rig as described by Horizontal Directional Drilling Good Practices Guidelines.

B. Pump Capacity: The pump used by the Contractor shall be adequate to supply the required flow rate and pressures at the anticipated drilling fluid viscosity at all times. Drilling speeds shall not exceed pump capacity.

C. Bore Tracking and Monitoring: At all times during the pilot bore the Contractor shall provide and maintain a bore tracking system designed for operation over freshwater with a conductivity less than 800 Microsiemens per centimeter (μS/cm). The bore tracking system shall be capable of accurately locating the position of the drill head in the x, y, and z axis. The Contractor shall record the data at least once per drill pipe length or every twenty (20) feet or thirty (30) minutes, whichever is more frequent.

1. Contractor shall establish survey stakes or other visible markers along the bore path at no greater than 20-foot intervals. The Contractor shall devise a means for establishing this visible bore path alignment control above the water surface. The survey stakes or visual markers shall have the following information clearly displayed:
    a. Bore path stationing
    b. Depth from ground or water surface to center of proposed bore path
    c. Elevation of center of proposed bore path.

2. Deviations between the recorded and design bore path shall be calculated and reported on the daily report. If the deviations exceed tolerances specified in Paragraph 3.5.F.1, such occurrences shall be reported immediately to the Engineer. The Contractor shall undertake all necessary measures to correct deviations and return to design line and grade.

3. Drilling Fluid Pressures and Flow Rates: Drilling fluid pressures and flow rates shall be continuously monitored and recorded by the Contractor. The pressures shall be monitored at the pump. These measurements shall be made during pilot bore drilling, reaming, and pullback operations. Maximum allowable drilling speeds shall be calculated for pilot boring and each reaming pass and shall not be exceeded for pilot boring or reaming passes. Measurements shall be taken every twenty (20) feet or thirty (30) minutes, whichever is more frequent.
    a. Prior to penetrating the river bottom at the exit location, the Contractor shall discontinue pumping drilling fluid to minimize the amount of drilling fluid discharged into Kwiguk Pass.

D. Location of Entry and Exit Points: Entry and exit points shall be as shown on the Plans, unless otherwise approved in writing by the ENGINEER. The Contractor shall employ licensed, experienced surveyors to locate the entry and exit points, and to establish horizontal and vertical datum for the bore and the pipe layout and fabrication areas.

E. Entry and Exit Angles: Drill entrance and exit angles shall be as shown on the Plans, unless otherwise approved in writing by the ENGINEER.

F. Pilot Bore: The pilot bore shall follow the design path of the bore shown on the Plans.

1. Horizontal and Vertical Tolerances: Horizontal and vertical deviations shall be less than plus or minus four (4) feet from the design path centerline.

2. Radius of Curvature: The radius of curvature shall not be less than that shown on the Plans.

3. Entry and Exit Tolerances: The location of the entry and exit points shall be as shown on the Plans. The Contractor shall be solely responsible for all WORK necessary to correct excessive deviations from line and grade, including re-drilling, redesigning connections, and acquiring additional easement, at no additional cost to the OWNER and without schedule extension.

G. Pre-reaming and Reaming: The pilot bore shall be pre-reamed and reamed using equipment and methods submitted by the Contractor. The Contractor shall completely ream the bore to the final diameter prior to pullback.

H. In the event a FRAC-OUT occurs, the Contractor shall contain and clean up the spill immediately. Clean up of FRAC-OUT events shall be at no additional cost to the OWNER.

I. Hydrostatic Pretest: The Contractor shall perform a hydrostatic water pressure test after fusing is completed and before pullback. The test shall be at 120 psi in accordance with section 33 05 33 Polyethylene Utility Pipe. This pressure test shall include the entire pipeline.

J. Pipe Pullback:

1. The Contractor shall provide the equipment and labor necessary to retrieve the drill string from the river bottom and connect the drill string to the product pipe for pullback.

2. Contractor shall devise a means for positioning the product pipe in the river for pullback. CONTRACTOR shall provide visual marking on pipe as a navigational warning to boat traffic. Visual markings must be spaced every 100 feet along the pipe and be visible from 500 feet. Possible options to consider are: orange buoys or flashing lights.

3. The pipe shall be installed by pulling it into the reamed bore path in a continuous operation, behind a final reaming tool selected by the Contractor.

4. The pipe shall be isolated from excessive torsional and axial stresses by a swivel device with a pre-established breakaway tensile capacity that is lower than the allowable tensile strength of the pipe.

5. The Contractor shall monitor and record installation loads once per drill pipe or every 20 feet, whichever is more frequent

6. The Contractor shall cease operations if the pipe is damaged and shall remove the pipe from the bore and repair the pipe using the manufacturer’s recommended procedure or replace the damaged pipe before resuming installation.

7. Damage to the pipe resulting from installation is the responsibility of the Contractor, including costs for replacement and labor and materials.

8. Plan work accordingly to prevent mud or debris from entering the HDPE product pipe. If mud of debris enters the pipe the Contractor shall clean the entire pipe at no additional cost.

K. Obstructions: The Contractor shall notify the ENGINEER immediately in the event that any obstruction is encountered that prevents further advancement of the drill pipe, or pullback of the pre-reamer, reamer, and/or pipe. The Contractor shall make all diligent and reasonable efforts to advance past the object by drilling slowly through the object, pulling back, and drilling along a new bore path that avoids the object, or excavating and exposing and removing the object, and all other reasonable attempts to continue the bore. The Contractor shall notify the ENGINEER of proposed measures to attempt to advance past the object, prior to initiating the attempt. If the Contractor attempts to pullback and re-drill, the Contractor shall adhere to line and grade tolerances established in this specification, unless the ENGINEER approves variance, in writing, prior to the Contractor's attempt to re-drill. The Contractor and ENGINEER shall investigate the cause and together determine an appropriate response. Appropriate response may include revisions to equipment or methods, retraction and re-drilling of a portion of the bore, or abandonment of the hole. If abandonment is deemed necessary, the Contractor shall recover, to the extent practicable, any drill pipe, product pipe, and tools in the bore, and properly abandon the bore, unless otherwise directed in writing by the ENGINEER. If the bore is abandoned, the Contractor shall pressure-grout the abandoned bore with a lean cement-sand grout mixture, or other approved materials. If the bore is abandoned, the Contractor shall be allowed to begin a second attempt to install the pipeline at an alternate location subject to approval, in writing, by the ENGINEER. The Contractor shall take all reasonable actions to complete the installation with minimal delays. The extra costs and payments associated with encountering a confirmed obstruction will be negotiated between the OWNER and Contractor, based on reasonable time and materials.

L. Final Hydrostatic Test: The Contractor shall conduct a final hydrostatic test of the installed pipeline. Final test shall be at 120 psi in accordance with section 33 05 33 Polyethylene Utility Pipe. This pressure test shall include the entire pipeline.

M. The Contractor shall repair any defects discovered during this test, and repeat until the pipe passes the test.

N. Site Restoration and Demobilization: The Contractor shall remove all equipment, materials, drilling fluids, muck, waste, and debris from the site and restore the site to its original condition upon completion of the installation. Restoration and demobilization shall be completed by the Contractor within seven (7) days of the completion of the pipeline installation.

O. As-Builts: The Contractor shall develop and submit legible mark-ups of the installed product pipe on the Plan and Profile Views of the Drawings. These mark-ups shall include the following:

1. Installed bottom of pipe (BOP) elevations at all geometry callouts in the profile view of the Drawings.

2. Installed pipe shall be sketched as installed to scale in both the plan and profile view of the Drawings.

3. GPS and survey coordinates of the installed product pipe at the entrance and exit locations and the intake end of the new pipe.

END OF SECTION

SECTION 33 05 33
POLYETHYLENE UTILITY PIPE

PART 1 - 1. GENERAL

1.1 GENERAL

A. The work includes construction of new raw water piping and connection to existing raw water piping. Locations for existing and new water piping are shown in the Plans.

B. All components in contact with raw water shall be ANSI/NSF 61 certified.

C. All raw water piping is either above grade supported on treated timber sleepers or shallow buried beneath the road corridor. Locations for both cases are shown on the plans.

D. Requirements for the HDD pipeline are in Section 33 05 23.13 - Utility Horizontal Directional Drilling.

E. Requirements for the process piping (inside the raw water pump house) are in Section 40 23 00 – Process Piping.

F. All new exterior above-grade raw water piping (that connects to the existing arctic pipe raw water line) will consist of insulated High Density Polyethylene (HDPE) piping with corrugated aluminum jacketing as shown in the Plans and described in this Specification and elsewhere in the Project Documents.

G. All new exterior below-grade raw water piping (that connects to the new HDD pipeline) will consist of High Density Polyethylene (HDPE) piping as shown in the Plans and described in this Specification and elsewhere in the Project Documents.

H. All HDPE pipe and fittings shall be from a single manufacturer, who is fully experienced, reputable and qualified in the manufacture of the HDPE pipe to be furnished. The pipe shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with these Specifications.

1.2 Related Requirements:

1. Section 33 05 23.13 - Utility Horizontal Directional Drilling
2. Section 33 07 00 – Insulated Pipe and Fittings
3. Section 40 23 00 – Process Piping and Tanks

1.3 REFERENCES

A. ASTM International:

1. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
2. ASTM A726 - Standard Specification for Cold-Rolled Magnetic Lamination Quality Steel, Semiprocessed Types
3. ASTM D1238 - Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer
4. ASTM D1248 - Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
5. ASTM D1505 – Density of Plastics
6. ASTM D2657 - Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings
7. ASTM D2837 – Hydrostatic Design Basis
8. ASTM D3035 – Standard Specification for PE Pipe (DR-PR) Based on Controlled Outside Diameter
9. ASTM D3261 – Butt Heat Fusion PE Fittings for PE Pipe and Tubing
10. ASTM D3350 – Standard Specification for PE Pipe & Fittings Materials
11. ASTM F714 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
12. ASTM F1055 – Standard Specification for Electrofusion Type Polyethylene Fittings for OD Controlled PE Pipe and Fittings

B. American National Standards Institute
   1. ASME/ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings

C. American Water Works Association
   1. AWWA C651-05 Disinfecting Water Mains
   2. AWWA C509 - Resilient-Seated Gate Valves for Water
   3. AWWA C901 - Polyethylene (PE) pressure Pipe & Tubing, ½ inch through 3-inch for water.
   4. AWWA C906 - Polyethylene (PE) pressure Pipe & Fittings, 4-inch through 63-inch for water.

D. National Sanitation Foundation
   1. NSF Standard #14 – Plastic Piping Components and Related Materials
   2. NSF Standard #61 - Drinking Water System Components – Health Effects

E. Plastic Pipe Institute
   1. TR-33/2012 – Generic Butt Fusion Joining Procedure for Field Joining of Polyethylene Pipe

1.4 EXISTING RAW WATER SUPPLY PIPING

A. Contractor shall not inhibit the Owner's efforts to operate and maintain any part of the existing utility. Owner shall have full access to the existing system at all times.

B. The Owner reserves the right to make use of any portion of the proposed work prior to completion of the entire Contract without invalidating the Contract and without constituting acceptance of any of the work.

1.5 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data on pipe materials, pipe fittings, valves and accessories.

C. Shop Drawings: See Section 330700 Insulated Piping

D. HDPE Fusion Procedure Certifications (Butt Fusion and Electrofusion) for all personnel performing butt fusion and/or installing electrofusion couplings in the field on HDPE pipe.

1.6 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record location of pipe runs, connections, valves, cleanouts and invert elevations.

C. HDPE butt fusion and electro fusion joint records.

PART 2 - PRODUCTS

2.1 MATERIALS FOR PIPE (ALL SIZES)

A. Materials used for the manufacture of polyethylene pipe and fittings shall be made from a PE 3408 high density polyethylene resin compound meeting cell classifications 34534C per ASTM D3350; and meeting Type 111, Class C, Category 5, Grade P34 per ASTM D1238.

B. High Density Polyethylene (HDPE) pipe shall comply with AWWA Specifications C906 or C901 as appropriate for size.

C. If rework compounds are required, only those generated in the Manufacturer’s own plant from resin compounds of the same class and type from the same raw material supplier shall be used.

D. Dimensions and workmanship shall be as specified by ASTM F714. HDPE fittings and transitions shall meet ASTM D3261. HDPE pipe shall have a minimum density of 0.955 grams per cubic centimeter. All HDPE pipe and fittings shall have a Hydrostatic Design Basis (HDB) of 1,600 psi.

E. 3-inch HDPE pipe and accessories shall have a Standard Dimension Ratio (SDR) of 11 and be pressure rated to a minimum of 160 psi.

F. 6-inch HDPE pipe and accessories shall have a Standard Dimension Ratio (SDR) of 17 and be pressure rated to a minimum of 100 psi.

G. Shall be ANSI/NSF 61 certified

2.2 FITTINGS

A. All molded fittings and fabricated fittings shall be fully pressure rated to match the pipe SDR pressure rating to which they are made. All fittings shall be molded or fabricated by the manufacturer. No Contractor fabricated fittings shall be used unless approved by the Engineer.

B. The manufacturer of the HDPE pipe shall supply all HDPE fittings and accessories as well as any adapters and/or specials required to perform the work as shown on the Drawings and specified herein.

C. All fittings shall be installed using butt-fused fittings or flanged adapters and must be approved by the Engineer.

D. All transitions from HDPE pipe to other pipe materials and valves shall be made per the HDPE pipe manufacturer's recommendations and specifications. A molded flange connector adapter with 316 stainless steel back-up ring assembly shall be used for pipe type transitions. Back-up rings shall mate with cast iron flanges per ANSI B16.1. No solid sleeves shall be allowed between material transitions.

2.3 VALVES

A. Resilient Wedge Gate Valve

1. Wedge gate valves shall conform to the applicable requirements of AWWA C509, and shall be ANSI/NSF 61 certified. Valve shall have a non-rising stem. Valve shall have a cast iron body and shall be coated with a fusion bonded epoxy. Valve shall be flange x flange. Mueller 2360 series or approved equal.

2.4 TRANSITION FITTINGS

A. Transition fittings - HDPE to threaded shall aluminum bronze (NSF 61) as manufactured by Poly-cam OAE.

2.5 PIPE IDENTIFICATION

A. The following shall be continuously indent printed on the pipe or spaced at intervals not exceeding 5-feet.
   1. Name and/or trademark of the pipe manufacturer.
   2. Nominal pipe size.
   3. Dimension ratio.
   4. The letters PE followed by the polyethylene grade in accordance with ASTM D1248 followed by the hydrostatic design basis of the piping.
   5. A production code from which the date and place of manufacture can be determined.

2.6 ELECTROFUSION COUPLINGS

A. Electrofusion couplings should be avoided to the extent possible for fusion of HDPE pipe. Where required, couplings shall be installed by a certified technician.

B. One-piece construction, tubular, and same material as the adjacent HDPE pipe.

C. Couplings shall have attached around the circumference at each end a fusion wire which when energized shall provide a complete watertight fusion weld.

D. Fusion weld wires are factory attached and with sufficient lead for connection to factory supplied power converter.

E. Couplings shall be capable of sustaining pipeline pressure without damage.

F. Electrofusion couplings shall not be used for outer jacket sleeves or to repair damaged piping.

G. Installation of coupling shall be in accordance with manufacturer's written instructions and using manufacturer's recommended tools and materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

3.2 RAW WATER PIPING

A. Install raw water piping as shown on the Plans.

B. Contractor shall work around, support and protect existing the existing raw water piping as required to complete the Work.

C. Existing raw water piping shall remain in service during construction. Contractor shall plan appropriately to maintain continuous water service during construction.

D. Contamination Prevention:
   1. Contractor shall take particular care to keep potential sources of contamination from collecting around the raw water piping.
   2. Adequate provisions shall be made to direct surface flows and other sources of potential contamination away from the work area during construction.

3.3 JOINING METHOD (BUTT FUSION)

A. HDPE pipe shall be joined with butt, heat fusion joints as outlined in ASTM D2657 and conform to the Generic Butt Fusion Joining Procedure for Field Joining of Polyethylene Pipe, Technical Report TR-33/2012, published by the Plastic Pipe Institute (PPI) unless otherwise authorized by Engineer. All Joints shall be made in strict compliance with the manufacturer's recommendations. Personnel performing butt fusion of HDPE pipe shall be certified in the procedure by a representative of the fusion machine manufacturer.

B. Lengths of pipe shall be assembled into suitable installation lengths by the butt-fusion process. All pipes so joined shall be made from the same class and type of raw material made by the same raw material supplier. Pipe shall be furnished in standard laying lengths not to exceed 50-feet.

C. On days butt fusions are to be made, the first fusion shall be a trial fusion in the presence of the Engineer. The following shall apply:
   1. Heating plat surfaces shall be inspected for cuts and scrapes and shall be free of dirt and residue. Heater surfaces should be between 400°F (minimum) and 450°F (maximum). Measure the temperature at 12:00, 3:00, 6:00, and 9:00 o'clock positions using a pyrometer or infrared thermometer at locations where the heating plate will contact the pipe/fitting ends. The maximum temperature difference between any two points on a single heating surface must not exceed 24°F. If this temperature is exceeded, the heating plate shall be cleaned per the manufacturer's recommendations.
   2. The fusion or test section shall be cut out after cooling completely for inspection.
   3. The test section shall be 12" or 30 times (minimum) the wall thickness in length and 1" or 1.5 times the wall thickness in width (minimum)
   4. The joint shall be visually inspected as to continuity of "beads" from the melted material, and for assurance of "cold joint" prevention (i.e. – joint shall have visible molded material between walls of pipe). Joint spacing between the walls of the two ends shall be a minimum of 1/16" to a maximum of 3/16".

D. The polyethylene flange adapters at pipe material transitions shall be backed up by stainless steel flanges conforming to ANSI B16.1 and shaped as necessary suit the outside dimensions of the pipe. The flange adapter assemblies shall be connected with corrosion resistant bolts and nuts of Type 316 Stainless Steel as specified in ASTM A726 and ASTM A307. All bolts shall be

tightened to the manufacturer's specified torques. Bolts shall be tightened alternatively and evenly.

3.4 JOINT METHOD (ELECTROFUSION COUPLINGS)

A. Perform installation of electrofusion couplings in accordance the coupling manufacturer's instructions. At all times, protect the fusion site from inclement weather (rain, wind or snow). At all times, provide recommended ambient temperatures for proper electro-fusion.

B. Check pipe ovality. If out-of-round conditions exist and exceed the manufacturer's requirements, re-rounding clamps shall be used to bring the pipe back into a round condition.

C. Cut both pipe ends square with a pipe cutter and then clean both ends to removed dirt, mud and other debris. Clean water may be used for initial cleaning prior to scraping. Check pipe surface for any embedded debris that may cause damage to the scraping tools.

D. Measure the total length of the coupler to be installed and make a mark on one pipe a distance the full coupling length from the pipe end. Make a mark on the other pipe end a distance equal to the ½ the length of the coupling.

E. Completely scrape the first pipe end the full coupling length and the second pipe end half coupling length to remove oxidation and other contaminates. The first pipe end shall be scraped the full coupling length to prevent contamination of the coupler by sliding over un-scraped pipe.
   1. Use only appropriate scraping tools as recommended by the coupling manufacturer and follow the manufacturer's recommended scraping procedures.
   2. Scrape the pipe surface until the outer layer or "skin" of the pipe has been removed to expose a clean, virgin pipe material.
   3. Inspect the entire circumference of the scraped area to ensure total scraping coverage.
   4. Do not use abrasives, grinding wheels or other inappropriate tools that do not cleanly remove the contaminated material.
   5. If after the first scrape the fitting does not slide onto the pipe easily, pipe may be scraped again to achieve the proper pipe fit. Always assure uniformity in the pipe scrape.

F. Avoid touching the scraped pipe surface or the inside of the coupler as body oils and other contaminates can affect fusion joint performance.
   1. If the surfaces become contaminated, clean thoroughly with a clean lint free towel and isopropyl alcohol (consult coupling manufacturer for appropriate minimum percentage) and allow to dry before assembling.
   2. Additional scraping can be performed if the pipe section becomes contaminated before fusion, as long as the total amount of the material removed from the surface does not exceed 10% of the original pipe wall thickness. Do not scrape more than two times under any circumstances.

G. Using and indelible, greaseless marker, mark both pipe sections exactly one-half the coupling length. Open one end of the couplings protective packaging and slide the coupling over the pipe

end which has been scraped the full coupling length until the pipe end is flush with the opposite side of the coupling.

1. Leave plastic bag over coupler to prevent contamination and debris from entering the open end.
2. If center stops are present, pop or press the coupling fully onto the pipe with a quick motion in order to knock the stops out or fold them over inside the fitting.
3. Be careful not to slide the coupling past the scraped portion of the pipe.

H. Position second pipe end so that it is against the first and a maximum gap of 1/8-inch exists between pipes and slide electrofusion coupling onto second pipe to one half the length of the coupling.

I. A fusion control box which can scan the barcode provided on the electrofusion coupling shall be used to ensure proper installation.

1. Contractor shall observe the manufacturer's procedure for pre-heating or temperature specific fusion times.
2. Do not leave the fusion process unattended.
3. If multiple barcodes corresponding to ambient temperature or a separate pre-heat barcode are present, consult manufacturer's recommend procedure for scanning the proper barcode.

J. Fusion Cycle:

1. Verify that fusion cycle is complete. Check melt indicators if equipped.
2. After fusion cycle is complete, not the cooling time and mark the time when the clamping time has elapsed on the pipe.
3. For couplers with dual fusion zones, repeat fusion cycle for both ends of coupler.

K. Do not allow any individual to install electrofusion couplings unless they are adequately trained and certified in the technique involved.

3.5 INSTALLATION

A. High Density Polyethylene (HDPE) Pipe shall be installed in accordance with the manufacturer's instructions, as shown on the Plans and as specified herein. A certified joining technician shall perform all heat fusion joints.

B. Care shall be taken in loading, transporting and unloading to prevent damage to the pipe. Pipe or fittings shall not be dropped. All pipe and fittings shall be examined before installation and no pieces shall be installed if found to be defective. Any damage to the pipe shall be repaired as directed by the Engineer. If any defective pipe is discovered after it has been installed, it shall be removed and replaced with a sound pipe in a satisfactory manner by the Contractor at his own expense.

C. Care shall be taken during transportation of the pipe such that it will not be cut, kinked, or otherwise damaged.

D. Ropes, fabric or rubber protected slings and straps shall be used when handling pipes. Chains, cables or hooks inserted into the pipe ends shall not be used. Two slings spread apart shall be used for lifting each length of pipe.

E. Pipes shall be stored on level ground, preferably turf or sand, free of sharp objects, which could damage the pipe. Stacking of the polyethylene pipe shall be limited to a height that will not cause excessive deformation of the bottom layers of pipes under anticipated temperature conditions. Where necessary due to ground conditions, the pipe shall be stored on wooden sleepers, spaced suitably and of such width as not to allow deformation of the pipe at the point of contact with the sleeper or between supports.

F. Pipe shall be stored on clean level ground to prevent undue scratching or gouging. The handling of the pipe shall be in such a manner that the pipe is not damaged by dragging it over sharp and cutting objects. The maximum allowable depth of cuts, scratches or gouges on the exterior of the pipe is 5 percent of wall thickness. The interior pipe surface shall be free of cuts, gouges or scratches.

G. Pipe shall be laid to lines and grade shown on the Drawings.

H. When laying is not in progress, including lunchtime, the open ends of the pipe shall be closed by fabricated plugs, or by other approved means.

I. Sections of pipe with cuts, scratches or gouges exceeding 5 percent of the pipe wall thickness shall be removed completely and the ends of the pipeline rejoined.

J. The pipe shall be joined by the method of thermal butt fusion, as outlined in PART 3 – Execution, Section 3.2 Joining Method. All joints shall be made in strict compliance with the manufacturer's recommendations.

K. Mechanical connections of the polyethylene pipe to auxiliary equipment such as valves, pumps and tanks shall be through flanged connections which shall consists of the following:
   1. A polyethylene flange shall be thermally butt-fused to the stub end of the pipe.
   2. A 316 stainless steel back up ring shall mate with a 316 stainless steel flange.
   3. 316 stainless steel bolts and nuts shall be used.

L. Flange connections shall be provided with a full-face neoprene gasket.

M. If a defective pipe is discovered after it has been installed, it shall be removed and replaced with a sound pipe in a satisfactory manner at no additional cost to the Owner. All pipe and fittings shall be thoroughly cleaned before installation, shall be kept clean until they are used in the work and when laid, shall conform to the lines and grades required.

3.6 CLEANING

A. At the conclusion of the work, thoroughly clean all of the new pipe lines to remove all dirt, stones, pieces of wood or other material which may have entered during the construction period

by forcing a cleaning swab through all mains 4" or greater. Flushing velocities shall be a minimum of 2.5 feet per second. All flushing shall be coordinated with the Engineer. Debris cleaned from the lines shall be removed from the job site.

3.7 TESTING

A. Pressure testing shall be conducted per Manufacturer's recommendations and as approved by the Engineer.

B. All HDPE mains shall be field-tested. Contractor shall supply all labor, equipment, material, gages, pumps, meters, and incidentals required for testing. Each main shall be pressure tested upon completion of the pipe laying and backfilling operations, including placement of any required temporary roadway surfacing.

C. All new raw water piping shall be tested to 120 psi unless otherwise approved by the Engineer.
   1. Should a leak be found in a section of existing piping that was not modified during Contractor's operations, coordinate with Engineer to determine method for repairing the damaged piping. Owner will pay for cost of repairs.
   2. Should a leak be found in a section of new piping or at a new joint in a section of existing piping the damaged piping shall be repaired at the Contractor's expense.

D. Pressure testing procedure shall be as follows:
   1. Restrain pipeline against movement in event of catastrophic failure. Leave joints exposed for leakage examination.
   2. Isolate section of piping to be tested.
   3. Fill line slowly with water. Maintain flow velocity less than 2 feet per second.
   4. Expel air completely from the line during filling and again before applying test pressure. Air should be expelled by means of taps at points of highest elevation.
   5. Pressurize pipeline to test pressure and add make-up test water as required to maintain maximum test pressure of 120 psi for four hours.
   6. After four hour expansion phase, reduce pressure by 10 psi to target test pressure of 110 psi.
   7. The final test pressure shall be within 5% of the target pressure at the end of one hour. .
   8. Upon completion of the test, the pressure shall be bled off from a location other than the point where the pressure is monitored. The pressure drop shall be witnessed by the Engineer at the point where the pressure is being monitored.

E. If the final test pressure is within 5% of the target test pressure at the end of the test period and there are no visual leaks the installed pipe shall be considered to have passed.

F. All visible leaks are to be repaired regardless of the amount of leakage.

G. The Contractor shall submit his plan for testing to the Engineer for review and approval at least 10 days before starting testing.

H. The Contractor shall notify the Engineer a minimum of 48 hours before actually beginning field testing.

3.8 PROTECTION OF FINISHED WORK

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.

B. Protect pipe from damage or displacement until pipes straps are installed and secured.

END OF SECTION

SECTION 33 05 61

CONCRETE MANHOLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Modular precast concrete manhole with tongue-and-groove joints, covers, anchorage, and accessories.
   2. Bedding and cover materials.

B. Related Requirements:
   1. Section 31 05 13 - Soils for Earthwork: Soil for backfill.
   2. Section 31 23 16 - Excavation: Excavating for manholes

1.2 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials
   1. AASHTO M230 - Standard Specification for Expanded and Extruded Foam Board (Polystyrene)

B. American Concrete Institute:
   1. ACI 318 - Building Code Requirements for Structural Concrete.
   2. ACI 530/530.1 - Building Code Requirements and Specification for Masonry Structures.

C. ASTM International:
   1. ASTM A48 - Standard Specification for Gray Iron Castings.
   2. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   3. ASTM C55 - Standard Specification for Concrete Building Brick.
   4. ASTM C62 - Standard Specification for Building Brick (Solid Masonry Units Made From Clay or Shale).
   5. ASTM C157 - Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete
   6. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
   7. ASTM C293 - Standard Test Method for Flexural Strength of Concrete (Using Simple Beam With Center-Point Loading)
   8. ASTM C469 - Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression
   9. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections.
   10. ASTM C496 - Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens
   11. ASTM C497 - Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile.
   12. ASTM C531 - Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes

13. ASTM C596 - Standard Test Method for Drying Shrinkage of Mortar Containing Hydraulic Cement
14. ASTM C882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear
15. ASTM C913 - Standard Specification for Precast Concrete Water and Wastewater Structures.
16. ASTM C923 - Standard Specification for Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
17. ASTM D522 - Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings
18. ASTM D1621 - Standard Test Method for Compressive Properties of Rigid Cellular Plastics
19. ASTM D2485 - Standard Test Methods for Evaluating Coatings For High Temperature Service
20. ASTM D2794 - Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
21. ASTM D3363 - Standard Test Method for Film Hardness by Pencil Test
22. ASTM D4060 - Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
23. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
24. ASTM D7234 - Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers

D. NACE International
   1. NACE No. 6/SSPC-SP 13, Surface Preparation of Concrete

E. National Sanitation Foundation
   1. NSF Standard #61 - Drinking Water System Components – Health Effects

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit cover and frame construction, features, configuration, dimensions.

C. Shop Drawings: Indicate manhole locations, elevations, piping, sizes and elevations of penetrations.

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

E. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

G. Qualifications Statements:
   1. Submit qualifications for manufacturer.

1.4 QUALITY ASSURANCE

A. Architect/Engineer shall have open access to the prime fabrication facility and any sub-tier Contractors to assure conformance with the Specifications and quality of workmanship.

B. Contractor shall submit to the Architect/Engineer for approval a Quality Assurance program which incorporates as a minimum a description of the proposed methods of fabrication and schedule for completion.

C. Contractor shall notify the Architect/Engineer a minimum of 48 hours in advance of any required inspections or tests. In the event the Architect/Engineer does not make the inspection or witness the test, certify in writing that the work was completed in accordance with the Drawings and Specifications.

D. Contractor shall immediately correct all deficiencies which are evidenced during an inspection or test, and will repeat the tests until system is approved.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Unload, store, and handle precast manholes according to manufacturer instructions.

C. Storage:
   1. Store precast concrete manholes as to prevent damage to Owner's property or other public or private property.
   2. Repair property damaged from materials storage.

1.7 AMBIENT CONDITIONS

A. Cold Weather Requirements: According to ACI 530/530.1.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

A. Equivalent strength: Based on structural design of reinforced concrete as outlined in ACI 318.

B. Design of Lifting Devices for Precast Components: According to ASTM C913.

C. Design of Joints for Precast Components:
   1. According to ASTM C913.
   2. Maximum Leakage: 0.025 gal. per hour per foot of joint at 3 feet of head.

D. Shaft Construction: Concentric with flat top section; lipped male/female dry joints; sleeved to receive pipe and conduit sections.

E. Shape: Cylindrical.

F. Clear Inside Dimensions:
   1. 72-inch diameter.

G. Design Depth: As indicated on Drawings.

H. Clear Cover Opening:
   1. As indicated on Drawings.

I. Pipe and Conduit Entry: Furnish openings as indicated on Drawings.

2.2 MANHOLES

A. Manhole Sections:
   1. Reinforced precast concrete according to ASTM C478.
   2. Gaskets: According to ASTM C923.

2.3 WETWELL COVER

A. Double leaf access frames and covers shall have a 1/4" thick one-piece, mill finish, extruded aluminum frame, incorporating a continuous concrete anchor. A bituminous coating shall be applied to the frame exterior where it will come in contact with concrete. Door panel shall be 1/4" aluminum diamond plate, reinforced to withstand a live load of 300 lbs. psf. uniform live load. Doors shall open to 90 degrees and automatically lock with a T-316 stainless steel hold open arm with aluminum release handle. For ease of operation, the hold open arm shall incorporate an enclosed stainless steel compression spring assist. Doors shall close flush with the frame and rest on a built-in neoprene cushion/gasket. Hinges and all fastening hardware shall be T-316 stainless steel. Unit shall lock with a T-316 stainless steel slam lock with removable key and have a non-corrosive handle.

B. Protective grating panel shall be 1 inch aluminum “I” bar grating with Safety Orange powder-coated finish. Grating shall be hinged with tamper proof stainless steel bolts, and shall be supplied with a positive latch to maintain unit in an upright position. Grating shall have a 6-in. viewing area on each lateral unhinged side for visual observation and limited maintenance. Grating support ledges on 300 lbs. psf loaded access covers shall incorporate nut rail with a minimum of four (4) stainless steel spring nuts for mounting pump brackets and/or cable holders. A padlock hasp for owner-supplied padlock shall be provided.

C. Unit shall carry a lifetime guarantee against defects in material and/or workmanship. Halliday, or approved equal.

2.4 MATERIALS

A. Bedding and Cover:
   1. Bedding: Fill Type as specified in Section 310513 – Soils for Earthwork.
   2. Cover: Fill Type, as specified in Section 310513 – Soils for Earthwork.

2.5 COATING

A. Manhole interior:

1. Prepare concrete surface in accordance with NACE No. 6 / SSPC SP 13 – Surface Preparation of Concrete
2. System shall be NSF 61 certified for potable water
3. Bug hole filler
   a. Waterbased epoxy cementitious resurfacer containing Portland Cement, hydrophobic thixotropes, fiber reinforcement, graded silica sand and other abrasion resistant aggregates

Test Name	Test Method	Results
Adhesion to Concrete	ASTM D7234	403 psi* / >438 psi**
Coefficient of Thermal Expansion	ASTM C531	6.9 x 10^{-6} in/in/F**
Flexural Strength	ASTM C293	795 psi* / > 1,270 psi**
Linear Shrinkage	ASTM C596 ASTM C531	-0.014%** -0.366%**
Modulus of Elasticty	ASTM C469	>1,680,000 psi* >1,860,000 psi **
Shear Bond	ASTM C882	2,094*/ 2,804 psi**
Shrinkage	ASTM C157	<0.18%**
Splitting Tensile Strength	ASTM C496	480 psi* / 600 psi**
Tensile Strength	ASTM C307	>600 psi*

   b.
   c. Sherwin Williams Duraplate 2300
4. Intermediate coat
   a. Ultra high solids epoxy amine

Test Name	Test Method	Results
Abrasion Resistance	ASTM D4060, CS17 wheel, 1000 cycles, 1 kg load	20.8 mg loss
Adhesion	ASTM D4541	800 psi, minimum
Corrosion Weathering	ASTM D5894, 6 cycles, 2016 hours	Rating 10 per ASTM D610 for rusting; Rating 10 per ASTM D714 for blistering
Direct Impact Resistance	ASTM D2794	30 in. lb.
Dry Heat Resistance	ASTM D2485	250°F (121°C)
Flexibility	ASTM D522, 180° bend, 1/2" mandrel	Passes, 9.7% elongation
Pencil Hardness	ASTM D3363	3H

   b.
   c. 4.0 – 8.0 mils DFT
   d. Sherwin Williams Duraplate UHS Primer
5. Finish coat
   a. Ultra high solids epoxy amine
   b. 18.0 – 22.0 mils DFT
   c. Sherwin Williams Duraplate UHS

2.6 ACCESSORIES

A. Manhole Steps:
   1. As shown in drawings.

B. Base Pad:
   1. Leveled top surface.

2.7 MANHOLE JOINTS

A. Joint Sealant/Gasket
   1. Non-toxic, butyl rubber sealant
   2. For use on concrete joints in drinking water applications.
   3. NSF 61 certified for potable water
   4. Service temperature: -30ºF to 200ºF
   5. ConSeal CS-665, or approved equal

2.8 INSULATION

A. Rigid Board Insulation:
   1. Insulation board shall be extruded, closed cell, polystyrene conforming to the requirements of AASHTO M230. The insulation board shall be rigid, homogeneous, and conform to the following:
      a. Minimum compressive strength at yield or 5% strain of 40 psi in accordance with ASTM D1621.
      b. Maximum water absorption by volume of 0.10% in accordance with AASHTO M230.
      c. Minimum thermal resistance at 25°F shall be in accordance with ASTM C-177. The thermal resistance property shall be based on minimum values expected after stabilization of the blowing agents, typically at least 15 years after the manufacture date. Provide a minimum R=10 thermal resistance for every 2 inches of insulation thickness specified.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that items provided by other Sections of Work are properly sized and located.

C. Verify that built-in items are in proper location and ready for roughing into Work.

D. Verify correct size of manhole excavation.

3.2 PREPARATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.

B. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers as indicated on Drawings to indicate its intended use.

C. Coordinate placement of inlet and outlet pipe or duct sleeves required by other Sections.

D. Do not install structures where Site conditions induce loads exceeding structural capacity of structures.

E. Inspect precast concrete structures immediately prior to placement in excavation to verify structures are internally clean and free from damage; remove and replace damaged units.

3.3 INSTALLATION

A. Excavation and Backfill:
   1. Excavate manholes as specified in Section 31 23 16 - Excavation in location and to indicated depth.
   2. Provide clearance around sidewalls of structure for construction operations.
   3. When groundwater is encountered, prevent accumulation of water in excavations; place manholes in dry trench.
   4. Where possibility exists of watertight structure becoming buoyant in flooded excavation, anchor structure to avoid flotation as approved by Architect/Engineer.

B. Base Pad:
   1. Place base pad.
   2. Trowel top surface level.

C. Place manhole sections plumb and level, trim to correct elevations, and anchor to base pad.

D. Backfill excavations for manholes as specified in Section 31 23 16 - Excavation.

E. Place manhole cylinder plumb and level and to correct dimensions and elevations.

F. Cut and fit for pipe and conduit.

G. Grout base of shaft sections to achieve slope to exit piping, trowel smooth, and contour to form continuous drainage channel.

H. Set cover frames and covers level without tipping and to correct elevations.

I. Coordinate with other Sections of Work to provide correct size, shape, and location.

J. Precast Concrete Manholes:
   1. Lift precast components at lifting points designated by manufacturer.
   2. When lowering manholes into excavations and joining pipe to units, take precautions to ensure that interior of pipeline and structure remains clean.

3. Set precast structures bearing firmly and fully on bedding material, compacted as specified in Section 31 23 16 - Excavation or on other support system as indicated on Drawings.
4. Assemble multi-section structures by lowering each section into excavation; set level and firmly position base section before placing additional sections.
5. Remove foreign materials from joint surfaces and verify sealing materials are placed properly.
6. Maintain alignment between sections by using guide devices affixed to lower section.
7. Joint sealing materials may be installed on Site or at manufacturer's plant.
8. Verify that installed manholes meet required alignment and grade.
9. Remove knockouts or cut structure to receive piping without creating openings larger than required to receive pipe; fill annular spaces with mortar.
10. Cut pipe flush with interior of structure.
11. Shape inverts through manhole as indicated on Drawings.

3.4 FIELD QUALITY CONTROL

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.

B. Test concrete manhole and structure sections according to ASTM C497

END OF SECTION

SECTION 33 07 00
INSULATED PIPE AND FITTINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Related Sections:

1. Section 33 11 13: Public Water Utility Distribution Piping.

B. Raw water pipe shall be supplied as insulated pipe and fittings for use in pressure pipe applications. The minimum service temperature range of all individual components and final products shall be -60 to 100°F unless otherwise specified. All pipe and fittings shall be capable of withstanding the cyclic freezing of water under its rated service pressure without breaks, leaks, gross deformities or impaired service characteristics. The core pipe and fittings shall be in accordance with Section 33 05 33 Polyethylene Utility Pipe, as appropriate. The core pipe shall be factory insulated with polyurethane insulation and protected with an outer jacket of 16-gauge aluminum pipe.

1.2 REFERENCES

A. The following specifications are referenced in this document and shall be considered integral to this specification:

1. ASTM C177 Thermal transmission (guarded hot-plate apparatus)
2. ASTM C273 Shear properties of sandwich-core materials
3. ASTM C518 Thermal transmission (heat flow meter apparatus)
4. ASTM D1248 Polyethylene (PE) extrusion materials – wire and cable
5. ASTM D1621 Compressive properties of rigid cellular plastics
6. ASTM D1622 Apparent density of rigid cellular plastics
7. ASTM D2126 Response of rigid cellular plastics to thermal humid aging (thermal dimensional stability)
8. ASTM D2657 Heat Joining Polyolefin Pipe and Fittings
9. ASTM D2837 Obtaining pressure design basis for thermoplastic pipe products
10. ASTM D2842 Water absorption of rigid cellular plastics

10. ASTM D2842 Water absorption of rigid cellular plastics

11. ASTM D3350 Specification for Polyethylene Plastic Pipe and Fittings Materials

12. ASTM E96 Water vapor transmission of rigid cellular plastics

13. ASTM E398 Water vapor transmission rate of sheet materials (dynamic relative humidity measurement)

14. ASTM F714 Polyethylene (PE) plastic pipe (SDR-PR) – based on outside diameter

15. AWWA C901 Polyethylene Pressure Pipe and Tubing, 1/2-inch through 3-inch for Water Service

16. AWWA C906 Polyethylene Pressure Pipe and Fittings, 4-inch through 63-inch for Water Distribution and Transmission

17. NSF/ANSI-61 Drinking Water System Components-Health Effects

18. PPI TR-33 Generic Butt Fusion Joining Procedure for Polyethylene Gas Pipe

B. Unless otherwise noted herein or on the drawings, all fittings shall be constructed utilizing core pipe of the same material, resin, and dimensions as that used for the core pipe of the straight lengths.

1.2 SUBMITTALS

A. The Contractor shall furnish to the Engineer for approval one (1) copy of the submittals indicated below. No work shall commence on any item until the required shop drawing submittals have been approved. The submittals shall include:

1. Product Data: Submit manufacturer's standard printed information and literature for all materials to be incorporated in the work.

2. Shop Drawings: Submit dimensionally correct (scaled) shop drawings for all items to be fabricated prior to beginning fabrication.

3. Fabrication Procedures: Submit a written description of the methods/procedures to be used in fabricating the pipe and fitting.

4. Inspections and Testing of Pipe and Fittings:

    a) Submit proposed hydrostatic testing procedure for review and approval before any testing is undertaken.

    b) Submit results of foam density tests on daily basis for all specified inspections and testing of pipe and fittings.

5. Quality Assurance program in accordance with 1.3.

6. Laboratory Testing Results:

    a) K-factor testing of insulation.

    b) Core pipe/insulation bond

    c) Density of insulation

    d) Testing frequency shall be a minimum of one set of tests per 400 linear feet of pipe.

1.3 QUALITY ASSURANCE

A. The manufacturer shall be experienced and regularly engaged in the production of pre-insulated piping systems. The manufacturer shall understand the system design and its intent and shall produce components suitable to accomplish that intent. Any deficiencies in the Drawings or these Specifications which may jeopardize the performance of the system shall be brought to the immediate attention of the Engineer, prior to submittal of product description and information for acceptance, whenever possible.

B. Engineer shall have open access to the fabrication facility and any sub-tier suppliers to assure conformance with the Specifications and quality of workmanship.

C. The Contractor shall submit to the Engineer for approval a Quality Assurance program which incorporates as a minimum the following:

    1. A description of the method of manufacture.

    2. A description of the methodology for the quality assurance program.

D. The Contractor shall implement the Quality Assurance program to assure compliance with all requirements of this Specification.

E. A record of all tests which were performed shall be provided to the Engineer as required. (As a minimum, all test reports shall be submitted to the Engineer upon completion of work).

F. Where a method of testing has not been specified, the Contractor shall submit detailed test procedures for approval by the Engineer.

G. Any deficiency found in a stick of pipe shall be cause for rejection of the entire stick of pipe. All rejected pipe shall be replaced by the Contractor at no additional cost to the Owner.

H. All insulated pipe and fittings supplied under this specification shall utilize the same manufacturer of core pipe. Contractor shall identify the core pipe manufacturer with his submittal.

PART 2 - PRODUCTS:

2.1 CORE PIPE:

A. All core pipe shall be made of high-density polyethylene (HDPE) that conforms to all applicable provisions and requirements of the latest revision of AWWA C901 and AWWA C906 and, by inclusion, all appropriate standards referenced therein.

B. Core pipe shall be in accordance with Section 33 05 33 – Polyethylene Pipe, as applicable.

2.2 INSULATION

A. Insulation between core pipe and outer jacket of all pipe and fittings shall be low-density rigid closed-cell urethane insulation with a nominal thickness as shown on the drawings. It shall be applied and cured in strict accordance with the manufacturer's recommendations and good commercial practices such that the resulting insulation completely fills the annular space between core pipe and outer jacket and is free of defects affecting its intended purpose.

B. Urethane insulation shall exhibit the following properties and characteristics specified by the referenced ASTM tests below.

1.	ASTM C518 or C177	Maximum K-factor, as produced	0.15 btu-in/hr-ft2-°F
2.	ASTM D1622	Core Density Range	2.0 to 4.0 lbs/ft3
3.	ASTM D1621	Minimum Compressive Strength	35 psi
		(parallel and perpendicular to pipe axis)	
4.	ASTM D2842	Maximum Water Absorption	0.05 lb/ft3
5.	ASTM D2126	Dimensional Stability	1% at -20°F
		(Maximum Linear Change)	3% at +100°F

C. Exposed urethane insulation faces at pipe and fitting ends shall be coated to protect against physical abuse, UV exposure during shipping and storage, and against water intrusion in service. The coating shall be suitable for direct application over urethane insulation with no deleterious effects to the insulation or coating. The coating shall be formulated for long-term service and retained flexibility over extended periods of exposure to sunlight, harsh weather, and saltwater spray. The strength of the adhesive bond of the coating to the insulation shall be greater than the tensile strength of the coating. In the event the coating is nicked or an edge is rolled up in

handling, the coating that has been dislodged shall tear free from the coating still adhering to the insulation rather than pull the balance of the coating off as a sheet.

D. The coating shall be applied and cured in strict accordance with the manufacturer's recommendations and good commercial practice such that the finished product is free of defects affecting its intended purpose.

E. The coating material shall exhibit the following properties and characteristics:

1.	ASTM E398 or E96	Maximum Water Vapor Permeance	1.0 perm
		Dry Film Thickness Range:	15 to 63 mils

2.3 METAL OUTER JACKET

A. Metal outer jackets for pipe and fittings shall be constructed of 16-gauge internal helical lock-seam corrugated aluminum pipe with a nominal diameter as shown on the drawings. Aluminum alloy material shall be 3004-H34 with a 7072 coating on the outside of the jacket or 5052-H32. All helical seams shall be continuous, tightly locked and folded. The outer jacket of all pipe and fittings shall be watertight under a five-foot head of water and the outside of the jacket shall present a relatively smooth, flat overall appearance. Standard corrugated culvert pipe is not acceptable.

B. The outer jacket corrugations shall be between 3/16-inch and 3/8-inch deep as measured from the flat area between corrugations to the bottom of the corrugation on the outside of the jacket and shall be spaced no more than 2 2/3-inches apart and formed diagonally around the pipe, resulting in not less than 2 nor more than 10 complete corrugations crossing the pipe's circumference at a given cross-section.

C. The nominal diameter shall be the inside diameter as measured between the innermost portion of the corrugations, with a dimensional tolerance of +1/2".

D. All joints in the aluminum outer jacket fabricated around fittings shall be welded with a continuous bead, resulting in a finished jacket that is watertight per the requirements of section 2.3A.

E. The Contractor shall provide company name and production date (month and year) on the outer jacket of each pipe and fitting. Information shall be stamped onto an aluminum plate with 1/8-inch to 1/4-inch high lettering, and the plate shall be riveted onto the jacket with a minimum of 4 aluminum rivets. The plate shall be secured to the jacket within 8" of one end of the jacket.

F. All surfaces of the outer jacket, including end-cuts and welds, shall be finished such that no jagged edges exist that could cause personal injury.

G. The interior of the jacket shall be free of oils, grease, or other residue that could interfere with the adhesion of insulation to the outer jacket.

2.4 HEAT TRACE CHANNEL – NOT USED

2.5 GLYCOL TRACE CHANNEL – NOT USED

2.6 MANUFACTURING AND DIMENSIONAL TOLERANCES

A. Allowable offset of the centerline of the outer jacket and core pipe shall be not more than 1/4-inch at the pipe ends. Elsewhere along pipe lengths the centerline offset shall not be greater than 3/8-inch.

B. The minimum temperature of all components used to manufacture pipe and fittings shall be 50 °F at the start of fabrication. The fabricated pipe shall be placed in a facility maintained at a temperature of 50 °F or greater for a minimum of 12 hours after fabrication.

C. All elbows shall have a bend radius as specified in the drawings with a tolerance of + 2 degrees without reversion. All elbows must maintain normal outside diameters along their entire length without tolerance as per ASTM-F714.

D. All branches of fabricated fittings must lie in a single plane with a maximum deviation of + 2 degrees.

E. The length of core pipe protruding from the insulation on the ends shall be 12 inches + 1/4 -inch. The core pipe ends shall be smooth and oriented perpendicularly to the core pipe longitudinal axis + 1/8-inch.

F. The outer jacket shall be cut in one pass perpendicular to the length of the jacket + 1 degree. The coupling on bell ends shall be perpendicular to the length of the jacket + 1 degree and flush with the jacket end with a tolerance of -1/8-inch. No part of the coupling shall protrude beyond the end of the jacket as determined by placing a straight-edge across the jacket at any two points. The bell end of the coupling shall be flush with the insulation and outer jacket. Before coating, the plane of the exposed insulation face at bell and spigot ends shall be perpendicular to the centerline axis of the outer jacket + 1/8-inch. The insulation profile of the coated ends shall not exceed a relief deviance of + 1/4-inch across the face.

2.7 FABRICATED FITTINGS

A. All fusion joints used in fabricated fittings shall be documented by a computer that records pressure and temperature applied at each fused joint. Computer printouts and electronic data for each fitting shall be made available to the owner upon request. The contractor shall ensure that each joint is fused at the temperature and pressure recommended by the pipe manufacturer in order to achieve the maximum pressure rating for that joint.

B. All fittings for each project shall be labeled with a unique identifier that corresponds with the fusion computer printouts for each fitting.

2.8 INSULATING

A. All Federal and State regulations applicable to the type of insulation and its use shall be strictly adhered to.

B. Insulation shall be placed into the pipe by a single injection application. Fittings may be manufactured using one insulation injection for each open end of the fitting. In no case shall the jacket be drilled to perform, monitor, or inspect the injection.

C. The maximum allowable void size is 0.05 in^3 (for reference, a 3/8-inch cube is .05 in^3).

D. Insulation and chemicals shall be prevented from coming in contact with the end or inside of the exposed core pipe.

2.9 CORE PIPE/INSULATION BOND

A. Core pipe and fittings shall be bonded to the insulation with a minimum shear bond strength of 15 psi, or in such a manner as to produce insulation-to-insulation separation when a sample is tested in shear.

B. The core pipe surface preparation will be performed in a manner that does not leave foreign material imbedded in the plastic. Gouges or scratches in the pipe surface that exceed the tolerance specified by the pipe manufacturer for the pipe pressure rating shall be cause for rejection.

2.10 PRODUCTION TESTING AND INSPECTION

A. Only finished pipe lengths and fittings that meet the requirements of these specifications and drawings shall be used for destructive testing. Should any product fail to meet the visual quality control specifications listed below, that product shall be either re-built to meet the specifications or rejected. Only those products that meet all visual quality control specifications shall be considered final products suitable for receipt by the Owner or for laboratory or other destructive testing.

1. VISUAL QUALITY CONTROL:
    a. DIMENSIONAL TOLERANCE: Each length of pipe and each fitting will be examined by the Contractor for off-set tolerances, insulation cut-back distances, exposed insulation face alignment and relief profile, and alignment and smoothness of core pipe ends.
    b. INSULATION INTEGRITY: Completed pipe and fitting ends shall be inspected for voids in excess of 0.05 in3 or discontinuities by the Contractor prior to coating. Any glazing left on the uncoated pipe end from the forms used during the insulating operation shall be removed before coating.

2. LABORATORY TESTING

a. The density and K-factor shall be measured on insulation specimens of the appropriate size and under the specified conditions as set forth in the applicable ASTM test. Insulation specimens shall be retrieved by cutting a 12-inch section of insulated pipe from a production sample. The remaining length shall be trimmed to the dimensional tolerances of this specification to allow Owner use of that pipe section.

b. Should the Contractor choose to test the "K" factor as outlined in ASTM C518, the testing apparatus shall be calibrated within 24 hours of the test using a calibration standard certified accurate by the National Bureau of Standards (NBS). The "K" factor test sample shall be removed from the insulated pipe, prepared for testing, and left open to the atmosphere at 70°F for a minimum of 24 hours prior to testing.

c. In addition to the testing identified above, the following tests shall be performed to verify the quality of the finished product:

1) Core pipe/insulation bond:

a) Two 6-inch lengths of cured insulated pipe shall be cut from one uncoated insulation face end of completed pipe length. The remaining length shall be trimmed according to the dimensional tolerances of this specification and coated to allow Owner use of that pipe section.

b) One specimen shall be tested at +70°F. The other specimen shall be brought to -60°F in 4 hours or less, and remain there for at least 24 hours before testing. Acceptance will be indicated by a minimum shear bond strength of 15 psi and insulation-to-insulation (or insulation-to-insulation pipe surface film) separation or tearing.

c) Testing shall be conducted as indicated on the attached drawing labeled “Core pipe/insulation bond test setup.”

2.11 PACKING

A. The core pipe spigot ends of all pipe and fittings shall be capped with PE pipe caps (Caplugs, or approved equal) and the plugs taped to the pipe with black electrical tape (such as 3M #33+) or other approved tape after final inspection and prior to shipment. Duct tape shall not be used to secure the PE pipe caps to the pipe spigot ends.

B. Pre-insulated pipe shall be packed in bundles with a maximum gross weight of 4,000 pounds per bundle unless otherwise specified by the Owner. The end geometry of each bundle shall be rectangular. Each layer of pipe within the bundle including the bottom layer shall rest upon a minimum of 3 each 4-inch x 4-inch cross cleats banded to that individual layer using 1 1/4-inch steel strapping. All cleats shall feature a 45-degree stop block at least nominal 4-inches high by 4-inches long fastened securely to both ends of the cleats to prevent the pipe from rolling off the cleat when the banding is cut. The outer cross cleats shall be installed between 1 to 2-feet from the insulation face of the pipe ends with the middle cleat centered on the bundle. In addition, 1 1/4-inch steel straps shall securely fasten all the layers together to form a complete bundle. Bundles 5 pipes wide by 5 pipes high are recommended.

C. All fittings and couplings shall be packaged in crates sheathed with minimum 1/2-inch sheathing not to exceed 4 ft x 4 ft x 8 ft. Minimum nominal 2-inch x 3-inch framing members shall be installed in all corners of the crate and fastened securely to the sheathing. On crates longer than 6-

feet, framing members shall be installed along the shorter centerline of all the 4 long panels. The framing members shall be securely fastened to each other and to the sheathing. For crates 4-feet long or less, 2 each 4-inch x 4-inch cleats shall be installed on the bottom edges of the crate to provide for forklift handling. For crates longer than 4-feet, 3 cleats shall be installed, with the middle cleat centered on the crate. These cleats shall be fastened through the bottom sheathing and also banded to the crate with 1 1/4-inch wide steel bands that wrap around the entire crate. The crates shall be designed to stack 3 crates high, provide protection to the contents during rough ocean, air freight transport, and on-site handling without damage.

2.12 FINAL INSPECTION

A. After completion of the quantity of pipe and fittings contracted for, the Owner may perform a final inspection at the fabrication point. The certified results of all required laboratory tests made during production by the Contractor shall be made available in report form at this time. During the final inspection, the product packing will be inspected to see that all specifications listed in section 3.6 have been met. Should any of the packing fail to meet the specifications, the Contractor shall re-pack the pipe to meet the specifications.

2.13 JOINT INSULATION KIT

A. Joints between segments of insulated pipe and fittings shall be installed using a two-part field poured polyurethane foam.

1. Two-part foam mixing chemicals shall be shipped to the site in separate containers of 50 gallons or less each.

2. Contractor shall provide two-part form mixing chemicals in sufficient quantity to fill all required joints.

3. Chemicals shall be applied to the joint using a foam dispensing gun which mixes the chemical immediately prior to injection into the joint.

4. Joint kit foam shall only be installed by a qualified individual who has taken part in a training program offered by the foam supplier. Proof of qualification shall be submitted to Engineer prior to foaming of any joints.

5. Foam shall be installed using an aluminum coupling band form to be removed after foam is cured. Minimum two holes are required in the coupling band. One hole for injection and the other to vent air.

6. Pre-formed “half-shells” are unacceptable and shall not be used.

B. After curing, foam shall be covered by a protective heat shrinkable sleeve specifically designed for pipes made of HDPE, Canusa Superseal or approved equal.

C. Joint kits shall include foam insulation, heat shrink, and coupling band form complete with bolts, nuts and washers to field fabricate the pipe joint.

D. Joint kits shall be sized for 24-inch cut back (12 inches for each pipe) and 12-inch jacket overlap (6 inches for each pipe) for a total heat shrink sleeve length of 36 inches.

E. Manufacture to fit the fitting or the pipe joint.

PART 3 - EXECUTION

3.1 CORE PIPE FUSION

A. Install core HDPE piping in accordance with Section 33 05 33 Polyethylene Utility Pipe as applicable.

3.2 JOINT INSULATION KITS

A. Construct all piping, heat trace channels, and electrical heat trace before installing joint insulation kits.

B. Joint insulation kits shall only be installed on piping that has passed hydrostatic pressure test as described in Section 33 05 33 Polyethylene Utility Pipe.

C. Apply release agent to inside of removable coupling bands prior to application of foam.

D. Inject 2-part foam insulation in liquid form through one hole in top of aluminum coupling band.

E. Remove band and inspect foam insulation at joint for void space.

1. Fill small voids (less than 2-inches in diameter) with spray foam insulation, DOW Great Stuff, or equal.

2. Fill large voids (greater than 2-inches in diameter) by re-installing aluminum joint kit band and injecting additional foam insulation. Cut out cured foam as necessary to apply new foam to void area.

3. Remove aluminum band and re-inspect foam. Repeat above steps if required.

F. Install heat shrink sleeve over joint kit, Canusa Wrap or equal. Follow Manuufacturer’s installation instructions.

G. Install permanent aluminum joint kit band.

END OF SPECIFICATION

SECTION 33 21 00

WATER SUPPLY PUMP

PART 1 - GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. Division 26 - Electrical

1.2 REFERENCES

A. NSF Standard 61

B. ANSI – American National Standards Institute

C. ASTM – American Society for Testing and Materials

D. NEMA – National Electrical Manufacturers Association

E. NEC – National Electrical Code

F. UL – Underwriters Laboratories, Inc.

1.3 SUBMITTALS

A. Product Data:
   1. Include procedures for unpacking and installation of the equipment.
   2. Include characteristic curves of performance and NPSH curve, the control wiring diagrams and service connections for pumps and controls.
   3. Submit manufacturer’s recommended spare parts list.

B. Shop Drawings: Furnish certified shop drawings showing the general assembly, components, dimensions, weights, clearances, and methods and instruction of assembly.

C. Provide manufacturer's literature and performance characteristics on all components including pumps, motors, valves, fittings, controls and the like.

D. Submit manufacturer's recommended spare parts list for each piece of equipment.

E. Provide Operation and Maintenance Manuals as prescribed in Section 017300, Operation and Maintenance Data.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Products shall comply with NSF 60 and 61, and any other agency requirements for pumps and related equipment used in drinking water.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling, and Unloading:
   1. Protect pumps and components from physical damage including effects of exposure to freezing temperatures for extended periods; water, and construction debris.
   2. Prepare packing for export shipping.

B. Acceptance at Site: Inspect the received product at the unloading site, for completeness according to shipping list, damage, and proper packing for storage.

1.6 WARRANTY

A. All components supplied by the pump manufacturer shall have a 1-year warranty against defects and a limited 5-year warranty from the data of project substantial completion.

1.7 LISTING AND LABELING

A. Per Division 26, Electrical.

PART 2 - PRODUCTS

2.1 WELL PUMP

A. General:
   1. Furnish and install one submersible well pump.
   2. The motor and pumps shall be designed for continuous operating service in submerged conditions and constructed as follows to meet the intended service.
   3. Pumps shall be Model 75S-3 as manufactured by Grundfos.
   4. Pumps shall be driven by a motor attached below the pump section.
   5. Design operating conditions shall be as follows:

Design Capacity	80 US GPM
Design Total Dynamic Head	62 ft
Maximum Speed	3450 RPM
Min. Efficiency Design Point	55 %
Discharge Size	2-inch
Pumpage Temp	33 to 50 Degrees F.

Motor	3 hp

8. Lift Cable:
   a. Well pump shall include a lift cable capable of lifting well pump in case discharge pump is separated from the pump.
   b. Lift cable shall be routed to the well cap and secured.
   c. Lift cable shall be manufactured for use in a potable water system.

B. Pump Design:
1. A check valve shall be integrally designed into the pump discharge housing.
2. Pumping downthrust shall be absorbed by the motor thrust bearing.
3. Each impeller shall be fitted with a seal ring around its eye or skirt to prevent hydraulic losses.
4. A filter screen shall be included as part of the suction inlet assembly.

C. Pump Materials of Construction:
1. AISI 304 Stainless Steel

D. Motor Design:
1. Corrosion resistant stainless steel construction.
2. Built-in surge arrestor is provided on single phase motors through 5 HP.
3. Stainless steel splined shaft.
4. Hermetically sealed windings.
5. Replaceable motor lead assembly.
6. NEMA mounting dimensions.
7. Control box is required with 3 wire single phase units.

2.2 SPARE PARTS

A. Pumps:

1. Spare parts shall be provided for each pump installed as recommended by the manufacturer and approved by the Engineer.

2. Spare parts shall include, but not be limited to, the following items:
   a. Seals or packing
   b. Gaskets
   c. Bearings
   d. Wear rings

3. All parts shall be handled in a manner to insure delivery in an undamaged condition, in the original protective packaging and tagged with part number, description, and pump name.

4. Miscellaneous Items:
   a. Provide spare fuses, heaters, indication lamps and alarm lamp for each control panel installed.
   b. Number of spares shall be not less than 50 percent of the number of items installed.

PART 3 - EXECUTION

3.1 TESTING

A. General:

1. Perform testing on each pump prior to shipment as specified below.
2. All testing data shall be submitted to the Engineer for review and acceptance.

B. Performance Test:

1. Each pump shall be fully tested on water at the pump factory before shipment.
2. Tests shall consist of laboratory testing at shutoff and five points over the operating range of the pump; one of the points will be the specified primary design point.
3. Certified test data will include head, capacity, motor output HP, RPM, pump efficiency and be charted and graphed.
4. All tests will be under the direction of a registered engineer and be conducted in accord with the applicable Hydraulic Institute Standards and Procedures according to Level "B."
5. In making these tests, no minus tolerance or margins shall be allowed with respect to capacity, total head or efficiency at the specified design condition.

C. Vibration Test:

1. Each pump shall be vibration tested when operating at prime design point at the pump factory before shipment.
2. Test shall be conducted as directed by the Hydraulic Institute Standards according to Level "B" and under the direction of a registered Engineer.

D. Hydrostatic Test:

1. Each pump shall be hydrostatically tested for casing integrity at 1.25 times the shut-off pressure of actual trim at operating speed at the pump factory before shipment.
2. Tests shall be conducted as directed by a registered Engineer and data certified.

E. NPSHR Test:

1. Each pump shall be tested for its NPSHR, when operating and in conjunction with the H/Q performance test conducted at the pump factory before shipment.
2. The test shall include five points on the test performance curve using water at ambient temperature.

3.2 INSTALLATION

A. Shall be in accordance with the approved shop drawings and the manufacturer's instructions.

3.3 FIELD QUALITY CONTROL

A. Pump shall deliver the rated flowrate measured in GPM, at the conditions indicated, without vibration and cavitation.

B. Inspection: If any deficiencies are revealed during any test, such deficiencies shall be corrected and the test shall be conducted again.

3.4 ADJUSTMENTS

A. Startup equipment system and make adjustments required to place system in proper operating condition.

END OF SECTION

DIVISION 40 PROCESS INTERCONNECTIONS

SECTION 40 00 00.05
PROCESS CONTROL AND INSTRUMENTATION GENERAL

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The Original Equipment Manufacturer (OEM) shall provide all the Process Control and Instrumentation System (PCIS), control panels complete and operable, in accordance with the Contract Documents and also serve the role of Instrument Supplier. All initial programming and configuration shall be done by the OEM. The intent is to have a single point of contact for the Instrumentation and Control systems for the entire project.

B. The OEM along with qualified electrical and instrumentation installers shall be responsible for the installation, testing and commissioning of the PCIS.

C. The requirements of this Section apply to all components of the PCIS, unless indicated otherwise.

D. Responsibilities
   1. The OEM shall be responsible for
      a. Providing the final design and layout of the control panel components,
      b. Preparing submittals
         1) Pre-construction set for review, and
         2) As-built set upon completion of testing.
      c. Construct panel based on approved submittals,
      d. Author PAC program based on function description and software specifications,
      e. Design Screens based on design specifications,
      f. Install PAC and Screen programs, and
      g. Prepare test program and implement in the presence of owner's representative.
      h. Prepare Technical Manual covering components and software.
      i. Submit software and programs as specified elsewhere.
   2. OEM Qualifications: The OEM shall have the resources, space, and personnel needed to design and fabricate the panels. The OEM shall meet the following minimum qualifications:
      a. The OEM shall have been in the business of building panels and bonding the construction of these panels for at least 5 years. The bonding shall be under the name and ownership of the company fabricating the panels for this project.
      b. The OEM shall build the panels to UL standard 508A, shall be certified to build panels to UL standard 508A, and shall attach a UL label on all new panels, or the panel builder shall build to an equal standard, shall be certified to an equal standard, and shall attach a label to all new panels with a label that is acceptable to the State of Alaska Department of Labor, Mechanical Inspections Division.
      c. Panel to be constructed in the U.S.

3. The ENGINEER or other designated OWNER representative shall perform the following WORK:
    a. Implementation of the PCIS:
        1) procure analog hardware,
    b. review the test plan, the training plan, and the spare parts submittals
    c. procure CP,
    d. oversee and certify hardware installation,
    e. oversee, document, and certify loop testing,
    f. modify or assist OEM in modifying PLC and Screen software after installation and during the pre-commissioning and commissioning phases,
    g. Compile Technical Manuals, and
    h. prepare edited set of record drawings based on as-built submittals and field markups.
4. Additional requirements in this Section and throughout Division 40 which are stated to be the ENGINEER or OWNER's representative's responsibility may be performed by the OEM on a negotiated basis.

1.2 OEM SUBMITTALS

A. Furnish submittals in accordance with Section 26 00 00.
    1. Exchange of Technical Information: During the period of preparation of these submittals, the OEM shall authorize a direct, informal liaison with the ENGINEER for exchange of technical information. As a result of this liaison, certain minor refinements and revisions in the systems as indicated may be authorized informally by the ENGINEER, but will not alter the scope of work or cause increase or decrease in the Contract Price. During this informal exchange, no oral statement by the ENGINEER shall be construed to give approval of any component or method, nor shall any statement be construed to grant exception to or variation from these Contract Documents.
    2. Symbology and Nomenclature: In these Contract Documents, all systems, all meters, all instruments, and all other elements are represented schematically, and are designated by symbology as derived from Instrument Society of America Standard ANSI/ISA S5.1 – Instrumentation Symbols and Identification. The nomenclature and numbers designated herein and on the Drawings shall be employed exclusively throughout Shop Drawings, and similar materials. No other symbols, designations, or nomenclature unique to the manufacturer's standard methods shall replace those prescribed above, used herein, or on the Drawings.

B. Shop Drawings
    1. General
        a. Shop Drawings shall include the letterhead or title block of the panel Supplier. The title block shall include, as a minimum, the panel Supplier's registered business name and address, project name, drawing name, revision level, and personnel responsible for the content of the drawing. The quantity of submittal sets shall be as indicated in Section 26 00 00 - Electrical Methods and Materials.
        b. Organization of the Shop Drawing submittals shall be compatible with eventual submittals for later inclusion in the Technical Manual.

c. Shop Drawing information shall be bound in standard size, three-ring, loose-leaf, vinyl plastic, hard cover binders suitable for bookshelf storage. One set of drawings for each facility is to be hung inside each panel. The drawings are to be enclosed in PVC pockets suitable for hanging from a 3-ring binder, two drawings per pocket. The ring binder is to be attached to the inside of the front panel door.

d. Interfaces between instruments, motor starters, control valves, variable speed drives, flow meters, chemical feeders and other equipment related to the PCIS shall be included in the Shop Drawing submittal.

2. Test Procedure Submittals

a. The OEM shall submit the proposed procedures to be followed during tests of the PCIS and its components.

b. Preliminary Submittal: Outlines of the specific proposed tests and examples of proposed forms and checklists.

3. The OEM shall provide a submittal of their certifications, and project history before submitting any Shop Drawings or commencing any work on the control panels.

C. Technical Manual –as specified elsewhere

D. As-Built Drawings

The OEM shall keep current a set of complete schematic diagrams which shall include all field and panel wiring connections, cable, wire and termination numbers. These drawings shall include all instruments and instrument element connections at the CP. Two sets of drawings electronically formatted in AUTOCAD on CD-ROM and two hard copies shall be submitted after completion of all commissioning tasks. All such drawings shall be submitted for review prior to acceptance of the completed work by the OWNER.

1.3 WARRANTY

The warranty shall start from the date of final acceptance of the completed panel, and shall extend for 1 year.

PART 2 - PRODUCTS

2.1 GENERAL

A. Code and Regulatory Compliance: PCIS WORK shall conform to or exceed the applicable requirements of the National Electrical Code and local building codes.

B. Current Technology: Meters, instruments, and other components shall be the most recent field-proven models marketed by their manufacturers at the time of submittal of the Shop Drawings, unless otherwise required to match existing equipment.

C. Hardware Commonality: Instruments which utilize a common measurement principle (for example, d/p cells, pressure transmitters, level transmitters which monitor hydrostatic head) shall be furnished by a single manufacturer. Panel-mounted instruments shall have matching style and general appearance. Instruments performing similar functions shall be of the same type, model, or class, and shall be from a single manufacturer.

D. Instrument and Loop Power: Power requirements and input/output connections for all components shall be verified. Power for transmitted signals shall, in general, originate in and be supplied by the control panel devices. The use of "2-wire" transmitters is preferred, and use of "4-wire" transmitters shall be minimized. Individual loop or redundant power supplies shall be provided as required by the manufacturer's instrument load characteristics to ensure sufficient power to each loop component. Power supplies shall be mounted within control panels or in the field at the point of application.

E. Loop Isolators and Converters: Signal isolators shall be provided as required to ensure adjacent component impedance match where feedback paths may be generated, or to maintain loop integrity during the removal of a loop component. Dropping precision wirewound resistors shall be installed at all field side terminations in the control panels to ensure loop integrity. Signal conditioners and converters shall be provided where required to resolve any signal level incompatibilities or provide required functions.

F. Environmental Suitability: Indoor and outdoor control panels and instrument enclosures shall be suitable for operation in the ambient conditions associated with the locations designated in the Contract Documents. Heating, cooling, and dehumidifying devices shall be provided in order to maintain all instrumentation devices 20 percent within the minimums and maximums of their rated environmental operating ranges. . Enclosures suitable for the environment shall be furnished. All instrumentation in hazardous areas shall be suitable for use in the particular hazardous or classified location in which it is to be installed.

G. Signal Levels: Analog measurements and control signals shall be as indicated herein, and unless otherwise indicated, shall vary in direct linear proportion to the measured variable. Electrical signals outside control panels shall be 4 to 20 mA DC, except as indicated. Signals within enclosures may be 1 5 VDC. Electric signals shall be electrically or optically isolated from other signals.

H. Alternative Equipment and Methods: Equipment or methods requiring redesign of any project details are not acceptable without prior written approval of the ENGINEER through the "or equal" process of Section 26 00 00 – Electrical Materials and Methods. Any proposal for approval of alternative equipment or methods shall include evidence of improved performance, operational advantage and maintenance enhancement over the equipment or method indicated, or shall include evidence that an indicated component is not available. To match existing equipment and future equipment being installed under other contracts, equipment substitutions for equipment specified as no equal will not be accepted.

2.2 OPERATING CONDITIONS

The PCIS shall be designed and constructed for satisfactory operation and long, low maintenance service under the following conditions:

1.	Environment	-	water treatment/supply facility
2.	Indoor Temperature Range	-	32 through 84 degrees F
3.	Relative Humidity	-	20 through 90 percent, non-condensing
4.	Seismic Zone 4		

2.3 SPARE PARTS AND SPECIAL TOOLS

A. The OEM shall provide the following:
   1. Spare parts as listed in equipment specifications in Division 40.

B. The OEM shall furnish a priced list of all special tools required to calibrate and maintain the instrumentation provided under the Contract Documents. After approval, the OEM shall furnish tools on that list.

C. Special tools and spare parts shall be submitted before startup commences, suitably wrapped and identified.

PART 3 - EXECUTION

3.1 PRODUCT HANDLING

A. Shipping Precautions: After completion of shop assembly, factory test, and approval, equipment, cabinets, panels, and consoles shall be packed in protective crates and enclosed in heavy-duty polyethylene envelopes or secured sheeting to provide complete protection from damage, dust, and moisture. Dehumidifiers shall be placed inside the polyethylene coverings. The equipment shall then be skid-mounted for final transport. Lifting rings shall be provided for moving without removing protective covering. Boxed weight shall be shown on shipping tags together with instructions for unloading, transporting, storing, and handling at the Site.

B. Special Instructions: Special instructions for proper field handling, storage, and installation required by the manufacturer shall be securely attached to each piece of equipment prior to packaging and shipment.

3.2 INSTALLATION

A. General
   1. Instrumentation, including instrumentation furnished under other Divisions, shall be installed under Division 40 and the manufacturers' instructions.
   2. Equipment Locations: The monitoring and control system configurations indicated are diagrammatic. The locations of equipment are approximate. The exact locations and routing of wiring and cables shall be governed by structural conditions and physical interferences and by the location of electrical terminations on equipment. Equipment shall be located and installed so that it will be readily accessible for operation and maintenance. Where job

conditions require reasonable changes in approximated locations and arrangements, or when the OWNER exercises the right to require changes in location of equipment which do not impact material quantities or cause material rework, the OEM shall make such changes without additional cost to the OWNER.

B. Conduit, Cables, and Field Wiring
   1. Conduit shall be provided under Division 26.
   2. Process equipment control wiring, 4-20 mA signal circuits, signal wiring to field instruments, PLC input and output wiring and other field wiring and cables shall be provided under Division 26.
   3. PLC equipment cables, data highway communication networks shall be provided under Division 40.
   4. Terminations and wire identification at PCIS equipment furnished under this or any other Division shall be provided under Division 40.

C. Instrumentation Tie-Downs: Instruments, control panels, and equipment shall be anchored by methods that comply with seismic requirements applicable to the Site.

D. Existing Instrumentation: Each existing instrument to be removed and reinstalled shall be cleaned, reconditioned, and recalibrated by an authorized service facility of the instrument manufacturer. The OEM shall provide certification of this work prior to reinstallation of each instrument.

E. Ancillary Devices: The Contract Documents show all necessary conduit and instruments required to make a complete instrumentation system. The OEM shall be responsible for providing any additional or different type connections as required by the instruments and specific installation requirements. Such additions and such changes, including the proposed method of installation, shall be submitted to the ENGINEER for approval prior to commencing the WORK. Such changes shall not be a basis of claims for extra work or delay.

F. Installation Criteria and Validation: Field-mounted components and assemblies shall be installed and connected according to the requirements below:

G. Installation personnel have been instructed on installation requirements of the Contract Documents.
   1. Technical assistance is available to installation personnel at least by telephone.
   2. Installation personnel have at least one copy of the approved Shop Drawings and data.
   3. Flexible cables and capillary tubing shall be installed in flexible conduits. The lengths shall be sufficient to withdraw the element for periodic maintenance.
   4. Power and signal wires shall be terminated with crimped type lugs.
   5. Connectors shall be, as a minimum, watertight.
   6. Wires shall be mounted clearly with an identification tag that is of a permanent and reusable nature.
   7. Wire and cable shall be arranged in a neat manner and securely supported in cable groups and connected from terminal to terminal without splices, unless specifically approved by the ENGINEER. Wiring shall be protected from sharp edges and corners.

8. Mounting stands and bracket materials and workmanship shall comply with requirements of the Contract Documents.
9. Verify the correctness of each installation, including polarity of electric power and signal connections, and make sure process connections are free of leaks. The OEM shall certify in writing that discrepancies have been corrected for each loop or system checked out.
10. The OWNER will not be responsible for any additional cost of rework attributable to actions of the OEM or the Instrumentation Supplier.

3.3 CALIBRATION

A. General: Devices provided under Division 17 shall be calibrated according to the manufacturer's recommended procedures to verify operational readiness and ability to meet the indicated functional and tolerance requirements.

B. Calibration Points: Each instrument shall be calibrated at 25, 50, 75 and 100 percent of span using test instruments to simulate inputs. The test instruments shall have accuracies traceable to National Institute of Testing Standards.

C. Bench Calibration: Instruments that have been bench-calibrated shall be examined in the field to determine whether any of the calibrations are in need of adjustment. Such adjustments, if required, shall be made only after consultation with the ENGINEER.

D. Field Calibration: Instruments that were not bench-calibrated shall be calibrated in the field to insure proper operation in accordance with the instrument loop diagrams or specification data sheets.

E. Analyzer Calibration: Each analyzer system shall be calibrated and tested as a workable system after installation. Testing procedures shall be directed by the manufacturers' technical representatives. Samples and sample gases shall be furnished by the manufacturers.

F. Calibration Sheets: Each instrument calibration sheet shall provide the following information and a space for sign-off on individual items and on the completed unit:
   1. Project name
   2. Loop number
   3. Tag number
   4. Manufacturer
   5. Model number
   6. Serial number
   7. Calibration range
   8. Calibration data: Input, output, and error at 20 percent, 60 percent and 100 percent of span
   9. Switch setting, contact action, and deadband for discrete elements
   10. Space for comments
   11. Space for sign-off by Instrumentation Supplier and date
   12. Test equipment used and associated serial numbers

G. Calibration Tags: A calibration and testing tag shall be attached to each piece of equipment or system at a location determined by the ENGINEER or OWNER. The OEM shall have the Instrumentation Supplier sign the tag when calibration is complete. The ENGINEER or OWNER will sign the tag when the calibration and testing has been accepted.

3.4 LOOP TESTING

A. General: Individual instrument loop diagrams per ISA Standard S5.4 - Instrument Loop Diagrams, expanded format, shall be submitted to the ENGINEER for review prior to the loop tests. The OEM shall notify the ENGINEER of scheduled tests a minimum of 30 days prior to the estimated completion date of installation and wiring of the PCIS. After the ENGINEER's review of the submitted loop diagrams for correctness and compliance with the Specifications, loop testing shall proceed. The loop check shall be witnessed by the ENGINEER.

B. Control Valve Tests: Control valves, cylinders, drives and connecting linkages shall be stroked from the operator interface units as well as local control devices and adjusted to verify proper control action, hand switch action, limit switch settings, torque settings, remote control actions, and remote feedback of valve status and position. Control valve actions and positioner settings shall be checked with the valves in place to insure that no changes have occurred since the bench calibration.

C. Instrument and Instrument Component Validation: Each instrument shall be field-tested, inspected, and adjusted to its indicated performance requirement in accordance with manufacturer's specifications and instructions. Any instrument which fails to meet any Contract requirement, or, in the absence of a Contract requirement, any published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced, at the discretion of the ENGINEER or OWNER and at the OEM’s expense.

D. Loop Validation: Controllers and electronic function modules shall be field-tested and exercised to demonstrate correct operation of the hardware and wiring. Control loops shall be checked under simulated operating conditions by impressing input signals at the primary control elements and observing appropriate responses at register in the PLC processor. Actual signals shall be used wherever available. Following any necessary corrections, the loops shall be retested.

E. Loop Validation Sheets: The OEM shall prepare loop confirmation sheets for each loop covering each active instrumentation and control device including simple hand switches and lights. Loop confirmation sheets shall form the basis for operational tests and documentation. Each loop confirmation sheet shall cite the following information and shall provide spaces for sign-off on individual items and on the complete loop by the Instrumentation Supplier:
   1. Project name
   2. Loop number
   3. Tag number, description, manufacturer and model number for each element
   4. Installation bulletin number
   5. Specification sheet number
   6. Adjustment check
   7. Space for comments

8. Space for loop sign-off by Instrumentation Supplier and date
9. Space for ENGINEER witness signature and date

F. Loop Certifications: When installation tests have been successfully completed for all individual instruments and all separate analog control networks, a certified copy of each test form signed by the ENGINEER, OWNER or the OWNER's representative as a witness, with test data entered, shall be submitted to the ENGINEER together with a clear and unequivocal statement that the instrumentation has been successfully calibrated, inspected, and tested.

3.5 PERFORMANCE TEST

A. The entire PCIS hardware, field instruments, power supplies, and wiring shall operate for 30 days without failure.

B. The OEM shall furnish support staff as required for initial start up of the individual panels. Personnel provided shall be fully versed in the required design parameters and be prepared to alter programming and circuitry as needed to integrate the controls and provide a complete and operational system. Provide personnel for 5 days on site,

C. If any component, other than field instruments, fails during the performance test, it shall be repaired or replaced and the PCIS shall be restarted for another 30-day period.

3.6 REQUIREMENTS FOR COMPLETION

A. For the purpose of this Section, the following conditions, in addition to the requirements stated elsewhere, shall be fulfilled before the WORK is considered substantially complete:
   1. Submittals have been completed and approved.
   2. The PCIS has been tested and approved.
   3. Spare parts and expendable supplies and test equipment have been delivered to the ENGINEER.
   4. The performance test has been successfully completed.
   5. Punch-list items have been corrected.
   6. As-built drawings in both hard copy and electronic format have been submitted.
   7. Revisions to the Technical Manuals that may have resulted from the factory tests have been made and reviewed.
   8. Debris associated with installation of instrumentation has been removed.

END OF SECTION

SECTION 40 23 00

PROCESS PIPING AND TANKS

PART 1 - GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. Section 33 05 33: Polyethylene Utility Pipe

1.2 SCOPE OF WORK

A. This section covers the pipe and fittings within the pump house, and the PEX glycol heat trace tubing within the raw water arctic pipe.

1.3 QUALITY ASSURANCE

A. Install piping to meet requirements of local and state codes.

B. Provide manufacturer's certification that materials meet or exceed minimum requirements as specified.

1.4 SUBMITTALS

A. Certificates: Submit manufacturer's certificates of conformance.

B. Test Reports: Submit certified copies of test reports.

C. Product Data: Submit manufacturer's standard data for pipe, tubing and valves.

D. Tank Product Sheets
   1. Resin - A copy of the resin data sheet from the resin manufacturer for the tank is to be supplied and the tank manufacturer is to certify that it will be the resin used in the manufacture of the tank. Resin shall be NSF 61 listed.
   2. Wall thickness - Prior to the manufacture of the tank the designed wall thickness audit is to be supplied based upon 600 psi hoop stress (ASTM D 1998) @ 100 degrees F.

E. Shop Drawings: Submit dimensionally correct (scaled) shop drawings for tanks to be fabricated prior to beginning fabrication.

1.5 TANK SERVICE CONDITIONS

A. Note: The tank color will be based upon the chemical application and UV exposure of the installation. Tank color is to be natural or opaque white.

B. Table I – Service Conditions

Chemical Stored	Tank Location Inside / Outside	Tank Operating Temperature	Resin	Fitting Material	Gasket Material	Bolt / Insert Material
Potable Water	Outside – Ambient Temperature Range -60 to 100°F	45F	HDLPE	316SS	EPDM	316SS

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Exercise care in transporting and handling to avoid damage to pipe and fittings.

B. Store materials on the site so as to prevent damage.

C. Keep materials clean, dry, and free from deleterious conditions.

D. Do not store material directly on the ground.

E. Damaged Pipe: Repair or replace to satisfaction of Engineer.

1.7 REFERENCES

A. ASTM International:
1. ASTM B32 - Standard Specification for Solder Metal.
2. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes.
3. ASTM B75 - Standard Specification for Seamless Copper Tube.
4. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
5. ASTM B251 - Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube.
6. ASTM B302 - Standard Specification for Threadless Copper Pipe, Standard Sizes.
7. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV).
8. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.
9. ASTM F1281 - Standard Specification for Crosslinked Polyethylene/Aluminum/Crosslinked Polyethylene (PEX-AL-PEX) Pressure Pipe.

B. American Welding Society:
1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.

C. NSF

1. NSF/ANSI Standard 61, AWWA – Drinking Water System Components

PART 2 - PRODUCTS

2.1 HDPE PIPE

A. Materials used for the manufacture of polyethylene pipe and fittings shall be made from a PE 3408 high density polyethylene resin compound meeting cell classifications 34534C per ASTM D3350; and meeting Type 111, Class C, Category 5, Grade P34 per ASTM D1238.

B. High Density Polyethylene (HDPE) pipe shall comply with AWWA Specifications C906 or C901 as appropriate for size.

C. If rework compounds are required, only those generated in the Manufacturer's own plant from resin compounds of the same class and type from the same raw material supplier shall be used.

D. Dimensions and workmanship shall be as specified by ASTM F714. HDPE fittings and transitions shall meet ASTM D3261. HDPE pipe shall have a minimum density of 0.955 grams per cubic centimeter. All HDPE pipe and fittings shall have a Hydrostatic Design Basis (HDB) of 1,600 psi.

E. 3-inch HDPE pipe and accessories shall have a Standard Dimension Ratio (SDR) of 11 and be pressure rated to a minimum of 160 psi.

F. 6-inch HDPE pipe and accessories shall have a Standard Dimension Ratio (SDR) of 17 and be pressure rated to a minimum of 100 psi.

G. Shall be ANSI/NSF 61 certified

2.2 HDPE FITTINGS

A. All molded fittings and fabricated fittings shall be fully pressure rated to match the pipe SDR pressure rating to which they are made. All fittings shall be molded or fabricated by the manufacturer. No Contractor fabricated fittings shall be used unless approved by the Engineer.

B. The manufacturer of the HDPE pipe shall supply all HDPE fittings and accessories as well as any adapters and/or specials required to perform the work as shown on the Drawings and specified herein.

C. All fittings shall be installed using butt-fused fittings or flanged adapters and must be approved by the Engineer.

2.3 PEX TUBING

A. Crosslinked polyethylene PEX-a Engel Method

B. Hydrostatic ratings: 200°F at 80 psi; 180°F at 100 psi; 73.4°F at 160 psi

C. Linear expansion rate: 1.1"/10°F per 100 ft.

D. ProPEX fitting system, or approved eqaul

E. Wirsbo hePEX, or approved equal

2.4 FLEXIBLE DROP PIPE

A. Boreline flexible drop pipe, or approved equal.

2.5 FIRE HOSE

A. Extruded polyurethane hoes

B. Woven polyester reinforcement

C. NSF 61 approved.

D. -40 deg F to 180 deg F temperature range

E. All-American Hose TE Hoes, or approved equal

2.6 ISOLATION VALVES

A. Full port ball valve, lead free

B. Flourocarbon elastomer stem o-ring

C. PTFE stem packing seal, thrust washer and seats

D. Watts Series LFFBV-3C, or approved equal

2.7 CHECK VALVE

A. Stainless steel check valve

B. Body: stainless steel 316

C. Bolt: stainless steel 316

D. Disc: viton

E. Hardware: stainless steel 316

F. Flowmatic Model 80 S, or approved equal

2.8 TRANSITION FROM HDPE PIPE

A. Transition from HDPE to isolation valves and check valves with Polycam aluminum-bronze threaded adapter.

B. All other transitions from HDPE pipe to other pipe materials and valves shall be made per the HDPE pipe manufacturer's recommendations and specifications. A molded flange connector adapter with 316 stainless steel back-up ring assembly shall be used for pipe type transitions.

2.9 WALL AND FLOOR SLEEVES

A. Configuration and materials as shown.

2.10 HANGERS AND SUPPORTS

A. General:
   1. All piping shall be supported in a manner which will prevent undo strain on any valve, fitting, or piece of equipment, and will not over-stress connecting structural members.
   2. Pipe supports shall be provided at changes in direction or elevation, adjacent to flexible couplings, and where otherwise shown.
   3. Pipe supports and hangers shall not be installed in equipment access areas or overhead hoist runs.

B. Horizontal Piping:
   1. Support with adjustable swivel-ring, split-ring, or clevis type hangers: Grinnel Figure 67, 104 or 260; B-Line B3100, B3171 or B3690; or approved equal.
   2. Horizontal piping hanger support rods shall attach to steel beams with C-clamps or beam clamps.
   3. Piping shall not be supported from existing wood purlin members spanning between building frames.

C. Stacked Horizontal Runs:
   1. Stacked horizontal runs of piping shall be supported by a metal framing system: B-Line, Unistrut, or approved equal.
   2. No pipe shall be supported from the pipe above it.

D. Pedestals:

1. Pedestal pipe supports shall be adjustable, with stanchion, saddle, and anchoring flange: Grinnel Figure 259, B-Line Figure 3090, or approved equal.
2. Provide neoprene waffle isolation pad under anchoring flanges, adjacent to equipment or where otherwise required to provide vibration isolation.
3. Pads shall be Mason Industries, Inc. Type W; Korfund Korpad 40; or approved equal.

E. Vertical Piping:
1. Vertical piping hangers and supports shall be channel and pipe straps manufactured by B-Line, Unistrut, or approved equal.
2. Piping supports for vertical piping passing through floor sleeves shall be galvanized steel riser clamps: Grinnel Figure 261, B-Line Figure 3373, or approved equal.

F. Trapeze Hangers:
1. Assembly shall consist of structural attachments with rod size dependent upon total weight supported. Spacing at assemblies shall be determined by minimum pipe size including in group.
2. Trapeze horizontal shall be a structural angle or channel of sufficient size to prevent measurable sag between rods.
3. Manufacturers: Unistrut, B-Line, or approved equal.

G. All hangers, rods, clamps, protective shields, metal framing support components, and hanger accessories shall be galvanized, and shall be sized as recommended by the manufacturer to properly support the loads. Sizes shall not be smaller than those indicated on the Plans.

H. Maximum Support Spans: Unless recommended otherwise by the pipe and/or pipe support manufacturer, horizontal pipe support or hanger spacing shall not exceed the spans allowed by UPC.

I. The load rating for connections to structural members shall not be less than that of the hanger rods they support.

J. Where hanger rod lengths exceed 24 inches, vertical sway bracing shall be provided at the hanger rod(s).

K. Standard Hangers and Supports: MSS SP-58 or FS WW-H-171.
1. Type: As required for conditions or as indicated.
2. Hanger rods: Carbon Steel, ASTM A575.

L. Manufacturer's Hangers and Supports: Unistrut, B-Line or equivalent.
1. Type: As required for conditions or as indicated.
2. Metal Framing: Unistrut 1-5/8-inch minimum channel width series or equivalent, continuous slot channel, hot-dipped galvanized to ASTM A123 or A153.
3. End closures, Joint Covers, Closure Strips, Parts, Screws and Nuts: Electro-galvanized, FS QQ-Z-325 or cadmium plated.

M. Concrete and Fabricated Hangers and Supports:
1. Field erected cast-in-place concrete.

2. Shop fabricated steel.

2.11 DIELECTRIC SEPARATION

A. Install non-conducting dielectric connections or barriers wherever jointing dissimilar metals.

2.12 POLYETHYLENE TANK RESIN CLASSIFICATION

A. Type II - Tanks molded from linear polyethylene resin (not cross-linkable resin). The material used shall be virgin polyethylene resin as compounded and certified by the manufacturer. Type II tanks shall be made from high density linear polyethylene (HDLPE) resin as manufactured by ExxonMobil Chemical, or resin of equal physical and chemical properties.

B. All polyethylene resin material shall contain a minimum of a U.V. 15 stabilizer as compounded by the resin manufacturer. Pigments may be added at the purchaser's request, but shall not exceed 0.25% (dry blended) of the total weight.

C. Mechanical Properties of Type II tank material: High density Linear (HDLPE)

PROPERTY	ASTM	VALUE
Density (Resin)	D4883	0.941-0.948 g/cc
Tensile (Yield Stress 2"/min)	D638	3000 PSI
Elongation at Break (2"/min.)	D638	>1000%
ESCR (100% Igepal, Cond. A, F50)	D1693	550 hours
ESCR (10% Igepal, Cond. A, F50)	D1693	50 hours
Vicat Softening Degrees F. Temperature	D1525	235
Flexural Modulus	D790	130,000 PSI

D. POLYETHYLENE TANK DESIGN REQUIREMENTS

1. The designed specific gravity of the tank shall be based upon the actual chemical, its' concentration and temperature. From these factors it can be determined if polyethylene can be used and if so which family of polyethylene is to be used. NSF 61 certification is required and Type II HDLPE resin will be required.
2. The minimum required wall thickness of the cylindrical shell at any fluid level shall be determined by the following equation, but shall not be less than 0.187 in. thick.

   T = P x O.D./2 SD = 0.433 x S.G. x H x O.D./2 SD
   T = wall thickness
   SD = hydrostatic design stress, PSI
   P = pressure (.433 x S.G. x H), PSI
   H = fluid head, ft.
   S.G. = specific gravity, g/cm^3
   O.D. = outside diameter, in.
3. The hydrostatic design stress shall be determined by multiplying the hydrostatic design basis, determined by ASTM D2837 using rotationally molded samples, with a service factor selected for the application. The hydrostatic design stress is 600 PSI at 73 degrees Fahrenheit for Type II materials. In accordance with the formula in above, the tank shall have a stratiform (tapered wall thickness) wall.

4. The hydrostatic design stress shall be derated for service above 100 degrees Fahrenheit and for mechanical loading of the tank.
5. The standard design specific gravity shall be 1.5 or 1.9.
6. The minimum required wall thickness for the cylinder straight shell must be sufficient to support its own weight in an upright position without any external support.
7. The top head must be integrally molded with the cylinder shell. The minimum thickness of the top head shall be equal to the top of the straight wall.

E. BULKHEAD FITTINGS

1. Bolted stainless steel fittings shall be used. Fittings must be placed away from tank knuckle radius' and flange lines. Consult the manufacturer for placement questions. Allowable fittings sizes based on tank diameter for curved surfaces are shown below.

Tank Diameter	Maximum Bolted Fitting Size Allowable
48 in.	3 in.
64 in. - 142 in.	4 in.

2. The bolted stainless steel fittings shall allow tank wall thickness up to 2 1/2 in.
3. The bolted stainless steel fittings shall be constructed with a minimum of 4 fully threaded 3/8 in. studs. Each fitting shall have one gasket and two flanges. The gasket shall be compressed between the inside of the tank wall surface and the inside flange of the fitting. The stainless steel fittings shall be female x female pipe threads. The fittings shall be constructed of Type 316 stainless steel. Gaskets shall be a minimum of 1/4" thickness and constructed of 40-50 durometer EPDM, 60-70 durometer Viton or other specified material.

F. TANK MANUFACTURER

1. Snyder Industries, Norwesco, or approved equal.

2.13 PIPE AND TANK INSULATION

A. All raw water piping and the two water storage tanks shall be insulated with 1-inch thick insulation

B. Black flexible closed-cell elastomeric thermal insulation

C. Thermal conductivity – 0.245 in/h-ft^2-deg F

D. Water vapor permeability – 0.05 perm-in

E. AP Armaflex Tube Insulation, or approved equal (piping)

F. AP Armaflex Sheet insulation, or approved equal (tanks)

PART 3 - EXECUTION

3.1 INSTALLATION OF INTERIOR PIPE

A. Complete installation to present neat orderly appearance.

B. Pipe segments shall be prefabricated and coated prior to installation in order to facilitate construction and to minimize disruption of normal plant operations.

C. Do not block openings or passageways with piping.

D. Run piping parallel to walls to building, unless otherwise indicated.

E. Keep piping free from contact with structure or installed items.

F. Allow clearances for expansion and contraction of pipe.

G. Anchor horizontal runs over 50 feet at midpoint to force expansion equally toward ends.

H. Placement of Vertical Piping:
   1. Secure at sufficiently close intervals to keep pipe in alignment and to support weight of pipe and contents.
   2. Install supports at each floor or vertically at intervals of not more than 10 feet.
   3. If piping is to stand free of support, or if no structural element is available for support during construction, secure in position with wooden stakes or braces fastened to pipe.

I. Placement of Horizontal Piping:
   1. Support at sufficiently close intervals to maintain alignment and prevent sagging.
   2. Install hangers at ends of runs or branches and at each change of direction or alignment.

J. Support at Equipment: Install to not include strain on equipment during or subsequent to the installation of pipe work.

K. Provide flexible coupling or union at all connections to equipment to facilitate removal for maintenance.

L. Provide sufficient support of pipe at locations where flexible hose-type connections are specified.

3.2 FLANGED PIPE INSTALLATION

A. Tighten flange bolts so that gasket is uniformly compressed and sealed.

B. Do not distort flanges.

C. Ream ends of pipe after threading and before assembly to remove burrs.

D. Leave not more than three pipe threads exposed at each connection.

E. Joint Sealer - Teflon thread tape.

3.3 THREADED JOINTS INSTALLATION

A. Threads: ANSI B1.201, NPT.

B. Cut threads full and clean with sharp dies.

C. Ream ends of pipe after threading and before assembly to remove burrs.

D. Leave not more than three pipe threads exposed at each connection.

E. Joint Sealer - Teflon thread tape.

3.4 HDPE PIPE INSTALLATION

A. In accordance with Section 33 05 33 – Polyethylene Utility Pipe.

3.5 PEX TUBING INSTALLATION

A. Install in accordance with manufacturer recommendations.

3.6 TESTING

A. General:
   1. All pipe and fittings shall be pressure-tested as specified herein.
   2. The Contractor shall furnish all material, equipment, and labor for testing and retesting the piping system.
   3. Each system may be tested as a unit or in sections as directed by the Engineer, but each complete system shall successfully meet the requirements specified herein before acceptance by the Engineer.
   4. Should any defects appear in the pipe or fittings, the necessary repair should be made, and the line retested until it shall meet the requirements.
   5. The Contractor shall take all necessary precautions to prevent any joints from drawing while the pipelines and their appurtenances are being tested and he shall at his own expense repair any damage to the pipe and their appurtenances or to any other structures resulting from or caused by these tests.
   6. The Contractor shall inform the Engineer at least 2 days in advance of the time set for testing the piping system.

B. Water Piping:
   1. All piping shall be hydro-statically pressure tested as specified herein.

2. Test pressure for water piping shall be 120 psi.
3. The test shall be made by closing valves or providing bulkheads or plugs and filling the pipeline with water.
4. Provisions shall be made for release of all air in the lines.
5. Lines may be filled with water some time before testing to allow for absorption of water by pipe or joint material.
6. The test pressure must be maintained a minimum of one hour or sufficiently longer to permit the Engineer to make an inspection of the system.
7. During the test, pipe, fittings and joints shall be completely tight.

END OF SECTION

SECTION 40 95 13
PROCESS CONTROL PANELS AND HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes pump control system including motor control contactors and overloads where applicable, pump alternation, switches, push buttons, indicating lights, display and control relays.

B. Related Sections:
   1. Section 26 05 03 - Equipment Wiring Connections.
   2. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
   3. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
   4. Section 26 28 13 – Electrical Cabinets and Enclosures
   5. Section 40 90 00 – Process Measurement and Control

1.2 REFERENCES

A. National Electrical Manufacturers Association:
   1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

B. Underwriters' Laboratories
   1. UL 508 - Industrial Control Equipment.

1.3 CONTROL PANEL SCOPE

A. BUILDING ALARM PANEL (IAP)
   1. This panel collects the composite alarms from each control panel in the facility and annunciates visually, audibly and via telephone dialer. Alarms remain active until acknowledged.
   2. Panel layout and ladder logic shall be as shown on the plans.

1.4 SUBMITTALS

A. Section 26 00 00 - Electrical Methods and Materials

B. Control Panel Engineering Submittal: The CONTRACTOR shall submit a control panel engineering submittal (CPES) for each control panel and enclosure provided under Division 40. The CPES shall completely define and document the construction, finish, fuses, circuit breakers, internally-mounted hardware, communications hardware, and PLC system components. All panel drawings shall, as a minimum, be "B" size with all data sheets and manufacturer

specification sheets being "A" size. The submittal shall be in conformance with ISA-S20 – Standard Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves, shall be submitted as a singular complete bound volume or multi volume package within 60 calendar days after Notice to Proceed, and shall have the following contents:

1. A complete index shall appear in the front of each bound volume. All drawings and data sheets associated with a panel shall be grouped together with the panels being indexed by systems or process areas. All panel tagging and nameplate nomenclature shall be consistent with the requirements of the Contract Documents.
2. Scale construction drawings which define and quantify the type and gauge of steel to be used for panel fabrication, the ASTM grade to be used for structural shapes and straps, panel door locks and hinge mechanisms, type of bolts and bolt locations for section joining and anchoring, details and proposed locations for "UNISTRUT" members, stiffener materials and locations, electrical terminal box and outlet locations, electrical access locations, print pocket locations, writing board locations, and lifting lug material and locations.
3. Cutout locations with nameplate identifications shall be shown.
4. The Contract Drawing wiring diagrams shall be edited to identify electrical devices, terminals, and interconnecting wiring. These diagrams shall show interconnecting wiring by lines, designate terminal assignments, and show the physical location of all electrical and control devices.
5. A bill of material which enumerates all devices associated with the control panel.

C. Product Data: Submit catalog information and descriptive literature for components.

D. Test Reports: Submit certified factory test report indicating control panel successfully performs functions specified.

E. Manufacturer's Installation Instructions: Submit instructions on installation and field wiring connections.

F. Manufacturer's Field Reports: Submit certification after installation that control panel has been installed in accordance with manufacturer’s instructions and has been successfully field tested.

1.5 CLOSEOUT SUBMITTALS

A. Section 40 00 00.05 - Process Control and Instrumentation General.

B. Project Record Documents: Record actual locations of control panel and final wiring diagrams and connections.

C. Operation and Maintenance Data: Submit operation and maintenance instructions for components and devices.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with UL 508.

B. Provide components compatible with functions required to form complete working system.

C. Provide UL 508 label on complete assembly.

D. Perform Work in accordance with NEC.

E. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

A. Manufacturer and Fabricator: Company specializing in manufacturing and assembling products specified in this section with minimum three years' experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 40 00 00.05 - Process Control and Instrumentation General.

B. Inspect for damage.

C. Store in areas protected from weather, moisture, or possible damage; do not store directly on ground; handle to prevent damage to wiring and components.

1.9 COORDINATION

A. Section 40 00 00.05 - Process Control and Instrumentation General.

B. Coordinate work and component requirements with controlled pumps.

1.10 EXTRA MATERIALS

A. Section 40 00 00.05 - Process Control and Instrumentation General.Furnish the following spare parts for each panel provided under this contract:
   1. 4 pilot light bulbs.
   2. 1 24 volt DC power supply for each size utilized.
   3. 4 fuses for each type and size utilized.
   4. 1 general purpose relay for each type utilized.

PART 2 - PRODUCTS

2.1 CONTROL PANEL ASSEMBLIES

A. Acceptable manufacturers include but are not limited to:
   1. TecPRO, Anchorage, Alaska
   2. Dowland-Bach, Anchorage, Alaska
   3. Technical Systems Inc, (TSI), Lynnwood, Washington
   4. Systems Interface, Bothell Washington

2.2 GENERAL

A. Panel construction shall conform to NFPA 70 (NEC) Article 409 and NFPA 79.

B. The control panel controls shall be 120 or 24 VDC. Control conductors shall be provided in accordance with the indicated requirements.

C. The control panel shall be the source of power for any 120 VAC or 24VAC solenoid valves and their controllers interconnected with the control panel. All equipment associated with the control panel shall be ready for service after connection of conductors to equipment, controls, and control panel.

D. Unless indicated otherwise, control panels shall be housed in NEMA-rated enclosures as shown on the Drawings. Control panels shall be either wall-mounted, pedestal-mounted or equipment skid-mounted, as indicated. Internal control components shall be mounted on an internal back-panel or side-panel as required.
   1. All interior control or relay panels mounted above ground level shall be NEMA 12.

E. Each source of 'external' voltage shall be isolated by providing disconnecting fused terminal blocks or DIN rail mounted relays. Each control panel shall be provided with identified terminal strips for the connection of all external conductors. The CONTRACTOR shall provide sufficient terminal blocks as shown on the Drawings.

F. Discrete outputs from the control panels shall be provided by electrically isolated contacts rated for 2 amps at 24 VDC or 5 amps at 120 VAC.

G. All control panel mounted devices shall be provided as shown on the Drawings or called for in the specifications.

H. Painting: Steel control panels shall be thoroughly cleaned and sand blasted per Steel Structures Painting Council Specification SSPC SP 6 (Commercial Blast) after which surfaces shall receive a prime coat of **Amercoat 185**, or equal, 3 mils DFT, for a total thickness of the prime plus finish system of 6 mils. The finished color of the outside surfaces shall be ANSI 61 gray paint. Interior of the control panel, back-panel, and side-panels shall have a white finish coat.

2.3 COMPONENTS

A. General: Additional components are specified on the plans in individual component schedules.

B. Control Panel Enclosure:
   1. Furnish NEMA 250 Type 12 enclosure fabricated of 10 gage steel with continuously welded seams.
      a. Enclosure door gasketed with neoprene.
      b. Heavy-duty three-point latching mechanism.
      c. Power: 120/240 volt, 3 phase, 4 wire open delta service.
   2. Identify control panel components with engraved nameplate mounted on inside of panel.
   3. Mount components, not mounted on front of panel, on removable back panel secured to enclosure with collar studs.
   4. Install wiring in neat, workmanlike manner and group, bundle, support and route horizontally and vertically for neat appearance.
   5. Terminate wires leaving panel at terminal strips inside enclosure.
   6. Identify terminals and wires in accordance with panel wiring diagrams.
   7. Furnish copper grounding plate inside control panel for terminating ground wires.
   8. Note Size limits for VSCP listed in the Panel description in

C. Circuit Breakers:
   1. Furnish quick-make, quick-break thermal-magnetic molded case type, individually DIN rail mounted and identified.
   2. Furnish individual circuit breakers for each of the following:
      a. Main Circuit Breaker
      b. Control Circuit(s)
      c. Each pump served from the panel (with the exception of the Pressure Pump VFD's)

D. Legend Plates for Pilot Devices:
   1. Furnish 2x2-1/2 inch plastic legend plate with rounded corners for each selector switch, push button and pilot light.
   2. Color: Gray with white lettering.

E. Mounting of Instruments
   1. The panel vendor shall provide cut outs, and shall mount all instrument items indicated to be panel-mounted, including any instruments indicated to be furnished by other vendors but installed in the panel.
   2. The panel vendor shall also mount behind the panels other instrument accessory items as required for functionality or as indicated.
   3. Equipment mounted at the rear of panel shall be installed to allow for commissioning adjustments, servicing requirements, and cover removal.
   4. Spare space shall be kept clear of wiring, etc., to give maximum space for future additions.

F. Electrical Requirements
   1. The CONTRACTOR shall provide conduit, wireways, switches, wire, and electrical fittings for all 24 VDC and 120 VAC circuits to instruments and other electrical devices as required for a complete and operable installation.

2. Conduit, wireways, junction boxes and fittings shall include those required between sensors and transmitters and between the junction boxes and instruments.
3. Each terminal connection shall have a plastic plate with a terminal and instrument tag number. Wiring shall be identified with stamped tubular wire end markers. Terminals shall be DIN rail mounted, rated at 400 VAC, manufactured by **Entrelec**, or equal.
4. Each panel shall be provided with a motion sensing LED (400 lumen) light fixture, as shown on the Drawings. The fixture shall be **Hoffman model LEDA2S35**, or equal.
5. Each panel shall be provided with a switched light fixture, as shown on the Drawings. The fixture shall include a 120-volt receptacle and door switch.
6. Wiring Methods: Wiring methods and materials for all panels shall be in accordance with the N.E.C. requirements for General Purpose (no open wiring) unless otherwise indicated.
7. Signal and Control Circuit Wiring
    a. Wire type and sizes: Conductor shall be flexible stranded copper wire, UL. Wires for instrument signal circuits and alarm input circuits shall be No. 16 AWG Type MTW rated for 300 volts. The analog cables between the PLC I/O card and terminal strips shall be (8) conductor No. 18 AWG cable rated 300 volts for loop powered devices and 8-pair shielded No. 18 AWG cable rated 300 volts for 4-wire loops. DeviceNet cable shall be as per Allen-Bradley requirements, and terminated per Allen-Bradley requirements.
    b. Wire Insulation Colors:
        1) 120 VAC Power - Black 14 AWG minimum
        2) 120 VAC Neutral - White 14 AWG minimum
        3) 120 VAC Ground - Green 14 AWG minimum
        4) 120 VAC Control - Red 14 AWG minimum
        5) 120 VAC Foreign Power - Yellow 16 AWG minimum
        6) 120 VAC Foreign Neutral - Yellow 16 AWG minimum
        7) DC Positive - Blue 16 AWG minimum
        8) DC Negative - White/Blue 16 AWG minimum

        All 120 VAC power wiring protected by the main circuit breaker and incoming power service shall be No. 12 AWG.
    c. Wire Marking: Wire numbers shall be marked using white numbered wire markers made from heat shrink plastic. Wires shall be marked as shown on the Drawings. Numbers shall read from left to right.
    d. Flexible conduit is only to be used where specified.
    e. Conduit fittings shall be **Crouse Hinds cast fittings**, or equal.
    f. For equipment grounding, panels shall be provided with a 1/4 inch by 1 inch copper ground bus complete with solder-less connector for one No. 4 AWG bare stranded copper cable. The copper cable shall be provided by the CONTRACTOR and be connected to the electrical equipment ground of the 120-volt panel supplying power.
8. Power Supply Wiring
    a. Unless otherwise indicated, all instruments, alarm systems, and motor controls shall operate on 24 VDC circuits.
    b. The panel fabricator shall provide terminal box connections for the main power supply entry as shown on the Drawings.

c. When instruments do not come equipped with integral fuses, provide fuses as required for the protection of individual instruments against fault currents. Fuses shall be mounted on the back of the panel in a fuse holder, and each fuse shall be identified by a service name tag. Fuses shall be as manufactured by **Bussmann Manufacturing Division, Type KAW TRON**, or equal. Circuit breakers shall be provided as shown on the Drawings.

G. Relays:
1. DIN rail mounted interposing relays isolating the PLC outputs shall have contacts rated at 8 amps, 230 volts, at 20,000 operations. The coils shall be 24 VDC at 0.03 amps. Relays shall be **Entrelec model RB121A**, or equal, for single pole, and **RB122** for 5-amp double pole.
2. DIN rail mounted general purpose relays shall have square base with contacts rated at 10 amps, 230 volts, at 20,000 operations. The coils shall be 120 VAC at 0.03 amps. Relays shall be 2, 3 or 4-pole as required with power on LED and manual override, Allen Bradley or equal.
3. Intrinsic Safety Relay: The intrinsic safety relay shall provide isolation of 2-wire 24 VDC circuits in a hazardous location. The relays shall be **Turk model MK33**, or equal.

H. Each terminal connection shall have a plastic plate with a terminal and instrument tag number. Wiring shall be identified with stamped tubular wire end markers.

I. Analog and Digital Control Terminals: Fused Terminals for analog input and output points shall be a 3-wire terminal with a fused circuit, a feed through circuit and a ground terminal. Fused Terminals for the discrete input points shall be 2-wire terminal with a fused circuit and a feed through circuit. Provide a one-tenth of an ampere rapid blow 250-volt fuse for all analog circuits and all discrete input circuits. The analog terminals shall be **Weidmuller model KDKS 1 part 953245**, and the discrete input terminal shall be **Weidmuller model KDKS 1 PE part 953245**.

J. Each terminal connection shall have a plastic plate with a terminal and instrument tag number. Wiring shall be identified with stamped tubular wire end markers. 120V terminals shall be DIN rail mounted, rated at 400 VAC, manufactured by **Entrelec**, or equal.

K. Spare Fuses: For each panel, provide the following spare fuses:
1. A minimum of two spare fuses of each size
2. One spare fuse for every ten fused circuits

Provide the fuses in a spare fuse box mounted on the interior wall of the panel. Fuse box shall be **Plano Tackle Systems 1061 Accessory Box, Plano, IL**, **www.planomolding.com**, or equal.

L. Power Supply 24 VDC: Each panel's instrumentation and interposing relays shall be supplied from a 24 VDC power supply. Minimum 2.5A, **SOLA SDN2.5-24-100P** or equal

M. 120 VAC Surge Arrestor: A 120 VAC three-stage surge protector shall be provided on the control voltage supply for each panel. The surge protector shall include a first stage inline inductor, a second stage MOV to ground with a thermal fuse, and a third stage array of MOVs to provide a small amount of capacitance. The unit shall be DIN rail-mounted. The MOV shall include green LED to indicate the status of the second stage MOV. Provide two (2) spare units

for each panel. The unit shall be rated for 120 VAC and shall be either **Advance Surge Supressor model TSP-WG6-120VAC-10A-01, Control Concepts 'Islatrol Elite' model IE-110**, or equal.

N. Labor and Workmanship: Panels shall be fabricated, piped, and wired by fully qualified workmen who are properly trained, experienced, and supervised.

2.4 MARKING

A. Control panels shall be marked with the following information that is plainly visible after installation:
   1. Manufacturer's name
   2. Supply voltage
   3. Short-circuit rating of the main breaker
   4. Name of the project and site
   5. Enclosure rating
   6. Minimum Size of Control Wiring: Number 16.
   7. Tag control wiring at both ends in control panel with legible permanent coded wire marking sleeve. Mark with white PVC tubing sleeves with machine printed black marking. Mark in accordance with wire numbers shown on approved shop control wiring diagrams and terminal strip numbers.

2.5 SOURCE QUALITY CONTROL AND TESTS

A. Perform a factory test of completed control panel by demonstrating operation of control functions. Provide certified test results.

B. Factory assemble and test each control and alarm function.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 40 00 00.05 - Process Control and Instrumentation General.

B. Verify correct power supply is available.

C. Verify pumps are installed.

3.1 CONTROL PANEL SIGNAL AND CONTROL CIRCUIT WIRING

A. Wiring Installation: All wires shall be run in plastic wireways except (1) field wiring, (2) wiring between mating blocks in adjacent sections, (3) wiring from components on a swing out panel to components on a part of the fixed structure, and (4) wiring to panel mounted components. Wiring run from components on a swing out panel to other components on a fixed panel shall be made up in tied bundles. These bundles shall be tied with nylon wire ties and shall be secured to panels at both sides of the "hinge loop" so that conductors are not strained at the terminals.

B. Wiring run to control devices on the front panels shall be tied together at short intervals with nylon wire ties and be secured to the inside face of the panel using adhesive mounts.

C. Enclosures Wiring: All wiring shall be run in liquidtight flexible conduit (LFMC), unless otherwise noted on the Drawings. All enclosure wiring and raceways shall be installed by the panel builder in the shop.

D. Wiring to rear terminals on panel mount instruments shall be in plastic wireways secured to horizontal brackets above or below the instruments in about the same plane as the rear of the instruments.

E. Shop Drawings shall show conformance to the above wiring installation requirements.

F. Wire Marking: Each signal, control, alarm, and indicating circuit conductor connected to a given electrical point shall be designated by a single unique number as shown on the Contract Drawings. These numbers shall be marked on all conductors at every terminal.

3.2 CALIBRATION, TESTING, AND INSTRUCTION

A. General: Calibration, testing, and instruction shall be performed in accordance with Section 40 90 00 – Process Control and Instrumentation Systems.

B. Inspection and Approval
   1. Panel fabricator shall conduct the following tests prior to arrival of the ENGINEER or before shipment, if the ENGINEER chooses not to witness factory testing.
      a. All status, control, analog and alarm circuits rung out to determine their operability.
      b. All electrical power circuits checked for continuity and where applicable, operability.
      c. Any other test required to place the panel in an operating condition.
   2. It shall be the responsibility of the CONTRACTOR to furnish all necessary testing devices and sufficient manpower to perform the tests required by the ENGINEER.
   3. Field Testing: Each control panel shall be tested again for functional operation in the field after the connection of external conductors and prior to equipment startup.

3.3 INSTALLATION

A. Install control panel at location indicated on Drawings.

B. Install control panel in accordance with manufacturer’s instructions.

3.4 FIELD QUALITY CONTROL

A. Section 40 00 00.05 - Process Control and Instrumentation General.

B. Start-up control system by energizing system equipment and testing operation of hardware and process control logic under supervision of manufacturer's representative and in presence of Architect/Engineer.

C. Equipment Acceptance:

1. Adjust, repair, modify or replace system components that fail to perform as specified and rerun tests. Make final adjustments to equipment under direction of manufacturer's representative.
2. Document adjustments, repairs and replacements in manufacturer’s field services certification.

3.5 MANUFACTURER'S FIELD SERVICES

A. Section 40 00 00.05 - Process Control and Instrumentation General.

B. Furnish services of manufacturer's representative experienced in installation of products furnished under this specification for not less than 5 man days on-site for installation inspection and field testing, and instructing Owner's personnel in maintenance of equipment.

C. Certify that equipment has been properly installed and is ready for start-up and testing.

3.6 DEMONSTRATION

A. Section 40 00 00.05 - Process Control and Instrumentation General.

B. Demonstrate equipment startup, shutdown, routine maintenance, alarm condition responses, and emergency repair procedures to Owner’s personnel.

END OF SECTION

GEOTECHNICAL REPORTS

GEOTECHNICAL REPORT

Alaska Village Electric Cooperative - Bulk Fuel Upgrades
Emmonak, Alaska

March 17, 2014

Prepared By:
Doug P. Simon, P.E.
Senior Geotechnical Engineer

Reviewed By:
Lorie Dilley, P.E., C.P.G., PhD
Principal Geotechnical Engineer

HATTENBURG DILLEY & LINNELL
Engineering Consultants
3335 Arctic Blvd., Ste. 100
Anchorage, AK 99503
Phone: 907.564.2120
Fax: 907.564.2122

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF APPENDICIES

GEOTECHNICAL REPORT
EMMONAK BULK FUEL UPGRADES
ALASKA VILLAGE ELECTRIC COOPERATIVE
EMMONAK, ALASKA

1.0 INTRODUCTION

The existing Alaska Village Electric Cooperative (AVEC) tank farm and power plant in Emmonak, Alaska is located within the flood plain of Kwiguk Pass on the Yukon River. As a result, the facility routinely floods during seasonal high water events. Flooding has contributed to erosion of the secondary containment, corrosion, and ice damage has occurred to the tanks and power plant foundation. A new AVEC tank farm facility is needed in the community to provide year-round, safe, and code-compliant fuel storage and power generation that is flood-resistant. In addition to the tank farm, a new power plant will also be constructed. In 2002, URS Corporation prepared a Concept Design Report (CDR) for upgrades to bulk fuel storage and dispensing facilities owned and operated by City of Emmonak (City), AVEC, and Lower Yukon School District (LYSD). AVEC contracted HDL to update the existing CDR to reflect current fuel storage requirements using the recent community population, and proposed fuel consumption data after the Emmonak-Alakanuk intertie was constructed in 2011. As part of updating the CDR, a geotechnical evaluation was conducted to evaluate the subsurface conditions at the location of the proposed upgrades.

The purpose of this report is to present the results of the geotechnical subsurface evaluation for the proposed bulk fuel upgrades in Emmonak, Alaska. The geotechnical scope of this project was to evaluate subsurface conditions and provide foundation recommendations for the proposed upgrades. Soil borings were conducted on March 8 through March 11, 2013. Soil samples recovered from the soil borings were classified in the field and later returned to our laboratory for testing. Included in this report are descriptions of the site and project, soil borings, laboratory test results, and interpretation of the subsurface conditions. Design recommendations for the proposed bulk fuel storage, dispensing facilities, and power plant are also presented. The proposed power plant will be located at the current tank farm and this area could not be investigated during our geotechnical studies due to presence of the existing tanks and structures limiting access. The proposed foundation design for the power plant will need to be verified in the field using dynamic pile testing.

2.0 EXISTING LITERATURE REVIEWED

Geotechnical work was conducted east and west of the proposed site in 1982 by Northern Technical Services and summarized in their October report titled "*Soils Investigation Report, Proposed Emmonak Airport".* In addition, further geotechnical work was conducted for the airport east of the site by Dowl Engineers in 1999 and summarized in their October report titled "*Final Geotechnical Study-Emmonak Airport Improvements*". Geotechnical work was conducted by Northern Geotechnical Engineering, Inc. for the Emmonak High School Construction/Renovation project in 2012 and summarized in their February report titled "*Revised Geotechnical Report for the Proposed Emmonak High School Construction/Renovation Project, Emmonak, Alaska*". HDL was also able to obtain a report for work on piles that had jacked at the Emmonak washeteria, located just east of the proposed tank farm location. The report was prepared by Duane Miller & Associates (DMA) and was provided to Alaska Village Electric Cooperative (AVEC) via email. HDL reviewed the reports noted above to provide an understanding of the subsurface conditions observed by others near the site.

The 1982 Northern Technical Services report indicated that soil conditions in the area consisted of peat and organics underlain by silt in the northern portion of their work area. In the southern portion of their work area the silt layer was relatively thin and was underlain by thick deposits of fine sand. Groundwater was noted to correspond with the river elevation and was 4 feet to 7 feet below existing ground surface (bgs). The 1999 Dowl report indicated similar subsurface conditions. The 2012 Northern Geotechnical Engineering report indicated the surface organics were generally underlain by silt and then fine sand. The DMA report indicated that piles that were 8 inches in diameter and reportedly 35 feet long had jacked beneath the washeteria. The reports indicated that the soils were not frozen and that permafrost was not encountered in the soils. Select logs of borings conducted by others are presented in Appendix B.

3.0 SITE AND PROJECT DESCRIPTION

The proposed new tank farm site is south of the existing facility on Delta Street in the central portion of Emmonak, Alaska. The proposed tank farm will be constructed along Delta Street near the intersection with City Office Road, approximately 500 feet southwest of the existing tank farm. The proposed tank farm site is relatively level with a small depression near the center that will collect and hold surface water.

According to the Alaska Community Database Community Information Summaries (CIS), Emmonak is located near the mouth of the Yukon River, 10 miles from the Bering Sea, on the north bank of Kwiguk Pass. It lies 120 air miles northwest of Bethel and 490 air miles from Anchorage, in the Yukon Delta National Wildlife Refuge. The community lies at approximately 62°.77 North Latitude and 164°.52 West Longitude. The community is situated within a large

delta formed by the Yukon River and the delta generally has little topographical relief. The surface of the delta near the community has limited relief and contains numerous ponds, sloughs and small lakes. Due to the limited relief, the area around the Site often experiences flooding during the spring. The anticipated upgrade design includes pile-supported, elevated steel containment systems for the proposed tank farm and an elevated, steel supported foundation for the power plant design. The proposed design is similar to other flood resistant designs in the region.

The proposed tank farm will have a capacity of 560,000 gallons consisting of (11) 50,000 gallon tanks and (1) 10,000 gallon intermediate tank. The proposed 50,000 gallon vertical tanks have an approximate diameter of 21.8 feet and height of 18 feet. The proposed 10,000 gallon intermediate horizontal tank has an approximate diameter of 10 feet and length of 17 feet. The tanks will be constructed within a secondary containment structure supported on pile foundations. The pile foundations and secondary containment structure will also support fuel piping, pump boxes, walkways, and stairs. The approximate dimension of the secondary containment structure is 90 feet by 120 feet.

The proposed power plant facility will constructed on the site of the existing AVEC tank farm and consist of a two (2) story structure that will incorporate the generator building, storage warehouse, and living quarters within a single structure that is approximately 32 feet wide by 100 feet long. The existing tank farm is supported by a combination of shallow spread foundations and piling. The ground surface in the existing tank farm area is somewhat variable with areas that have been previously filled to support construction. The generator portion of the building will be approximately 32 feet wide by 75 feet long. The anticipated generator arrangement will include (2) midsized (400 kW - 600 kW) and (2) large (750 kW – 1.0 MW) generators that can be run in parallel to meet the combined peak load. The warehouse and living quarters will be located in an area of the building that is approximately 32 feet by 25 feet with the warehouse on the lower level and the living quarters above. A transformer pad and intermediate storage tank will be located adjacent to the building.

4.0 FIELD EXPLORATIONS

Six soil borings were advanced from March 8 through March 11, 2013 to evaluate subsurface conditions near the proposed bulk fuel storage and power plant upgrades. Borings BH-01 through BH-05 were advanced in the area of the proposed tank farm. Due to the presence of the existing tank farm, subsurface explorations could not be performed below the proposed power plant. Therefore, Boring BH-06 was advanced as close as practical to the proposed power plant location but could not be advanced directly below the existing tank farm.

The borings locations shown on Figure 2 were recorded using a handheld Garmin Oregon 450 GPS unit and should be considered approximate. Project fieldwork was performed in general accordance with the procedures outlined in the "Alaska Geotechnical Procedures Manual" (DOT&PF, 2007).

The borings were advanced by Discovery Drilling, Inc of Anchorage, Alaska working as a subcontractor to HDL. A CME 45 skid mounted drill rig with 3-½-inch hollow stem auger and a three-inch outside diameter (O.D.) split-spoon sampler was used to drill and sample the borings. Sampling with the split-spoon was conducted using the Modified Penetration Test procedure. In the Modified Penetration Test, samples are recovered by driving a three-inch O.D. split-spoon sampler into the bottom of the advancing hole with blows of a 340-pound hammer free-falling 30 inches onto the drill rod. The number of blows required to advance the sampler the middle 12 inches of a 24-inch penetration is termed the Penetration Resistance, which was recorded for each sample depth. The values give a measure of the relative density (compactness) or consistency (stiffness) of cohesionless or cohesive soils, respectively. However, it should be noted that in frozen soils the Penetration Resistance obtained should be used with care in design. For this field investigation the hammer was manually raised and lowered via cathead and rope system.

The six borings, designated Borings BH-01 through BH-06, were advanced to depths of 31.5 feet to 51.5 feet below existing ground surface (bgs). Modified Penetration Resistance tests were conducted in the borings at depths of 2.5 feet, 5 feet, and five foot intervals thereafter to a depth of 30 feet; between 30 feet and 50.5 bgs tests were conducted at 10 foot intervals. The recovered soils were classified in general accordance with the Unified Soil Classification System presented in Appendix A, Figure A1. As appropriate, the samples were also given a frost design classification in accordance with the United States Army Corps of Engineers system as presented in Figure A2 and based on the results of laboratory tests conducted on the samples. An experienced HDL engineering geologist was present continuously during drilling to locate the borings, observe drilling action, collect samples, log subsurface conditions, and observe groundwater depths, where encountered.

Capped one-inch diameter PVC pipe was placed in each of the borings to allow the monitoring of ground temperatures. Environmentally safe propylene glycol was poured into the PVC to limit vertical temperature convection in the PVC and improve thermal connection with the sensors. Temperatures within the PVC were typically allowed to equilibrate for 24 hours before down-hole temperatures were recorded by three digital temperature acquisition cables (TACs). Boring BH-06 was drilled on the last day of field work and was only able to equilibrate for about 12 hours before temperatures were recorded. The TACs were placed in the borings at least one hour before temperatures were recorded. The temperature results are presented in Appendix D.

Slotted, 1-inch diameter PVC was installed to the termination depth in Borings BH-03 and BH-06 for monitoring groundwater elevations. The boreholes were backfilled with auger cuttings and groundwater levels were measured 24 to 48 hours after drilling.

5.0 SITE CONDITIONS

5.1 General Geology

The site is located in a large delta formed by the Yukon River which discharges into the Bering Sea. The soils in the delta are comprised of silts and fine sands to unknown depths. The delta gives way to the Nulato Hills approximately 40 miles to the east of the site. The Nulato Hills consist of a formation of volcanic greywacke, mudstone and sandstone with some coal bearing rock. One of the largest faults in the regions trends northeast.

5.2 Climatology

A maritime climate predominates in Emmonak. Temperatures range from -25 to 79 °F. Precipitation averages 19 inches per year, while snowfall averages 50 to 60 inches per year. Freeze-up generally occurs during October while break-up generally occurs in June.

Recent analysis of air temperature data for Nome, relatively near Emmonak, shows that the area is experiencing a warming trend. The following graph from the Alaska Climate Research Center (ACRC) at the University of Alaska Fairbanks (2008) shows the increase in the mean annual temperature from 1949 to 2012. According to the ACRC, the stepwise shift appearing in the temperature data in 1976 corresponds to a phase shift of the Pacific Decadal Oscillation from a negative phase to a positive phase, which tends to consist of increased southerly flow and warm air advection into Alaska during the winter, resulting in positive temperature anomalies. Figure 5.1 presents the mean annual temperature for Nome from 1949 to 2012.

5.3 Flooding Potential

Based on National Flood Insurance maps, there is potential for floods that can rise to 4.3 feet above the existing ground surface at the proposed tank farm and power plant locations. Flooding can also be accompanied by ice flows that generate additional loads on structures and foundations such as the above ground piles of the proposed tank farm and power plant.

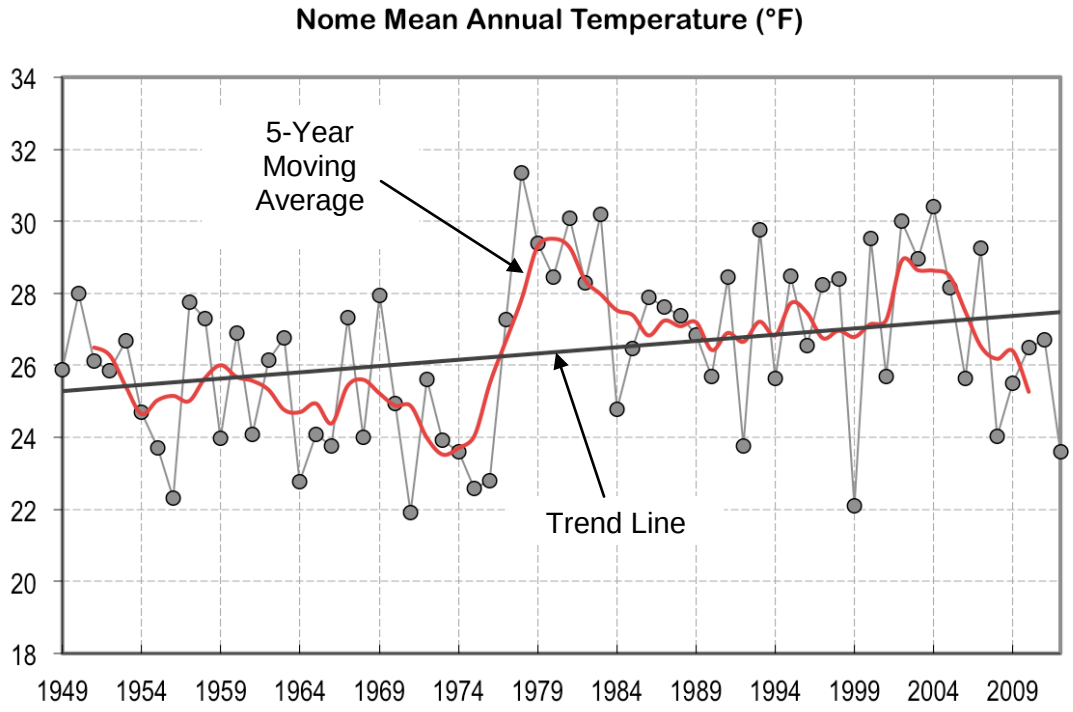


Figure 5.1. Mean Annual Temperatures for Nome from 1949 to 2012.

6.0 LABORATORY TESTING

Laboratory tests were performed on selected samples recovered from the borings to evaluate the pertinent engineering properties of the materials encountered. The laboratory testing was formulated with emphasis on determining the USCS classification, moisture content and frost characteristics of the soil. All testing was performed at the HDL soil laboratory in Anchorage, which is AASHTO accredited and certified by the U.S. Army Corps of Engineers. The results of the laboratory tests are shown on the boring logs and grainsize curves in Appendix A.

A total of 38 water content tests were performed on samples from the six borings. These tests were conducted in accordance with procedures described in ASTM D2216. The results of the water content measurements are presented on the boring logs, shown in Appendix A. The water contents are used to estimate frost behavior and saturation conditions. Water contents close to or above 100 percent generally indicates that a large amount of organics and/or ice was present.

Grain size distribution tests for this project consisted of eleven mechanical sieve tests. The results were used to estimate engineering characteristics and the frost susceptibility of the soils. The mechanical sieve tests were conducted according to procedures described in ASTM D-422,

Standard Test Method for Particle Size Analysis of Soils. Grain size distribution curves are presented in Appendix A, Figures A10 through A12.

Twelve P200 tests were performed to evaluate the percentage of fines present in select soil samples. The P200 tests were conducted according to procedures described in ASTM D-1140. The results of the P200 tests are presented on the boring logs, shown in Appendix A.

Salinity tests were performed on four samples from the borings. The tests were run for 24 hours. The results of the salinity tests are presented in Appendix C, along with the resulting calculated depression in freezing temperature (ΔT).

7.0 SUBSURFACE CONDITIONS

7.1 Tank Farm

The subsurface conditions at the proposed tank farm site are depicted on Figure 3. Detailed descriptions of the subsurface conditions for the proposed tank farm site are presented on the boring logs provided as Figures A3 through A8. The soils encountered generally consisted of silts with varying amounts of sand underlain by fine, silty sand.

Silt was generally encountered near the ground surface and was typically present to a depth of 15 feet to 20 feet below ground surface (bgs). Based on the laboratory test results, the soil was classified as low plasticity silt (ML) soil with 13 percent to 40 percent sand. The moisture content of the silt varied from 34 percent to 80 percent with higher moisture contents being encountered in frozen sections. The Penetration Resistance in the silt varied from 4 to 9 where it was not frozen indicating the soil was in a loose state. The silt is considered to be highly frost susceptible with a frost classification of F4.

Sand was encountered beneath the silt and was typically present to the boring termination depth of 31.5 feet to 55 feet bgs. Heaving sands were typically encountered at depths of approximately 15 feet to 20 feet bgs in the borings and were typically present to the boring termination depth. In Boring BH-01, the sand was underlain by silt at a depth of 35 feet bgs. Based on the laboratory test results, the soil was classified as a silty sand (SM) soil with 6 percent to 42 percent fines. The moisture content of the sand varied from 26 percent to 76 percent with higher moisture contents being encountered in frozen sections. The Penetration Resistance in the sand varied from 2 to 43 where it was not frozen indicating the most of the soil was in a loose to dense state. The sand is considered to be moderately to highly frost susceptible with a frost classification of F2 to F4.

Trace organic materials were encountered in several of the samples from multiple borings as would be expected in the alluvial depositional environment at the site. A layer of silt with

significant organic content was encountered from the ground surface to a depth of 5 feet in Boring BH-04. The organic silt in Boring BH-04 was underlain by approximately 5 feet of garbage and debris that was likely placed there as a result of flooding.

Frozen soils were encountered in several of the borings at a variety of depths. Seasonal frost was encountered in Borings BH-02 through BH-05 and was present to depths of 2 feet to about 10 feet bgs. In Boring BH-02 frozen soil extended to 20 feet bgs. Isolated zones of frozen soils were present at depths of approximately 25 feet to 35 feet bgs in Boring BH-04 and approximately 40 feet to 50 feet bgs in Boring BH-05. The subsurface temperatures in the soils were approximately 32°F to 35°F (Appendix D) indicating thawed or near thawed conditions.

7.2 Power Plant

The subsurface conditions encountered in Boring BH-06 near the proposed power plant site are presented on the boring log provided as Figure A8. The soils encountered generally consisted of silts with varying amounts of sand underlain by fine silty sand.

Silt was encountered near the ground surface to a depth 20 feet bgs. Based on the laboratory test results, the soil was classified as low plasticity silt (ML) soil with 9 percent to 35 percent sand. The moisture content of the silt varied from 41 percent to 58 percent with higher moisture contents being encountered in frozen sections. The Penetration Resistance in the silt was typically 4 where it was not frozen or heaving indicating the soil was in a loose state and wet. The silt is considered to be highly frost susceptible with a frost classification of F4.

Sand was encountered beneath the silt and was present to the boring termination depth of 31.5 feet bgs. Heaving sands were typically encountered at depths of approximately 15 feet to 20 feet bgs in the borings and were present to the boring termination depth. Based on the laboratory test results, the soil was classified as a silty sand (SP-SM) soil with 9 percent fines. The moisture content of the sand varied from 26 percent to 28 percent. The Penetration Resistance in the sand varied from 2 to 5 where it was not frozen indicating the soil was in a loose state. The sand is considered to be moderately frost susceptible with a frost classification of F2.

Trace organic materials were encountered in several of the samples as would be expected in the alluvial depositional environment at the site. Soils that appeared to be affected by seasonal frost action were encountered in Borings BH-06 and were present to depths of 10 feet bgs. Isolated zones of frozen soils were present at a depth of approximately 30 feet and present to the termination depth of 31.5 feet bgs. The subsurface temperatures in the soil was approximately 32°F to 35°F below the seasonal frost indicating thawed or near thawed conditions.

7.3 Permafrost and Groundwater

Permafrost was not reported in the geotechnical work conducted in the area by others and appeared sporadically in the borings drilled during this phase of work. Therefore, the permafrost appears to be discontinuous in the Emmonak area. This is most likely due to the presence of the Yukon River. The Yukon River periodically floods the area and the heat that it adds to the surrounding ground appears to limit the ability of the soils to remain frozen.

Groundwater was encountered at depths of approximately 13 feet to 21 feet bgs during drilling. Groundwater was measured to be 13 feet to 17 feet bgs in the temporary observation wells. Groundwater levels encountered during drilling and in the temporary observation wells are presented on the boring logs. Groundwater levels fluctuate depending on the season, temperatures, and infiltration. Groundwater levels during construction may be higher or lower than those observed.

8.0 ENGINEERING ANALYSIS & RECOMMENDATIONS

Design of any structure foundation must consider the bearing capacity of the supporting soils as well as the expected settlements and effects of seasonal frost action. The soils are predominantly loose silts and sands. Heaving sands were typically encountered at depths of approximately 15 feet to 20 feet bgs in the borings and were present to the boring termination depth. Based on the borings, the capacity in area of the heaving sands is expected to be similar to that encountered in borings where the heave was controlled. Therefore, blow counts in heaving soils were not utilized to evaluate the potential pile capacity. Based on the subsurface temperatures and groundwater levels, the soils have recently (geologically speaking) thawed. The typically loose state of the soils encountered also indicates thawed conditions.

8.1 Foundation Recommendations

Due to the presence of the existing tank farm, geotechnical information could not be collected beneath the proposed power plant. Therefore, HDL used information collected in previous geotechnical studies, borings from the tank farm area, and the subsurface conditions observed in Boring BH-06 to develop foundation recommendations to support the design of the proposed power plant.

Several types of foundations were considered including a pad with shallow foundations, and driven piles. Considering the loose state of the soils and the observed thermal regime indicating the soils are in a region of partially thawed permafrost, a shallow foundation is not a suitable option due to the differential settlement that may develop as a result of the anticipated loads. In addition, flooding on the order of 4.3 feet at the site may be anticipated for a 100-year event; adding additional loading and the potential for damage to the tanks. Therefore, a driven pile

foundation is recommended. The analysis and recommendations are presented in the following sections. The recommendations for the power plant foundation will need to be confirmed during pile driving by dynamic pile testing or static load testing.

8.1.1 Tank Farm Pile Capacities

Axial Capacity

Axial loads will be transmitted from the pile to the native soil. The primary capacity will develop through skin friction along the pile and end bearing at the soil interface. A factor of safety of three was used in determining the axial capacity of the pile foundation. Axial capacities were determined with the APILE software program. Output of the program using the API method is presented in Figure 8.1, below. The ultimate axial capacities of 6-inch, 8-inch, 12-inch, and 16-inch diameter pipe piles are plotted against the depth of pile bgs.

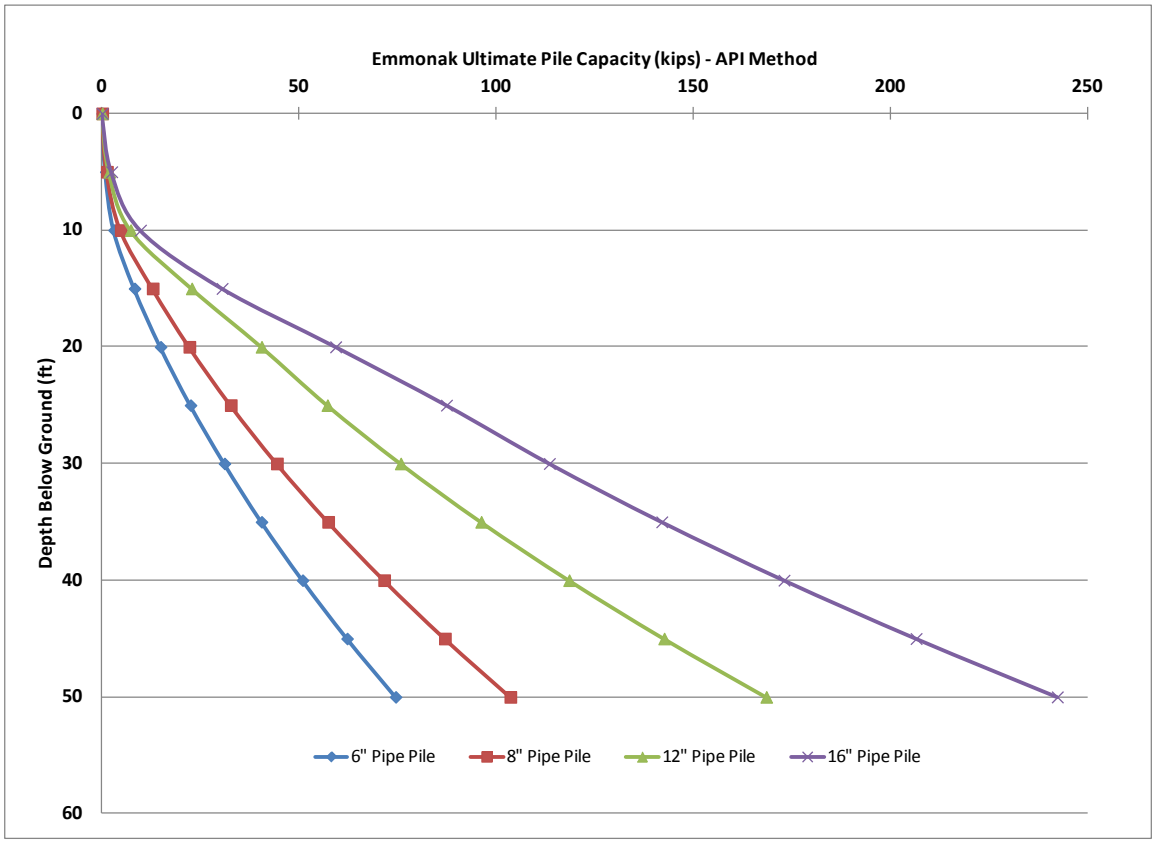


Figure 8.1 Ultimate Pile Capacities with Depth at Tank Farm

Based on the APile results, a 16-inch pile embedded to 49 feet below ground surface would have an allowable axial capacity of approximately 78 kips based on the factor of safety of 3.

Lateral Capacity

The lateral capacity of a pile is dependent upon the soils, stiffness of the pile, and how fixed the head of the pile is to the foundation. Once a foundation is known, the lateral capacity of the pile can be determined. A combination of lateral resistance provided by the soil and pile stiffness will play a significant role in the lateral deflection of the pile. Allowable deflections should be provided by the Structural Engineer. Using the LPILE software program, initial calculations show that a 49-foot long, 16-inch diameter by 0.375 inch thick pipe pile will provide adequate lateral support with 0.011 inch/kip of deflection for fixed head condition and 0.029 inch/kip for free head, at the ground surface. The point of fixity is approximately 29 feet below the ground surface. The bottom of the pile, or pile tip, should be driven at least five feet below the point of fixity even if axial capacities are attained at a shallower depth.

8.1.2 Power Plant Pile Capacities

The piles for the proposed power plant must resist the vertical and lateral forces to support the structure and resist the additional lateral loading during flood events. The structural and mechanical design must also limit the vibration levels encountered at the pile-soil interface to assure that vibrations do not reduce the ability of the soil to support the structure. The peak particle velocities at the pile-soil interface should be limited to less than 0.05 in/sec.

Axial Capacity

Axial loads will be transmitted from the pile to the native soil. The primary capacity will develop through skin friction along the pile and end bearing at the soil interface. A factor of safety of three was used in determining the axial capacity of the pile foundation. Axial capacities were determined with the APILE software program. Output of the program using the API method is presented in Figure 8.2, below. The ultimate axial capacities of 6-inch, 8-inch, 12-inch, and 16-inch diameter pipe piles are plotted against the depth of pile bgs.

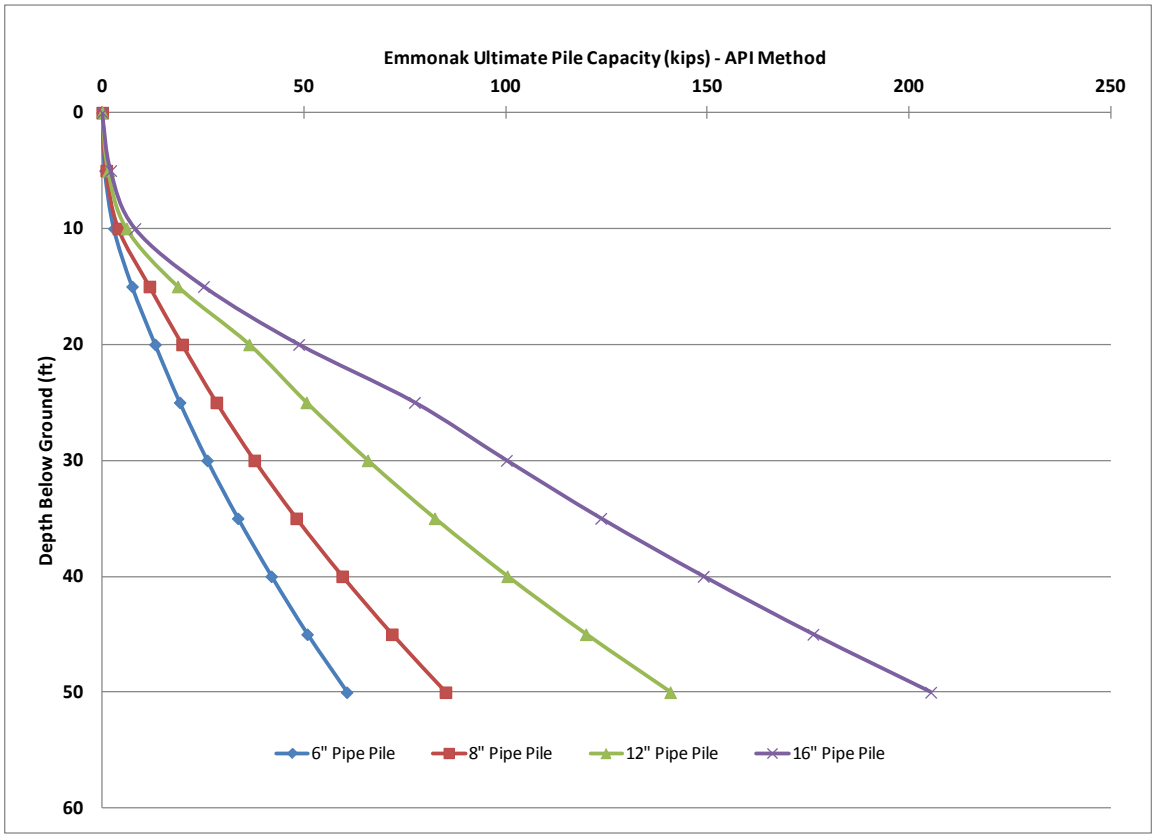


Figure 8.2 Ultimate Pile Capacity with Depth near Power Plant

Using Figure 8.2, 16-inch pile embedded to 49 feet bgs would have an allowable axial capacity of approximately 66 kips based on the factor of safety of 3. Using Figure 8.2, 12-inch pile embedded to 49 feet bgs would have an allowable capacity of approximately 45 kips based on a factor of safety of 3.

Lateral Capacity

The lateral capacity of a pile is dependent upon the soils, stiffness of the pile, and how fixed the head of the pile is to the foundation. Once a foundation is known, the lateral capacity of the pile can be determined. A combination of lateral resistance provided by the soil and pile stiffness will play a significant role in the lateral deflection of the pile. Allowable deflections should be provided by the Structural Engineer. Using the LPILE software program, initial calculations show that a 49-foot long, 16-inch diameter by 0.375 inch thick pipe pile will provide adequate lateral support with 0.011 inch/kip of deflection for fixed head condition and 0.029 inch/kip for free head, at the ground surface. Likewise, a 49-foot long, 12-inch diameter by 0.375 inch thick pipe pile will provide adequate lateral support with 0.016 inch/kip of deflection for fixed head condition and 0.042 inch/kip for free head, at the ground surface. The point of fixity is approximately 29 feet and 26 feet below the ground surface for the 16-inch diameter

and 12-inch diameter piles, respectively. The bottom of the pile, or pile tip, should be driven at least five feet below the point of fixity even if axial capacities are attained at a shallower depth.

8.1.3 Frost Heave Forces

Frost jacking of piles has been documented at the Emmonak washeteria. The piles at the washeteria consisted of 8-inch diameter steel piles that were reportedly installed to a depth of 35 feet. Based the report provided by DMA, the steel piles jacked approximately 2 inches in the southeast portion of the building. Assuming similar subsurface conditions, HDL was able to estimate the frost heave forces that would have been needed to cause jacking of the piles.

The frost heave force on the heaved piles was calculated to be 12.8 pounds per square inch to a depth of 9 feet, which is significantly higher than were predicted using published parameter values. The higher than anticipated frost jacking forces result in the frost heave forces controlling the depth for pile design.

Based on the frost heave forces encountered at the washeteria, we recommend a minimum embedment depth for the 16-inch and 12-inch diameter piles of 49 feet. A pile of that length that is 6-inches in diameter cannot be driven without risk of buckling. Therefore, we recommend the minimum pile diameter be 8 inches and also be embedded to a depth of 49 feet. .

To minimize the frost heave forces on the piles it is recommended that a smooth durable coating be applied. The coating should be applied to the pile embedded in the top five feet of the ground plus at least six inches above final grade. We recommend a Devoe coating consisting of: 3 to 4 mils of Catha-Coat 302H primer; 4 to 6 mils of Bar Rust 233H as an intermediate coat; and, 2 to 3 mils of Devthane 389 as a top coat. The coating should be applied per the manufacturer's specifications over a sand blasted near white metal surface to SSPC-10 standards. This will limit the adfreeze bond between the steel pile and the soil and reduce the uplift forces generated by the frost action.

8.1.4 Pile Groups

The foundation for the bulk fuel facilities will consist of multiple piles. Piles should not be installed with less than three times the pile diameter between them in order to avoid group affects. Piles spaced greater than three times the pile diameter apart will behave as individual piles.

8.1.5 Additional Analysis

Additional axial capacity, beyond that shown in Figures 8.1 and 8.2 may be obtained with helical piers as opposed to piles. However, helical piers will have lower lateral capacity. The actual

capacity for the piles should be verified in the field by dynamic pile testing (PDA testing) or by performing a load test in accordance with ASTM D-1143, “Standard test method for piles under static axial compressive load". The test pile should be loaded to the ultimate capacity of the pile. The results of the dynamic pile testing or static load test should be used to develop driving criteria for subsequent piles. Particularly verification is important at the power plant site, due to the limited geotechnical subsurface information.

8.2 Site Work

We recommend that a gravel pad be constructed at the site to support construction and maintenance equipment. A gravel pad is already present along portions of the existing tank farm and little additional gravel may be required in those areas. Where there is not gravel, the shallow subsurface soils may be wet and groundwater may be expected to be at or above the elevation of water in the river. Significant dewatering would be needed if organics and garbage are to be removed. Because the purpose of the gravel pad is to provide temporary support for construction vehicles and long-term support for lightly loaded vehicles and promote positive drainage, we recommend allowing the fine surface organics to remain in place. However, brushing should be performed to remove larger vegetation.

A separation geotextile, such as the woven GEOTEX 315ST, should be placed on the existing ground surface and structural fill consisting of non-frost susceptible (NFS) gravel should be placed directly on the woven geotextile. Based on the anticipated construction methods this pad may experience differential settlements of approximately four to six inches in areas of previously disturbed soils. The pad should be useable during the anticipated construction time span provided that the recommendations below are followed. Additional fill may be needed to level the construction pad and elevate it above ponded surface water, if present. A standard minimum structural section for temporary support below the tank farm and power plant is shown below.

Min. Thickness (inches)	Material
18	NFS Gravel
-	Geotextile –woven

The lift thickness may be reduced to 12 inches at the shoulders of the embankment to facilitate positive drainage away from the tank farm and power plant. The proposed gravel pad is expected to provide temporary support to construction equipment during normal movement across the site. The gravel pad has not been evaluated for the support of cranes during the critical lifts expected. The adequacy of the gravel pad to support a crane during operation should be evaluated once the loads are established and additional fill and/or crane mats may be

required. In addition, cranes should not be allowed to lift from areas where garbage is located beneath the surface.

We recommend that a Mirafi BXG11, or similar geogrid, be placed in the upper 18 inches of fill for areas that will be used on a permanent basis for access, dispensing and vehicle maneuvering. More fill may be necessary to provide a level surface as settlements occur. The following section should be used for the permanent driving areas.

Thickness (inches)	Material
18	NFS Gravel
-	Geogrid
-	Geotextile –woven

The NFS gravel should be granular with less than six percent passing the #200 sieve (by weight, based on minus ¾-inch portion) and 100% passing the three-inch sieve. All fills should be placed in lifts not exceeding 12 inches loose thickness and compacted to a density of at least 95 percent of the maximum density as determined by the Modified Proctor compaction procedure (ASTM D-1557). Compaction may be difficult to achieve when placing fill in areas where surface water is present.

9.0 CLOSURE AND LIMITATIONS

The analysis and conclusions included in this report are based on site conditions as they exist in the borings completed by HDL and by others. The analysis and conclusions assume that the exploratory borings are representative of the subsurface conditions throughout the site, that is, that the subsurface conditions everywhere are not significantly different from those disclosed in the borings. The subsurface profiles are idealized from the soils encountered in the borings. If, during construction, subsurface conditions are different from those encountered, advise us at once so we can review these conditions.

If substantial time has elapsed between submission of this report and the start of work at the site, or if conditions have changed because of natural causes or construction operations at or adjacent to the site, we recommend that this report be reviewed to determine the applicability of the conclusions considering the time lapse or changed conditions.

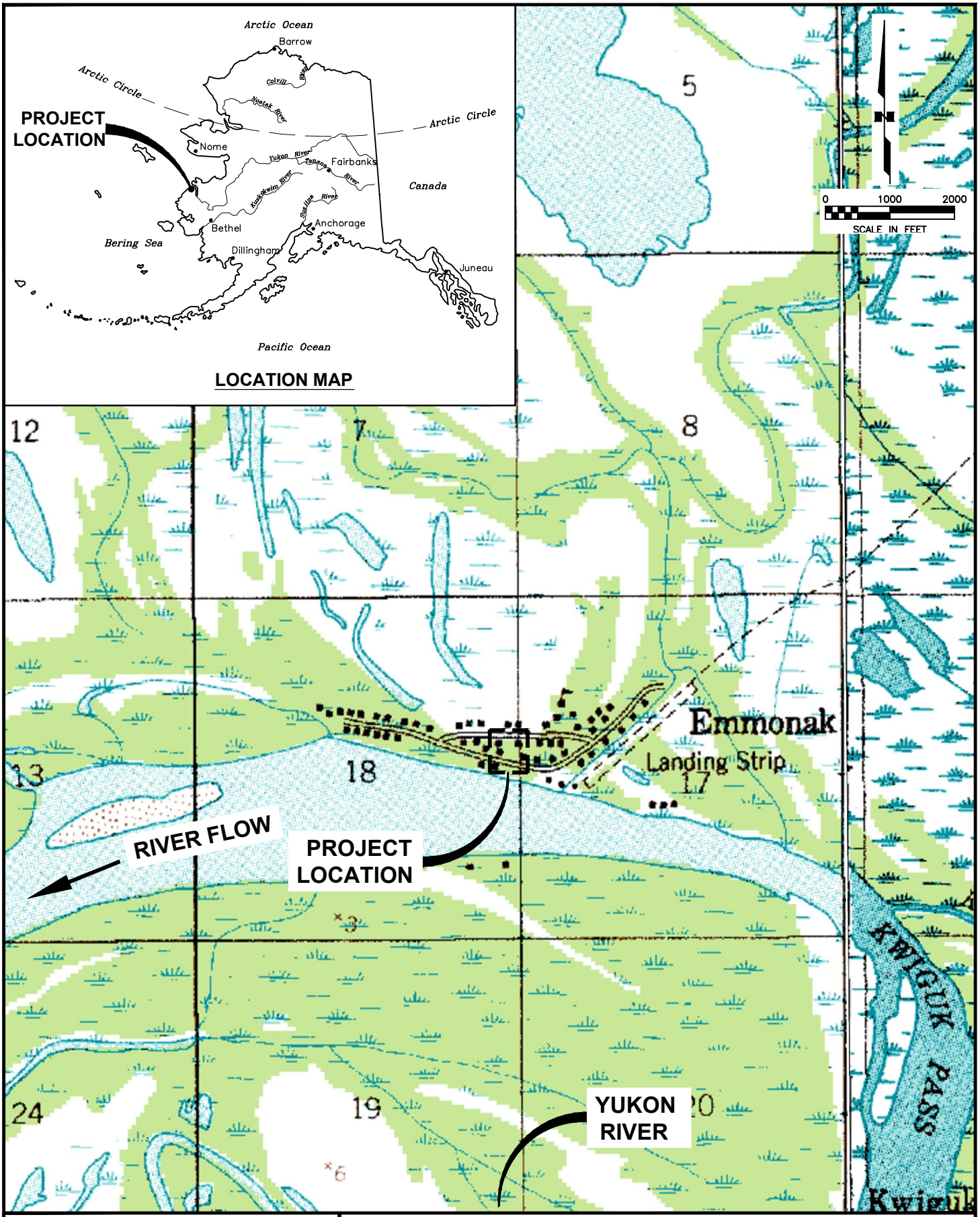
Unanticipated soil conditions are commonly encountered. Such unexpected conditions frequently require additional expenditure to attain a properly constructed project. Therefore, some contingency fund is recommended to accommodate such potential extra costs.

Prepared by:
Hattenburg Dilley and Linnell, LLC

Doug P. Simon, P.E.
Senior Geotechnical Engineer

Reviewed By:
Hattenburg Dilley and Linnell, LLC

Lorie Dilley, P.E., C.P.G., PhD
Principal Geotechnical Engineer



HATTENBURG DILLEY & LINNELL
Engineering Consultants

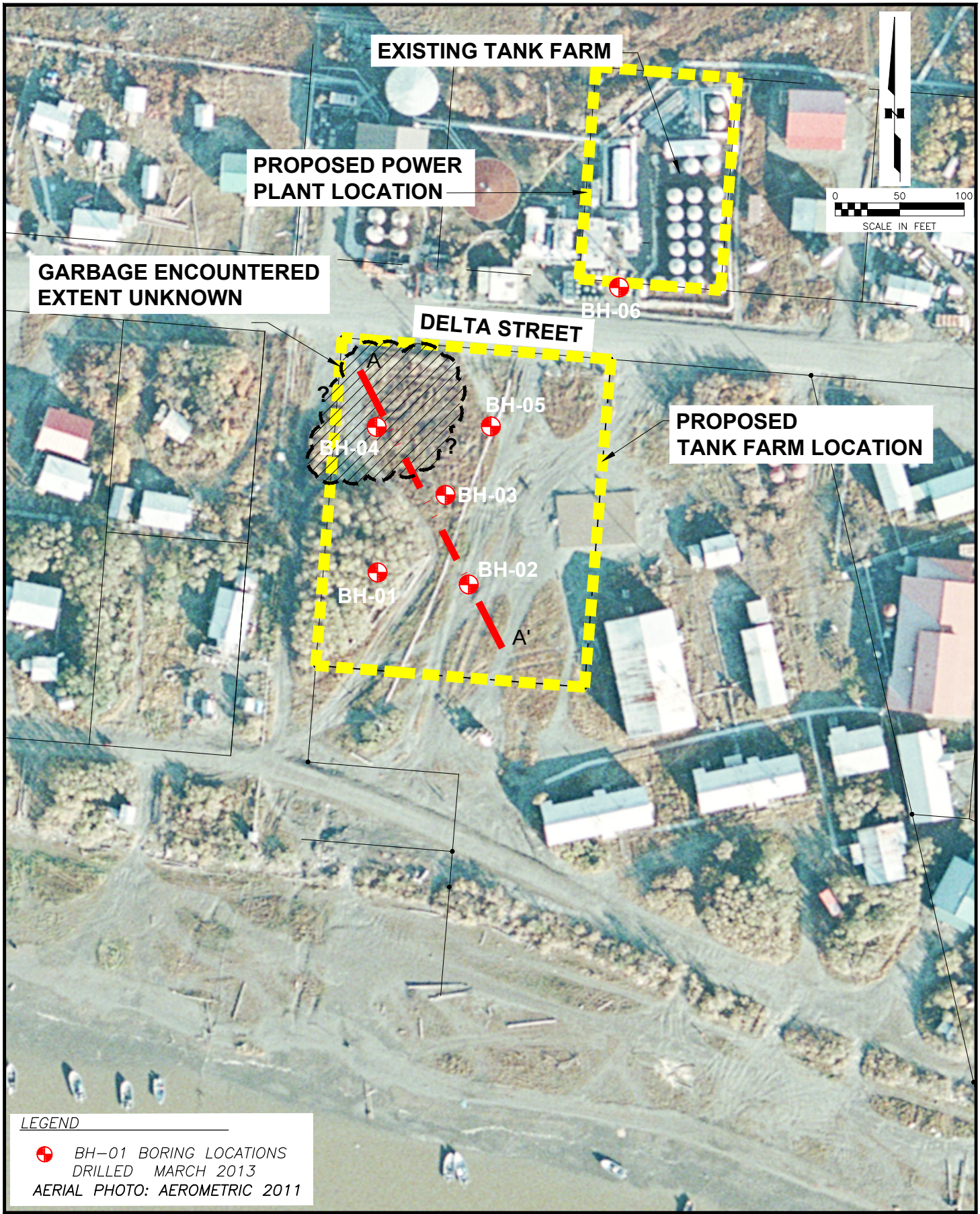
- ENGINEERING
- SURVEYING
- PROJECT MANAGEMENT
- ENVIRONMENTAL
- EARTH SCIENCE
- PLANNING

(907) 564-2120 - ANCHORAGE
(907) 746-5230 - PALMER
WWW.HDLALASKA.COM

EMMONAK BULK FUEL UPGRADES
VICINITY MAP
ALASKA VILLAGE ELECTRIC COOPERATIVE
EMMONAK, ALASKA

DATE:	6/7/2013	DRAWN BY:	KK	SHEET:	FIGURE 1
SCALE:	1" = 2000'	CHECKED BY:	DPS	JOB NO.:	11-008-03

H:\jobs\11-008 Emmonak Tank Farm CDR (AVEC)\CAD\Drawings\11008_03_F01, 1=100, 09/27/13 at 08:23 by unknown
LAYOUT: Layout1



HATTENBURG DILLEY & LINNELL
Engineering Consultants

- ENGINEERING
- SURVEYING
- PROJECT MANAGEMENT
- ENVIRONMENTAL
- EARTH SCIENCE
- PLANNING

(907) 564-2120 - ANCHORAGE
(907) 746-5230 - PALMER
WWW.HDLALASKA.COM

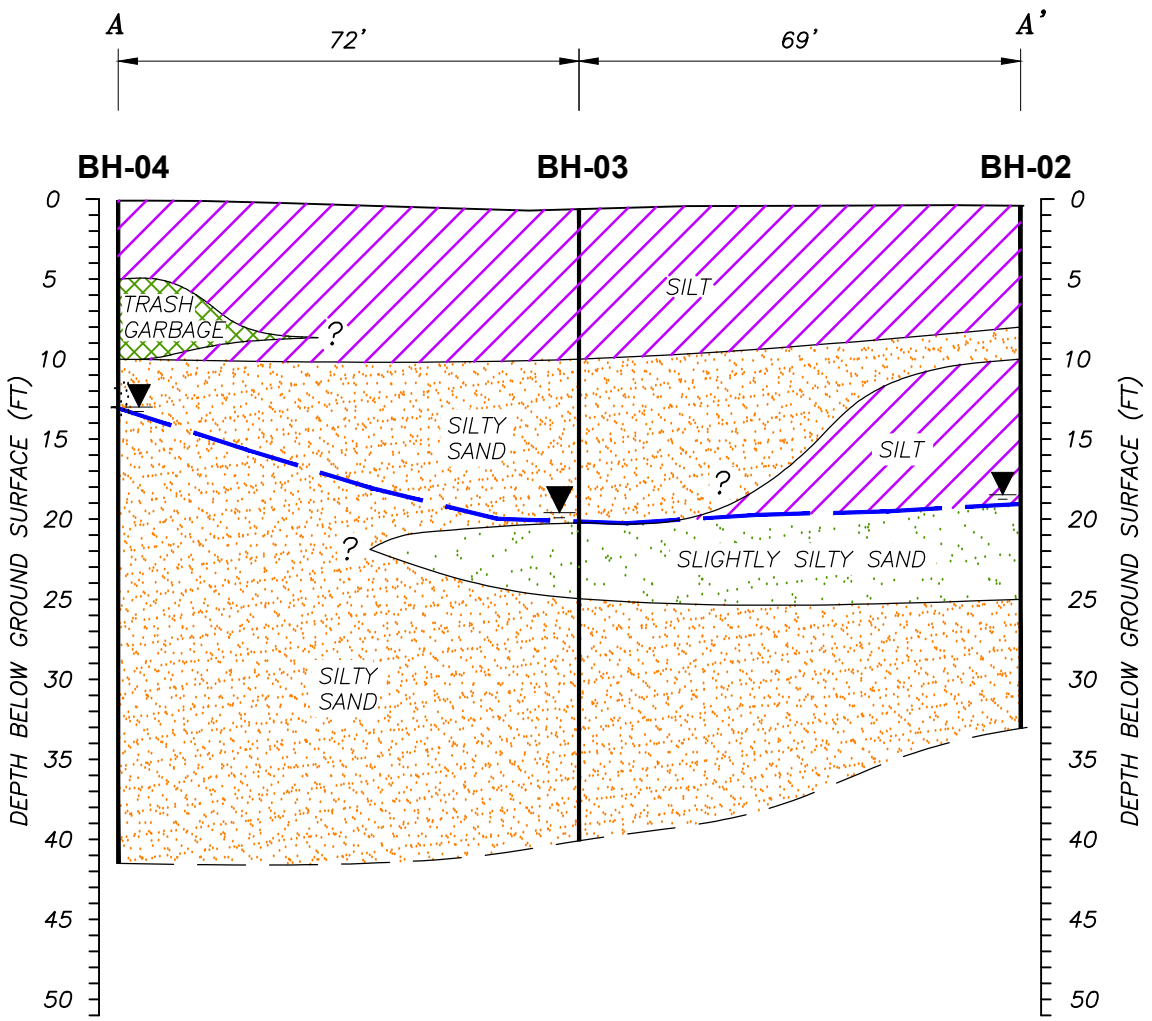
EMMONAK BULK FUEL UPGRADES
BOREHOLE LOCATION MAP
ALASKA VILLAGE ELECTRIC COOPERATIVE
EMMONAK, ALASKA

DATE:	9/23/2013	DRAWN BY:	KK	SHEET:	FIGURE 2
SCALE:	1" = 100'	CHECKED BY:	DPS	JOB NO.:	11-008-03

NOTES:

1. SURFACE ELEVATIONS ARE UNKNOWN. BASED ON MARCH 2013 HDL SITE SURVEY, TOPOGRAPHY VARIES BY TWO FEET OR LESS
2. FIGURE 2 PRESENTS LOCATION OF PROFILE.

NW SE



LEGEND

SILTY SAND

SLIGHTLY SILTY SAND

SILT

TRASH/GARBAGE

HATTENBURG DILLEY & LINNELL
Engineering Consultants
• ENGINEERING • ENVIRONMENTAL
• SURVEYING • EARTH SCIENCE
• PROJECT MANAGEMENT • PLANNING
(907) 564-2120 - ANCHORAGE
(907) 746-5230 - PALMER
WWW.HDLALASKA.COM

EMMONAK BULK FUEL UPGRADES
SUBSURFACE PROFILE A-A'
ALASKA VILLAGE ELECTRIC COOPERATION
EMMONAK, ALASKA

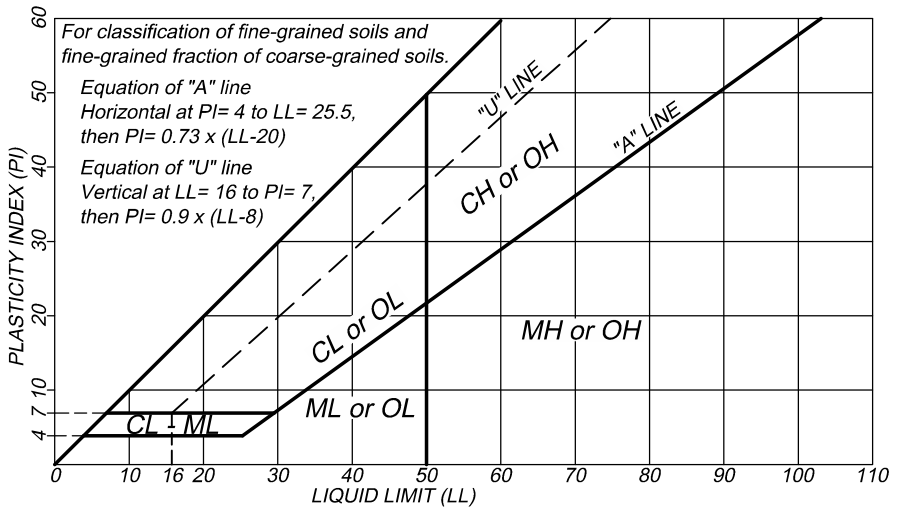
DATE:	6/7/2013	DRAWN BY:	KK	SHEET:	FIGURE 3
SCALE:	1" = 60'	CHECKED BY:	DPS	JOB NO.:	11-008-03

APPENDIX A

Figure A1	Unified Soil Classification
Figure A2	Frost Design Soil Classification
Figure A3 – A8	Boring Logs
Figure A9 – A11	Grain Size Distribution Curves

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Names			Soil Classification Generalized Group Descriptions	
COARSE-GRAINED SOILS More than 50% retained on No. 200 sieve	GRAVELS 50% or more of coarse fraction retained on No. 4 sieve	CLEAN GRAVELS Less than 5% fines	GW	Well-graded Gravels
			GP	Poorly-graded Gravels
		GRAVELS with fines More than 12% fines	GM	Gravel & Silt Mixtures
			GC	Gravel & Clay Mixtures
	SANDS More than 50% of coarse fraction passes No. 4 sieve	CLEAN SANDS Less than 5% fines	SW	Well-graded Sands
			SP	Poorly Graded Sands
		SANDS with FINES More than 12% fines	SM	Sand & Silt Mixtures
			SC	Sand & Clay Mixtures
FINE-GRAINED SOILS 50% or more passes the No. 200 sieve	SILTS AND CLAYS Liquid limit 50% or less	INORGANIC	ML	Non-plastic & Low Plasticity Silts
			CL	Low-plasticity Clays
		ORGANIC	OL	Non-plastic and Low Plasticity Organic Clays
				Non-plastic and Low Plasticity Organic Silts
	SILTS AND CLAYS Liquid limit greater than 50%	INORGANIC	CH	High-plasticity Clays
			MH	High-plasticity Silts
		ORGANIC	OH	High plasticity Organic Clays High Plasticity Organic Silts
HIGHLY ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor		PT	Peat



HATTENBURG DILLEY & LINNELL
Engineering Consultants
• ENGINEERING • ENVIRONMENTAL
• SURVEYING • EARTH SCIENCE
• PROJECT MANAGEMENT • PLANNING
(907) 564-2120 - ANCHORAGE
(907) 746-5230 - PALMER
WWW.HDLALASKA.COM

EMMONAK BULK FUEL UPGRADES
UNIFIED SOIL CLASSIFICATION SYSTEM
ALASKA VILLAGE ELECTRIC COOPERATIVE
EMMONAK, ALASKA

DATE: 5/13/2013	DRAWN BY: RSB	SHEET: FIGURE A1
SCALE: NONE	CHECKED BY: LMD	JOB NO.: 11-008

FROST DESIGN SOIL CLASSIFICATION
(Modeled after U.S. Army Corps of Engineers Standards)

GROUP	KIND OF SOIL	P200	TYPICAL SOILS
NFS	Sand or Gravel	0 to 6	SW, SP GW, GP
F1	Gravelly Soils	6 to 10	GM, GW-GM, GP-GM
F2	Gravelly Soils Sands	10-20 6-15	GM, GW-GM, GP-GM SW, SP, SM, SW-SM, SP-SM
F3	Gravelly Soils Sands, except very fine silty sands Clays PI > 12	Over 20 Over 15	GM, GC SM, SC CL, CH CL, CH
F4	All Silts Very fine silty sands Clays, PI < 12 Varved clays and other fine-grained, banded sediments	Over 15	ML, MH SM CL, CL-ML CL and ML CL, ML, and SM; CL, CH, and ML; CL, CH, ML, and SM

P200 = percent passing the number 200 sieve

HATTENBURG DILLEY & LINNELL
Engineering Consultants
• ENGINEERING • ENVIRONMENTAL
• SURVEYING • EARTH SCIENCE
• PROJECT MANAGEMENT • PLANNING
(907) 564-2120 - ANCHORAGE
(907) 746-5230 - PALMER
WWW.HDLALASKA.COM

EMMONAK BULK FUEL UPGRADES
FROST DESIGN SOIL CLASSIFICATION
ALASKA VILLAGE ELECTRIC COOPERATIVE
EMMONAK, ALASKA

DATE:	5/13/2013	DRAWN BY:	RSB	SHEET:	FIGURE A2
SCALE:	NONE	CHECKED BY:	LMD	JOB NO.:	11–008

HATTENBURG DILLEY & LINNELL Engineering Consultants

LOG OF BORING

HOLE # BH-01

PROJECT NUMBER : *11-008*
PROJECT : *Emmonak Bulk Fuel Upgrades*
CLIENT : *AVEC*

Station / Location: *Proposed Tank Farm*
Lat/Long: *N62°46'37.3" / W164°31'56.7"*
Elevation:

Equipment Type: *CME 45*
Drilling Method: *3.5 inch Hollow-Stem Auger*
Field Crew: *Discovery Drilling*

Total Depth: *40.0 feet*
Date: *3/9/2013*
Geologist: *N. Moran*

Ground Water Data		
Depth in (ft.)	21	
Time		
Date	3/9/13	
Symbol	▼	

Depth (Feet)	Sample Type	Number	Blow Count	Sample	Recovery	N-Value	USCS Classification Frozen Zone	Soil Graphic	SUBSURFACE MATERIAL
0									**sandy SILT** trace organics — 0.0
3	SS	S1	3 3 4						**sandy SILT** gray, moist, loose, trace organics — 2.5 S1 Moisture =60.1%
5	SS	S2	2 3 5						**sandy SILT** gray, moist, loose, trace organics — 5.0 S2 Moisture =46.1%
10	SS	S3	2 4 4						**sandy SILT** grayish brown, moist, loose — 10.0 S3 Moisture =40.8%
15	SS	S4	2 3 6				ML		**SILT with sand** (ML) gray, wet, loose, F4 — 15.0 S4 P200 =79.5%, Sa =20.5%, Gr =0.0%, Moisture =33.6%
20	SS	S5	5 7 10						**silty SAND** gray, wet, medium dense, F2 — 20.0 S5 P200=13.2%, Moisture =27.8%
25	SS	S6	12 12 7						**silty SAND** gray, wet, medium dense — 25.0 S6 Moisture =28.1%

☐ CME Auto Hammer ☒ Cathead Rope Method ☐ 140 lb. hammer with 30 in. drop ☒ 340 lb. hammer with 30 in. drop

Sheet Number 1 of 2

A USCS LOG OF TEST HOLE EMMONAK BULK FUEL UPGRADES.GPJ 2006DATATEMPLATE.GDT 9/27/13

Figure A3

HATTENBURG DILLEY & LINNELL Engineering Consultants

LOG OF BORING

HOLE # BH-01

PROJECT NUMBER : *11-008*
PROJECT : *Emmonak Bulk Fuel Upgrades*
CLIENT : *AVEC*

Station / Location: *Proposed Tank Farm*
Lat/Long: *N62°46'37.3" / W164°31'56.7"*
Elevation:

Equipment Type: *CME 45*
Drilling Method: *3.5 inch Hollow-Stem Auger*
Field Crew: *Discovery Drilling*

Total Depth: *40.0 feet*
Date: *3/9/2013*
Geologist: *N. Moran*

Depth (Feet)	Sample Data: Sample Type	Number	Blow Count	Sample	Recovery	N-Value	USCS Classification Frozen Zone	Soil Graphic	SUBSURFACE MATERIAL
27									**silty SAND** gray, wet, medium dense S6 Moisture =28.1% (cont.)
28									
29									
30	SS		3 4 4						30.0 **silty SAND** gray, wet, loose No sample collected due to observed heave.
31									
32									
33									
34									
35	SS	S7	2 2 3				ML		35.0 **SILT with sand** (ML) gray, wet, loose, F4 S7 P200=83.8%, Moisture =42.9%
36									
37									
38									
39									
40								BOH 40	40.0 Notes: 24" split barrel sampler driven 18" for most samples. PVC placed to depth of 40 feet for gound temperature monitoring.

Ground Water Data		
Depth in (ft.)	21	
Time		
Date	3/9/13	
Symbol	▼	

☐ CME Auto Hammer ☒ Cathead Rope Method ☐ 140 lb. hammer with 30 in. drop ☒ 340 lb. hammer with 30 in. drop

Sheet Number 2 of 2

A USCS LOG OF TEST HOLE EMMONAK BULK FUEL UPGRADES.GPJ 2006DATATEMPLATE.GDT 9/27/13

Figure A3

HATTENBURG DILLEY & LINNELL Engineering Consultants

LOG OF BORING

HOLE # BH-02

PROJECT NUMBER : *11-008*
PROJECT : *Emmonak Bulk Fuel Upgrades*
CLIENT : *AVEC*

Station / Location: *Proposed Tank Farm*
Lat/Long: *N62°46'37.2" / W164°31'55.1"*
Elevation:

Equipment Type: *CME 45*
Drilling Method: *3.5 inch Hollow-Stem Auger*
Field Crew: *Discovery Drilling*

Total Depth: *33.0 feet*
Date: *3/9/2013*
Geologist: *N. Moran*

Ground Water Data		
Depth in (ft.)	19	
Time		
Date	3/9/13	
Symbol	▼	

Depth (Feet)	Sample Type	Number	Blow Count	Sample	Recovery	N-Value	USCS Classification	Frozen Zone	Soil Graphic	SUBSURFACE MATERIAL
0										**SILT** 0.0
3	SS	S1	18 10 28 60				ML			**SILT** (ML) gray, frozen, F4 2.5 S1 P200 =90.0%, Sa =9.9%, Gr =0.1%, Moisture =47.6%
5	SS	S2	31 20 22 60							**SILT** gray, frozen 5.0 S2 Moisture =36.5%
8	SS	S3	21 15 15				ML			**SILT with sand** (ML) gray, frozen, F4 8.0 S3 P200 =79.1%, Sa =20.9%, Gr =0.1%, Moisture =34.5%
10	SS	S4	10 13 22				ML			**SILT** (ML) gray, frozen, F4 10.0 S4 P200=85.6%, Moisture =36.7%
15	SS	S5	14 23 40							**SILT** gray, frozen 15.0 S5 Moisture =29.3%
19 ▼										
20	SS	S6	14 17 21							**slightly silty SAND** gray, frozen, partially frozen, F2 20.0 S6 P200=6.6%, Moisture =33.7%
25	SS	S7	1 5 4							**silty SAND** grayish brown, wet, loose 25.0 S7 Moisture =48.4%

☐ CME Auto Hammer ☒ Cathead Rope Method ☐ 140 lb. hammer with 30 in. drop ☒ 340 lb. hammer with 30 in. drop

A USCS LOG OF TEST HOLE EMMONAK BULK FUEL UPGRADES.GPJ 2006DATATEMPLATE.GDT 9/27/13

Figure A4

HATTENBURG DILLEY & LINNELL Engineering Consultants

LOG OF BORING

HOLE # BH-02

PROJECT NUMBER : *11-008*
PROJECT : *Emmonak Bulk Fuel Upgrades*
CLIENT : *AVEC*

Station / Location: *Proposed Tank Farm*
Lat/Long: *N62°46'37.2" / W164°31'55.1"*
Elevation:

Equipment Type: *CME 45*
Drilling Method: *3.5 inch Hollow-Stem Auger*
Field Crew: *Discovery Drilling*

Total Depth: *33.0 feet*
Date: *3/9/2013*
Geologist: *N. Moran*

Depth (Feet)	Sample Data: Sample Type	Number	Blow Count	Sample Recovery	N-Value	USCS Classification Frozen Zone	Soil Graphic	Ground Water Data		
								Depth in (ft.)	19	
								Time		
								Date	3/9/13	
								Symbol	▼	

SUBSURFACE MATERIAL

27 28 29 30 31 32 33

silty SAND grayish brown, wet, loose
S7 Moisture =48.4% (cont.)

33.0

BOH 33

Notes:
Heaving sands encountered from 30 feet to the depth of the boring.
PVC placed to 23 feet for ground temperature monitoring.

☐ CME Auto Hammer ☒ Cathead Rope Method ☐ 140 lb. hammer with 30 in. drop ☒ 340 lb. hammer with 30 in. drop

Sheet Number 2 of 2

A USCS LOG OF TEST HOLE EMMONAK BULK FUEL UPGRADES.GPJ 2006DATATEMPLATE.GDT 9/27/13

Figure A4

HATTENBURG DILLEY & LINNELL Engineering Consultants

LOG OF BORING

HOLE # BH-03

PROJECT NUMBER : *11-008*
PROJECT : *Emmonak Bulk Fuel Upgrades*
CLIENT : *AVEC*

Station / Location: *Proposed Tank Farm*
Lat/Long: *N62°46'37.9" / W164°31'55.5"*
Elevation:

Equipment Type: *CME 45*
Drilling Method: *3.5 inch Hollow-Stem Auger*
Field Crew: *Discovery Drilling*

Total Depth: *40.0 feet*
Date: *3/10/2013*
Geologist: *N. Moran*

Ground Water Data		
Depth in (ft.)	20	17.2
Time		
Date	3/10/13	3/12/13
Symbol	▼	▽

Depth (Feet)	Sample Type	Number	Blow Count	Sample	Recovery	N-Value	USCS Classification	Frozen Zone	Soil Graphic	SUBSURFACE MATERIAL
0										**SILT** 0.0
1	SS	S1	30 13 4				ML			**SILT** (ML) gray, moist, very stiff, F4, trace organics 1.0 S1 P200=90.9%, Moisture =80.0%
2										2.0
3										
4	SS	S2	3 3 4				ML			**SILT** (ML) gray, moist, loose, F4, trace organics 4.0 S2 P200 =93.6%, Sa =6.4%, Gr =0.0%, Moisture =37.8%
5										
6										
7										
8										
9										
10	SS	S3	2 2 3							**sandy SILT** gray, moist, loose, trace root hairs 10.0 S3 Moisture =45.7%
11										
12										
13										
14										
15	SS	S4	1 2 7				ML			**sandy SILT** (ML) gray, moist to wet, stiff, F4, trace root hairs 15.0 S4 P200=59.3%, Moisture =35.7%
16										
17 ▽										
18										
19										
20 ▼	SS	S5	1 1 1							**slightly silty SAND** gray, wet, very loose 20.0 S5 P200=6.2%, Moisture =27.3%
21										
22										
23										
24										
25	SS		2 2 2							**silty SAND** gray, wet, very loose 25.0 No sample collected due to observed heave.
26										

☐ CME Auto Hammer ☒ Cathead Rope Method ☐ 140 lb. hammer with 30 in. drop ☒ 340 lb. hammer with 30 in. drop

Sheet Number 1 of 2

A USCS LOG OF TEST HOLE EMMONAK BULK FUEL UPGRADES.GPJ 2006DATATEMPLATE.GDT 9/27/13

Figure A5

HATTENBURG DILLEY & LINNELL Engineering Consultants

LOG OF BORING

HOLE # BH-03

PROJECT NUMBER : *11-008*
PROJECT : *Emmonak Bulk Fuel Upgrades*
CLIENT : *AVEC*

Station / Location: *Proposed Tank Farm*
Lat/Long: *N62°46'37.9" / W164°31'55.5"*
Elevation:

Equipment Type: *CME 45*
Drilling Method: *3.5 inch Hollow-Stem Auger*
Field Crew: *Discovery Drilling*

Total Depth: *40.0 feet*
Date: *3/10/2013*
Geologist: *N. Moran*

Ground Water Data		
Depth in (ft.)	20	17.2
Time		
Date	3/10/13	3/12/13
Symbol	▼	▽

Depth (Feet)	Sample Data: Sample Type	Number	Blow Count	Sample	Recovery	N-Value	USCS Classification Frozen Zone	Soil Graphic	SUBSURFACE MATERIAL
27									**silty SAND** gray, wet, very loose No sample collected due to observed heave. (cont.)
28									
29									
30	SS	S6	1 4 4				SM		**Silty SAND** (SM) grayish brown, moist to wet, loose, F4 S6 P200 =41.7%, Sa =58.3%, Gr =0.0%, Moisture =56.6%
31									
32									
33									
34									
35	SS		2 4 6						**silty SAND** gray, wet, loose No sample collected due to observed heave.
36									
37									
38									
39									
40								BOH 40	Notes: Heaving sands encountered from 20 feet to the depth of the boring. PVC placed to depth of boring for ground temperature monitoring. Slotted PVC placed to 25 feet for groundwater monitoring.

-30.0

-35.0

-40.0

☐ CME Auto Hammer ☒ Cathead Rope Method ☐ 140 lb. hammer with 30 in. drop ☒ 340 lb. hammer with 30 in. drop

Sheet Number 2 of 2

A USCS LOG OF TEST HOLE EMMONAK BULK FUEL UPGRADES.GPJ 2006DATATEMPLATE.GDT 9/27/13

Figure A5

HATTENBURG DILLEY & LINNELL Engineering Consultants

LOG OF BORING

HOLE # BH-04

PROJECT NUMBER : *11-008*
PROJECT : *Emmonak Bulk Fuel Upgrades*
CLIENT : *AVEC*

Station / Location: *Proposed Tank Farm*
Lat/Long: *N62°46'38.4" / W164°31'56.6"*
Elevation:

Equipment Type: *CME 45*
Drilling Method: *3.5 inch Hollow-Stem Auger*
Field Crew: *Discovery Drilling*

Total Depth: *41.5 feet*
Date: *3/11/2013*
Geologist: *N. Moran*

Ground Water Data		
Depth in (ft.)	13	
Time		
Date	3/11/13	
Symbol	▼	

Depth (Feet)	Sample Type	Number	Blow Count	Sample	Recovery	N-Value	USCS Classification	Frozen Zone	Soil Graphic	SUBSURFACE MATERIAL
0										**SILT w/ organics** 0.0
2.5	SS	S1	7 17 25							**SILT w/ organics** grayish brown, frozen 2.5
5.0	SS		8 2 3							**Trash/Garbage** grayish brown, frozen No sample collected due to high trash content. 5.0
10.0	SS	S2	2 3 3				ML			**SILT with sand** (ML) gray, moist to wet, loose, F4 S2 Salinity=0.25 ppt, P200 =79.4%, Sa =20.6%, Gr =0.0%, Moisture =33.6% 10.0
15.0	SS	S3	2 4 6							**silty SAND** gray, wet, loose, heave noted in borehole. 15.0
20.0	SS	S4	1 3 5				SM			**Silty SAND** (SM) gray, wet, loose, F3, heave noted in borehole. S4 P200 =17.1%, Sa =82.9%, Gr =0.0%, Moisture =25.8% 20.0
25.0	SS	S5	2 3 7							**silty SAND** grayish brown, partially frozen 25.0

☐ CME Auto Hammer ☒ Cathead Rope Method ☐ 140 lb. hammer with 30 in. drop ☒ 340 lb. hammer with 30 in. drop

Sheet Number 1 of 2

A USCS LOG OF TEST HOLE EMMONAK BULK FUEL UPGRADES.GPJ 2006DATATEMPLATE.GDT 9/27/13

Figure A6

HATTENBURG DILLEY & LINNELL Engineering Consultants

LOG OF BORING

HOLE # BH-04

PROJECT NUMBER : *11-008*
PROJECT : *Emmonak Bulk Fuel Upgrades*
CLIENT : *AVEC*

Station / Location: *Proposed Tank Farm*
Lat/Long: *N62°46'38.4" / W164°31'56.6"*
Elevation:

Equipment Type: *CME 45*
Drilling Method: *3.5 inch Hollow-Stem Auger*
Field Crew: *Discovery Drilling*

Total Depth: *41.5 feet*
Date: *3/11/2013*
Geologist: *N. Moran*

Ground Water Data		
Depth in (ft.)	13	
Time		
Date	3/11/13	
Symbol	▼	

Depth (Feet)	Sample Data: Sample Type	Number	Blow Count	Sample	Recovery	N-Value	USCS Classification Frozen Zone	Soil Graphic	SUBSURFACE MATERIAL
27									**silty SAND** grayish brown, partially frozen (cont.)
28									
29									
30	SS	S6	2 2 7				SM		**Silty SAND** (SM) brown, partially frozen, F4, trace organics S6 Salinity=0.75 ppt, P200 =37.4%, Sa =62.6%, Gr =0.0%, Moisture =76.4%
31									
32									
33									
34									
35	SS		1 1 1						**silty SAND** gray, wet, very loose No sample collected due to observed heave.
36									
37									
38									
39									
40	SS	S7	43 36 40						**silty SAND** gray, frozen
41								BOH 41.5	Notes: Bottom of hole at 41.5 feet.

30.0 — 35.0 — 40.0 — 41.5

☐ CME Auto Hammer ☒ Cathead Rope Method ☐ 140 lb. hammer with 30 in. drop ☒ 340 lb. hammer with 30 in. drop

Sheet Number 2 of 2

A USCS LOG OF TEST HOLE EMMONAK BULK FUEL UPGRADES.GPJ 2006DATATEMPLATE.GDT 9/27/13

Figure A6

HATTENBURG DILLEY & LINNELL Engineering Consultants

LOG OF BORING

HOLE # BH-05

PROJECT NUMBER : *11-008*
PROJECT : *Emmonak Bulk Fuel Upgrades*
CLIENT : *AVEC*

Station / Location: *Proposed Tank Farm*
Lat/Long: *N62°46'38.4" / W164°31'54.7"*
Elevation:

Equipment Type: *CME 45*
Drilling Method: *3.5 inch Hollow-Stem Auger*
Field Crew: *Discovery Drilling*

Total Depth: *51.5 feet*
Date: *3/10/2013*
Geologist: *N. Moran*

Ground Water Data		
Depth in (ft.)	16	
Time		
Date	3/10/13	
Symbol	▼	

Depth (Feet)	Sample Type	Number	Blow Count	Sample	Recovery	N-Value	USCS Classification	Frozen Zone	Soil Graphic	SUBSURFACE MATERIAL
0										**SILT w/ organics** 0.0
1	SS	S1	12 12 12							**SILT w/ organics** brown, frozen 1.0 S1 Moisture =49.6%
2										
3	SS	S2	12 12 18				ML			**SILT** (ML) grayish brown, frozen, F4, trace organics 2.5 S2 P200=86.7% Moisture =70.0%
4										
5	SS	S3	6 2 3							**SILT** gray, frozen 5.0 S3 Moisture =46.9%
6										6.0
7										
8										
9										
10	SS	S4	1 2 3				ML			**SILT with sand** (ML) grayish brown, moist to wet, loose, F4 10.0 S4 P200=70.6%, Moisture =37.3%
11										
12										
13										
14										
15	SS	S5	3 3 3							**sandy SILT** brown, moist to wet, loose 15.0 S5 Moisture =40.6%
16										
17										
18										
19										
20	SS	S6	1 3 3							**silty SAND** gray, wet, loose 20.0 S6 Moisture =32.8%
21										
22										
23										
24										
25	SS		1 2 2							**silty SAND** gray, wet, very loose 25.0 No sample collected due to observed heave.
26										

☐ CME Auto Hammer ☒ Cathead Rope Method ☐ 140 lb. hammer with 30 in. drop ☒ 340 lb. hammer with 30 in. drop

Sheet Number 1 of 2

A USCS LOG OF TEST HOLE EMMONAK BULK FUEL UPGRADES.GPJ 2006DATATEMPLATE.GDT 9/27/13

Figure A7

HATTENBURG DILLEY & LINNELL Engineering Consultants

LOG OF BORING

HOLE # BH-05

PROJECT NUMBER : *11-008*
PROJECT : *Emmonak Bulk Fuel Upgrades*
CLIENT : *AVEC*

Station / Location: *Proposed Tank Farm*
Lat/Long: *N62°46'38.4" / W164°31'54.7"*
Elevation:

Equipment Type: *CME 45*
Drilling Method: *3.5 inch Hollow-Stem Auger*
Field Crew: *Discovery Drilling*

Total Depth: *51.5 feet*
Date: *3/10/2013*
Geologist: *N. Moran*

Ground Water Data		
Depth in (ft.)	16	
Time		
Date	3/10/13	
Symbol	▼	

Depth (Feet)	Sample Type	Number	Blow Count	Sample	Recovery	N-Value	USCS Classification Frozen Zone	Soil Graphic	SUBSURFACE MATERIAL
27									**silty SAND** gray, wet, very loose No sample collected due to observed heave. (cont.)
28									
29									
30	SS	S7	2 4 1						**silty SAND** gray, wet, loose S7 Moisture =39.5%
31									
32									
33									
34									
35	SS		3 3 5						**silty SAND** gray, wet, loose No sample collected due to observed heave.
36									
37									
38									
39									
40	SS	S8	20 26 36						**silty SAND** gray, frozen, F4 S8 P200=29.7%, Salinity=0.20 ppt, Moisture =28.9%
41									
42									
43									
44									
45	SS	S9	16 31 19				SM		**Silty SAND** (SM) grayish brown, frozen, F2 S9 Salinity=0.47 ppt, P200 =12.8%, Sa =87.2%, Gr =0.0%, Moisture =36.3%
46									
47									
48									
49									
50	SS		7 10 5						**silty SAND** gray, wet
51								BOH 51.5	Notes: Heaving sands encountered from 20 feet to the depth of the boring. PVC placed to 50 feet for ground temperature monitoring.

☐ CME Auto Hammer ☒ Cathead Rope Method ☐ 140 lb. hammer with 30 in. drop ☒ 340 lb. hammer with 30 in. drop

Sheet Number 2 of 2

A USCS LOG OF TEST HOLE EMMONAK BULK FUEL UPGRADES.GPJ 2006DATATEMPLATE.GDT 9/27/13

Figure A7

HATTENBURG DILLEY & LINNELL Engineering Consultants

LOG OF BORING

HOLE # BH-06

PROJECT NUMBER : *11-008*
PROJECT : *Emmonak Bulk Fuel Upgrades*
CLIENT : *AVEC*

Station / Location: *Exisiting Tank Farm*
Lat/Long: *N62°46'39.5" / W164°31'52.7"*
Elevation:

Equipment Type: *CME 45*
Drilling Method: *3.5 inch Hollow-Stem Auger*
Field Crew: *Discovery Drilling*

Total Depth: *31.5 feet*
Date: *3/11/2013*
Geologist: *N. Moran*

Ground Water Data		
Depth in (ft.)	15	13.2
Time		
Date	3/11/13	3/12/13
Symbol	▼	▽

Depth (Feet)	Sample Data: Sample Type	Number	Blow Count	Sample	Recovery	N-Value	USCS Classification	Frozen Zone	Soil Graphic	SUBSURFACE MATERIAL
0										**sandy SILT w/ organics** 0.0
3	SS	S1	9 21 19				ML			**sandy SILT w/ organics** (ML) grayish brown, frozen, F4 S1 P200=64.6%, Moisture =47.7% 2.5
5	SS	S2	9 17 12							**sandy SILT w/ organics** grayish brown, frozen 5.0 S2 Moisture =58.5%
10	SS	S3	2 1 3				ML			**SILT** (ML) grayish brown, moist to wet, very loose, F4, trace organics 10.0 S3 P200 =91.1%, Sa =8.9%, Gr =0.0%, Moisture =45.1%
15	SS	S4	1 2 2				ML			**SILT with sand** (ML) gray, wet, very loose, F4 15.0 S4 P200=73.8%, Moisture =40.6%
20	SS	S5	5 4 1							**silty SAND** gray, wet, loose 20.0 S5 Moisture =28.3%
25	SS		1 1 1							**silty SAND** gray, wet, very loose 25.0 No sample collected due to observed heave.

☐ CME Auto Hammer ☒ Cathead Rope Method ☐ 140 lb. hammer with 30 in. drop ☒ 340 lb. hammer with 30 in. drop

Sheet Number 1 of 2

A USCS LOG OF TEST HOLE EMMONAK BULK FUEL UPGRADES.GPJ 2006DATATEMPLATE.GDT 9/27/13

Figure A8

HATTENBURG DILLEY & LINNELL Engineering Consultants

LOG OF BORING

HOLE # BH-06

PROJECT NUMBER : *11-008*
PROJECT : *Emmonak Bulk Fuel Upgrades*
CLIENT : *AVEC*

Station / Location: *Exisiting Tank Farm*
Lat/Long: *N62°46'39.5" / W164°31'52.7"*
Elevation:

Equipment Type: *CME 45*
Drilling Method: *3.5 inch Hollow-Stem Auger*
Field Crew: *Discovery Drilling*

Total Depth: *31.5 feet*
Date: *3/11/2013*
Geologist: *N. Moran*

Ground Water Data		
Depth in (ft.)	15	13.2
Time		
Date	3/11/13	3/12/13
Symbol	▼	▽

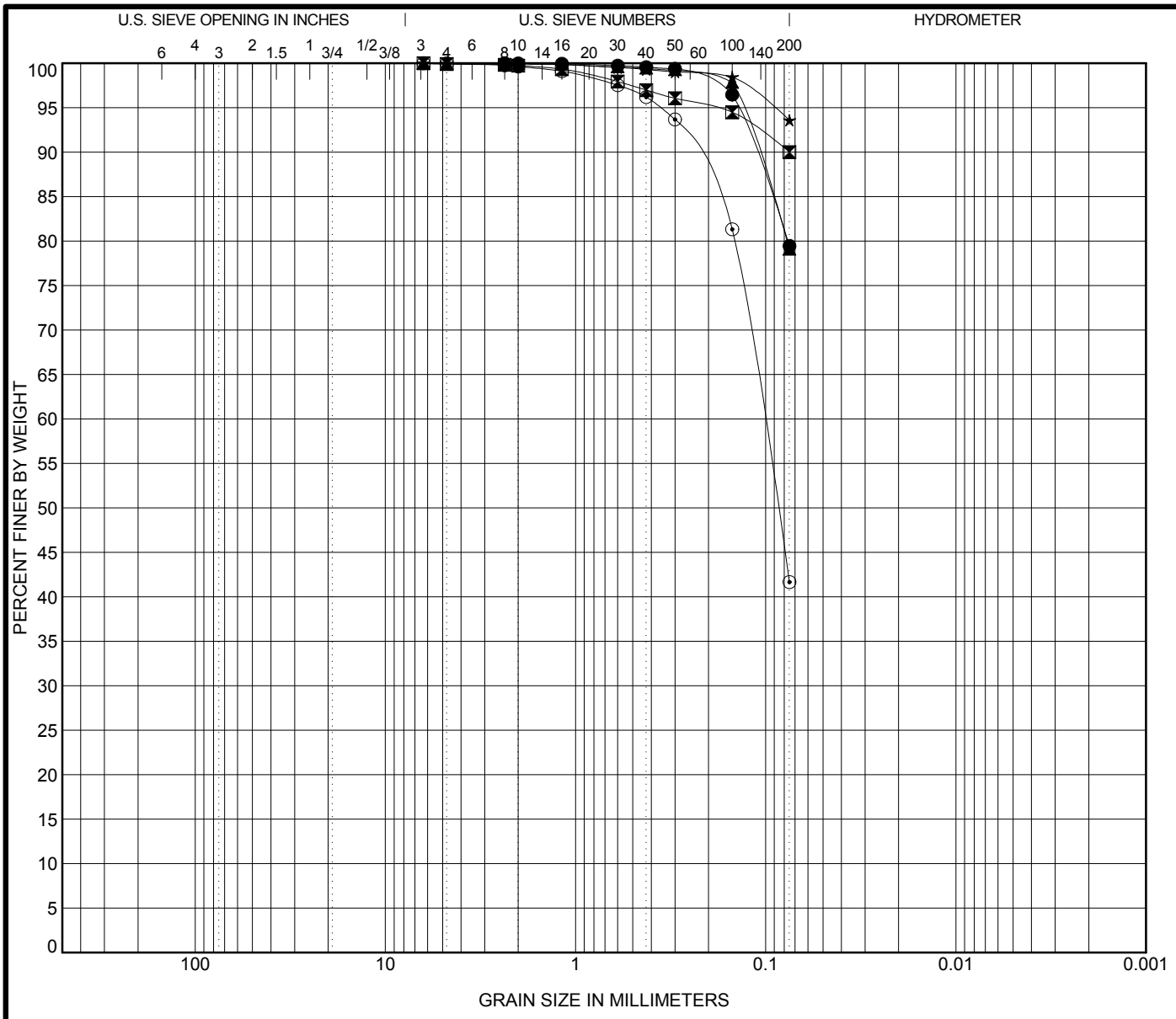
Depth (Feet)	Sample Data: Sample Type	Number	Blow Count	Sample	Recovery	N-Value	USCS Classification Frozen Zone	Soil Graphic	SUBSURFACE MATERIAL
27									**silty SAND** gray, wet, very loose No sample collected due to observed heave. (cont.)
28									
29									
30	SS	S6	15				SP-SM		**Poorly-graded SAND with silt** (SP-SM) gray, frozen, F2 S6 P200 =9.3%, Sa =90.7%, Gr =0.0%, Moisture =26.5% — 30.0
31								BOH 31.5	— 31.5 Notes: Heaving silts and sands encountered from 15 feet to the depth of the boring. PVC placed to 30 feet for ground temperature monitoring. Slotted PVC placed to 25 feet for groundwater monitoring.

☐ CME Auto Hammer ☒ Cathead Rope Method ☐ 140 lb. hammer with 30 in. drop ☒ 340 lb. hammer with 30 in. drop

Sheet Number 2 of 2

A USCS LOG OF TEST HOLE EMMONAK BULK FUEL UPGRADES.GPJ 2006DATATEMPLATE.GDT 9/27/13

Figure A8



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	BH-01	Depth 15.0	SILT with sand (ML)					
⊠	BH-02	Depth 2.5	SILT (ML)					
▲	BH-02	Depth 8.0	SILT with sand (ML)					
★	BH-03	Depth 4.0	SILT (ML)					
⊙	BH-03	Depth 30.0	Silty SAND (SM)					

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BH-01	Depth 15.0	2.36				0.0	20.5	79.5	
⊠	BH-02	Depth 2.5	6.3				0.1	9.9	90.0	
▲	BH-02	Depth 8.0	6.3				0.1	20.9	79.1	
★	BH-03	Depth 4.0	6.3				0.0	6.4	93.6	
⊙	BH-03	Depth 30.0	6.3	0.103			0.0	58.3	41.7	

HATTENBURG DILLEY & LINNELL
Engineering Consultants

GRAIN SIZE DISTRIBUTION

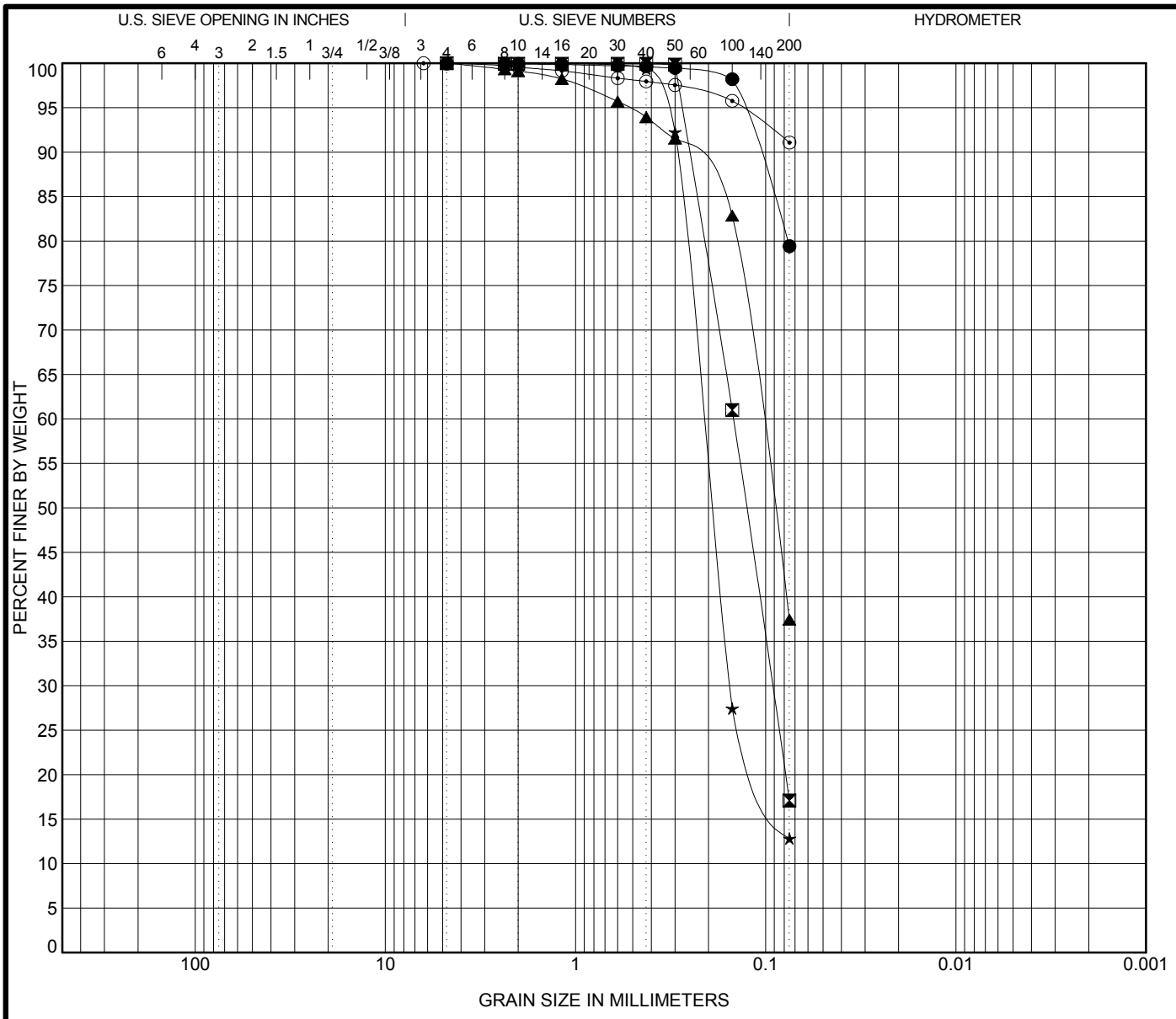
AVEC

Emmonak Bulk Fuel Upgrades

Emmonak, AK 11-008

GRAIN SIZE EMMONAK BULK FUEL UPGRADES.GPJ HDEC.GDT 6/17/13 08:27

Figure A9



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	BH-04	Depth 10.0	SILT with sand (ML)					
⊠	BH-04	Depth 20.0	Silty SAND (SM)					
▲	BH-04	Depth 30.0	Silty SAND (SM)					
★	BH-05	Depth 45.0	Silty SAND (SM)					
⊙	BH-06	Depth 10.0	SILT (ML)					

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BH-04	Depth 10.0	4.75				0.0	20.6	79.4	
⊠	BH-04	Depth 20.0	4.75	0.148	0.092		0.0	82.9	17.1	
▲	BH-04	Depth 30.0	4.75	0.106			0.0	62.6	37.4	
★	BH-05	Depth 45.0	4.75	0.212	0.154		0.0	87.2	12.8	
⊙	BH-06	Depth 10.0	6.3				0.0	8.9	91.1	

HATTENBURG DILLEY & LINNELL
Engineering Consultants

GRAIN SIZE DISTRIBUTION

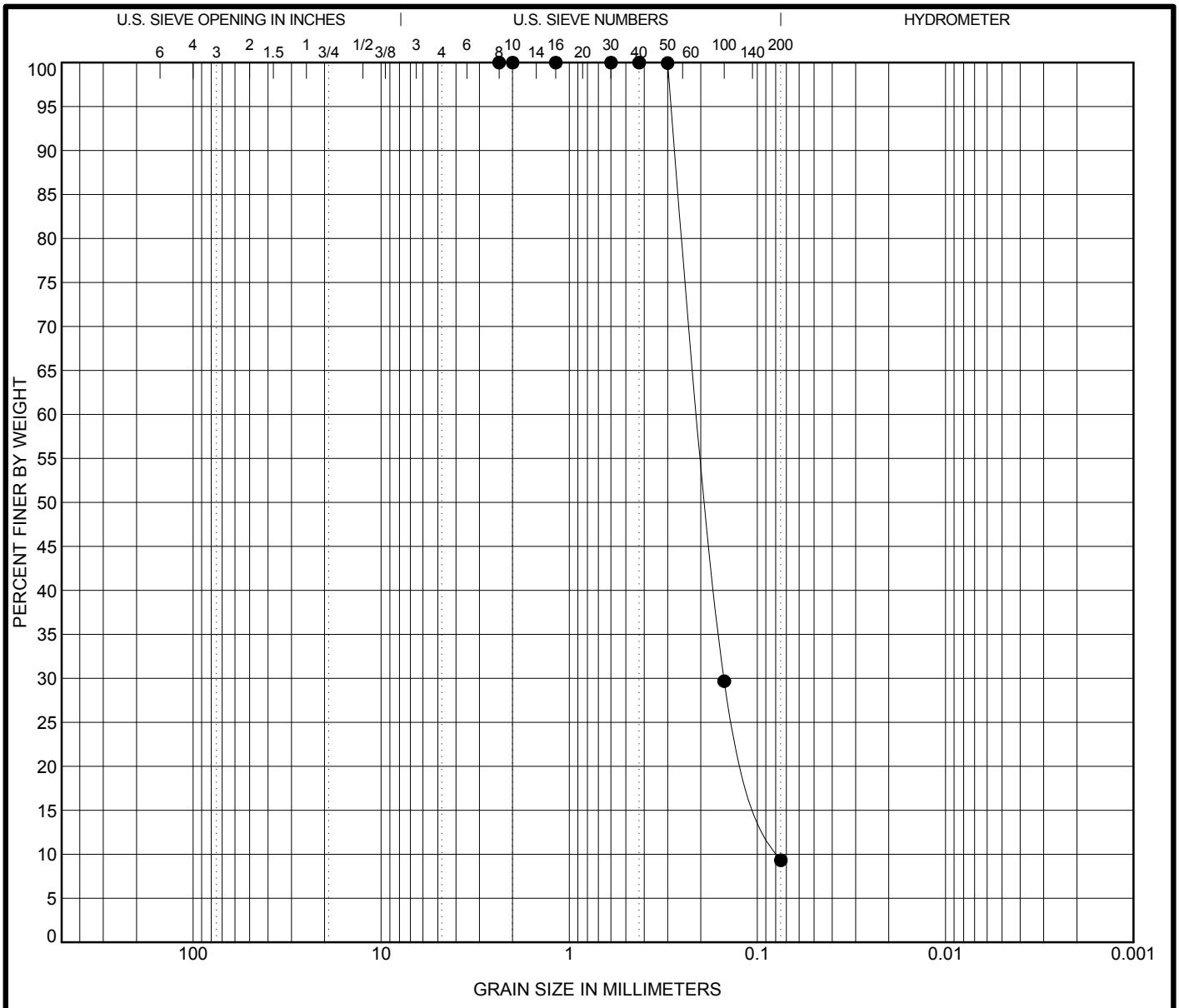
AVEC

Emmonak Bulk Fuel Upgrades

Emmonak, AK 11-008

GRAIN SIZE EMMONAK BULK FUEL UPGRADES.GPJ HDEC.GDT 6/17/13 08:27

Figure A10



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**BH-06**	**Depth 30.0**	**Poorly-graded SAND with silt (SP-SM)**				**1.46**	**2.64**

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**BH-06**	**Depth 30.0**	**2.36**	**0.202**	**0.15**	**0.077**	**0.0**	**90.7**	**9.3**	

HATTENBURG DILLEY & LINNELL
Engineering Consultants

GRAIN SIZE DISTRIBUTION

AVEC

Emmonak Bulk Fuel Upgrades

Emmonak, AK 11-008

GRAIN SIZE EMMONAK BULK FUEL UPGRADES.GPJ HDEC.GDT 6/17/13 08:27

Figure A11

APPENDIX B

Select Boring Logs from Previous Investigations

- APPROXIMATE BOREHOLE LOCATION

NORTHERN GEOTECHNICAL ENGINEERING, INC. TERRA FIRMA TESTING

2823-11

APPROXIMATE BOREHOLE LOCATIONS

Emmonak High School
Emmonak, AK

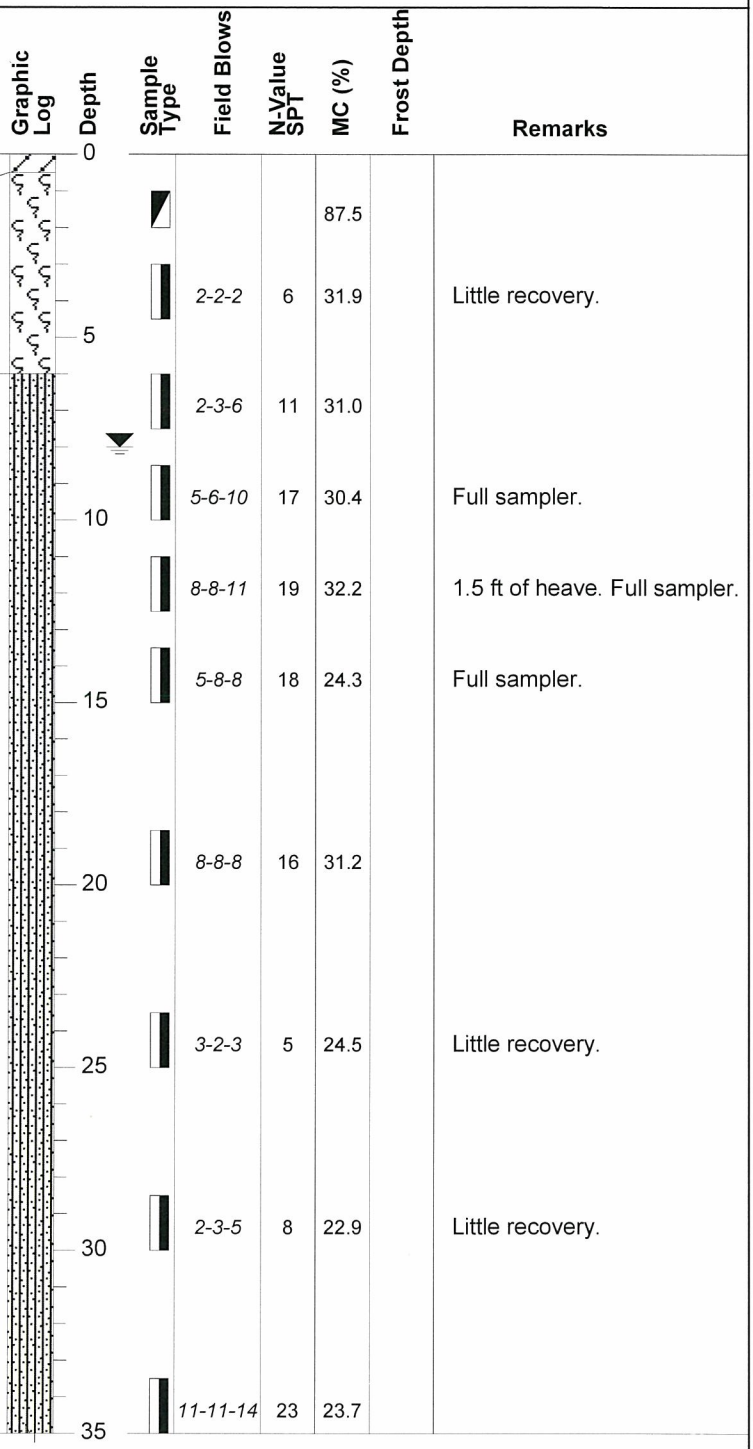
FIG 4

Borehole: B-2

Emmonak High School
Emmonak, Alaska

Drill: Skid Mounted CME 45
Sampling: Standard SPT
Logged By: CJB
Total Depth: 40 ft.
Groundwater: 8 ft.

Project: 2823-11
Date Started: 8/11/11
Date Completed: 8/11/11
Elevation: 4 ft below Parking Area
Frost Class:



Description	Depth	Sample Type	Field Blows	N-Value SPT	MC (%)	Frost Depth	Remarks
Grass.	0						
Wet soft gray sandy SILT.					87.5		
	5		2-2-2	6	31.9		Little recovery.
Wet loose brownish gray silty SAND.			2-3-6	11	31.0		
	10		5-6-10	17	30.4		Full sampler.
			8-8-11	19	32.2		1.5 ft of heave. Full sampler.
	15		5-8-8	18	24.3		Full sampler.
	20		8-8-8	16	31.2		
	25		3-2-3	5	24.5		Little recovery.
	30		2-3-5	8	22.9		Little recovery.
	35		11-11-14	23	23.7		

Borehole: B-2

Emmonak High School
Emmonak, Alaska

Drill: Skid Mounted CME 45
Sampling: Standard SPT
Logged By: CJB
Total Depth: 40 ft.
Groundwater: 8 ft.

Project: 2823-11
Date Started: 8/11/11
Date Completed: 8/11/11
Elevation: 4 ft below Parking Area
Frost Class:

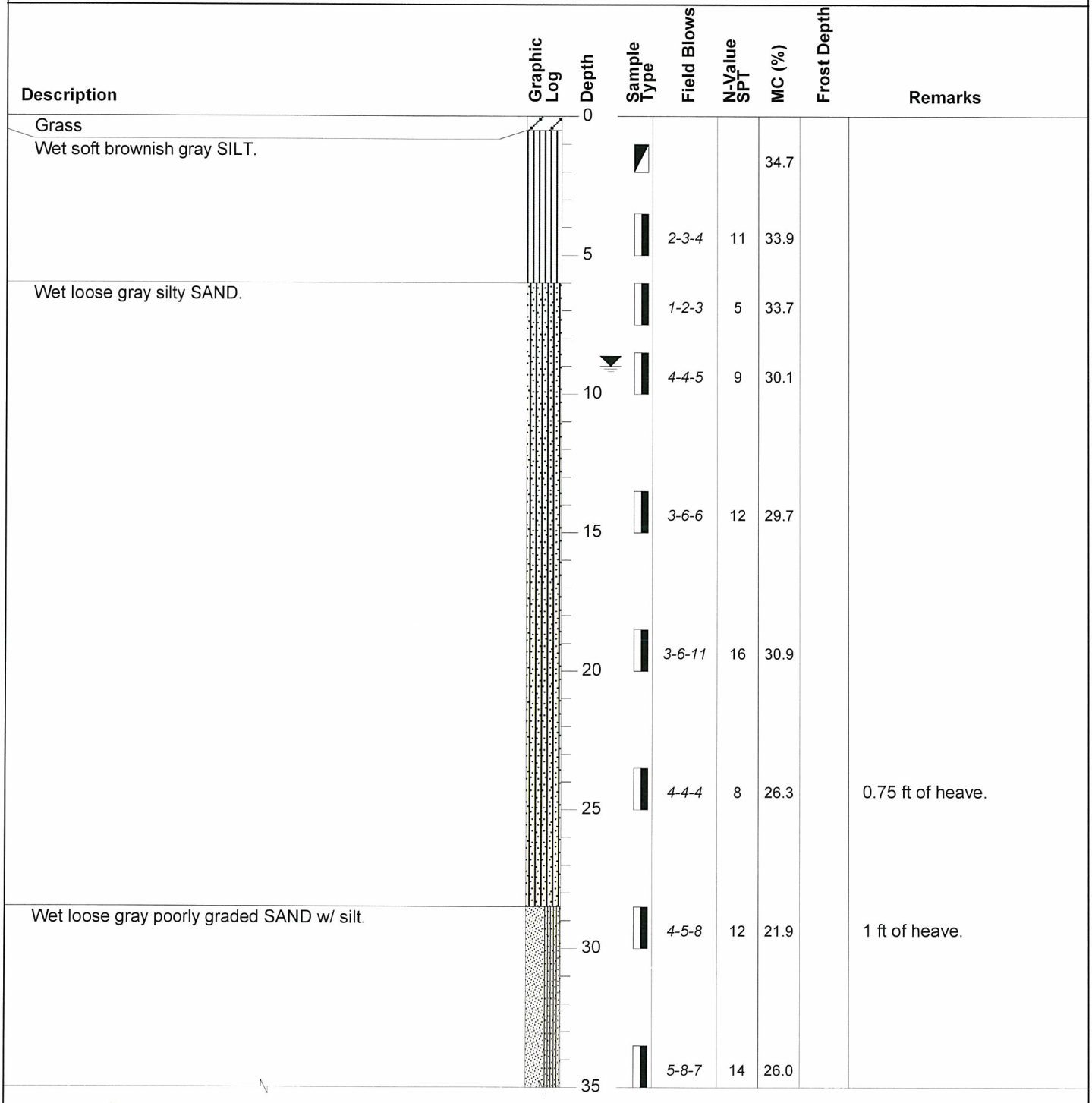
Description	Graphic Log	Depth	Sample Type	Field Blows	N-Value SPT	MC (%)	Frost Depth	Remarks
Wet loose brownish gray silty SAND. Moist stiff gray SILT.		35						
		40		8-8-15	23	35.3		
Boring completed at depth of 40 ft bgs.		45						
		50						
		55						
		60						
		65						
		70						

Borehole: B-3

Emmonak High School
Emmonak, Alaska

Drill: Skid Mounted CME 45
Sampling: Standard SPT
Logged By: CJB
Total Depth: 45 ft.
Groundwater: 9 ft.

Project: 2823-11
Date Started: 8/11/11
Date Completed: 8/11/11
Elevation: 3 ft below Parking Area
Frost Class: F4

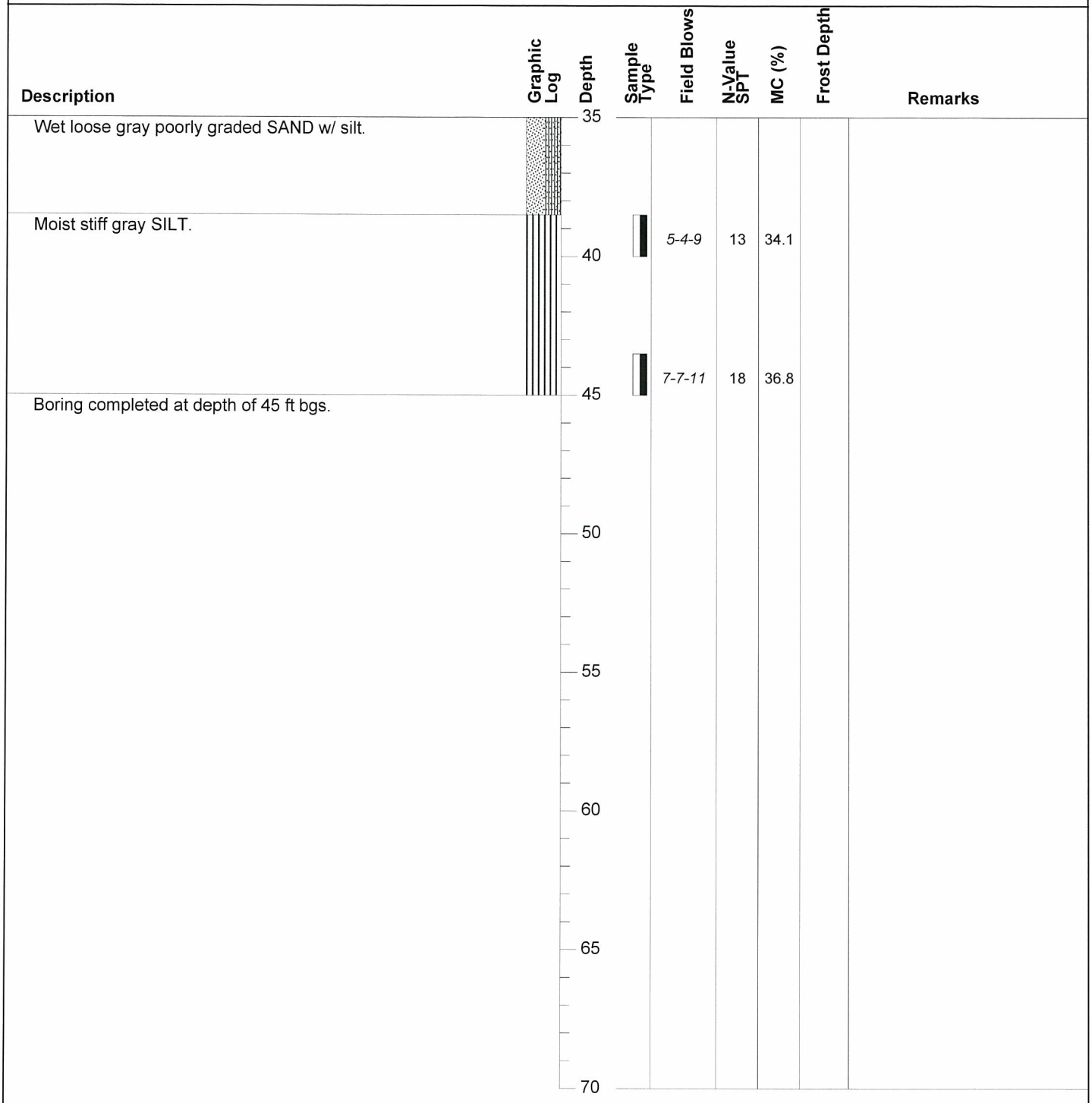


Borehole: B-3

Emmonak High School
Emmonak, Alaska

Drill: Skid Mounted CME 45
Sampling: Standard SPT
Logged By: CJB
Total Depth: 45 ft.
Groundwater: 9 ft.

Project: 2823-11
Date Started: 8/11/11
Date Completed: 8/11/11
Elevation: 3 ft below Parking Area
Frost Class: F4



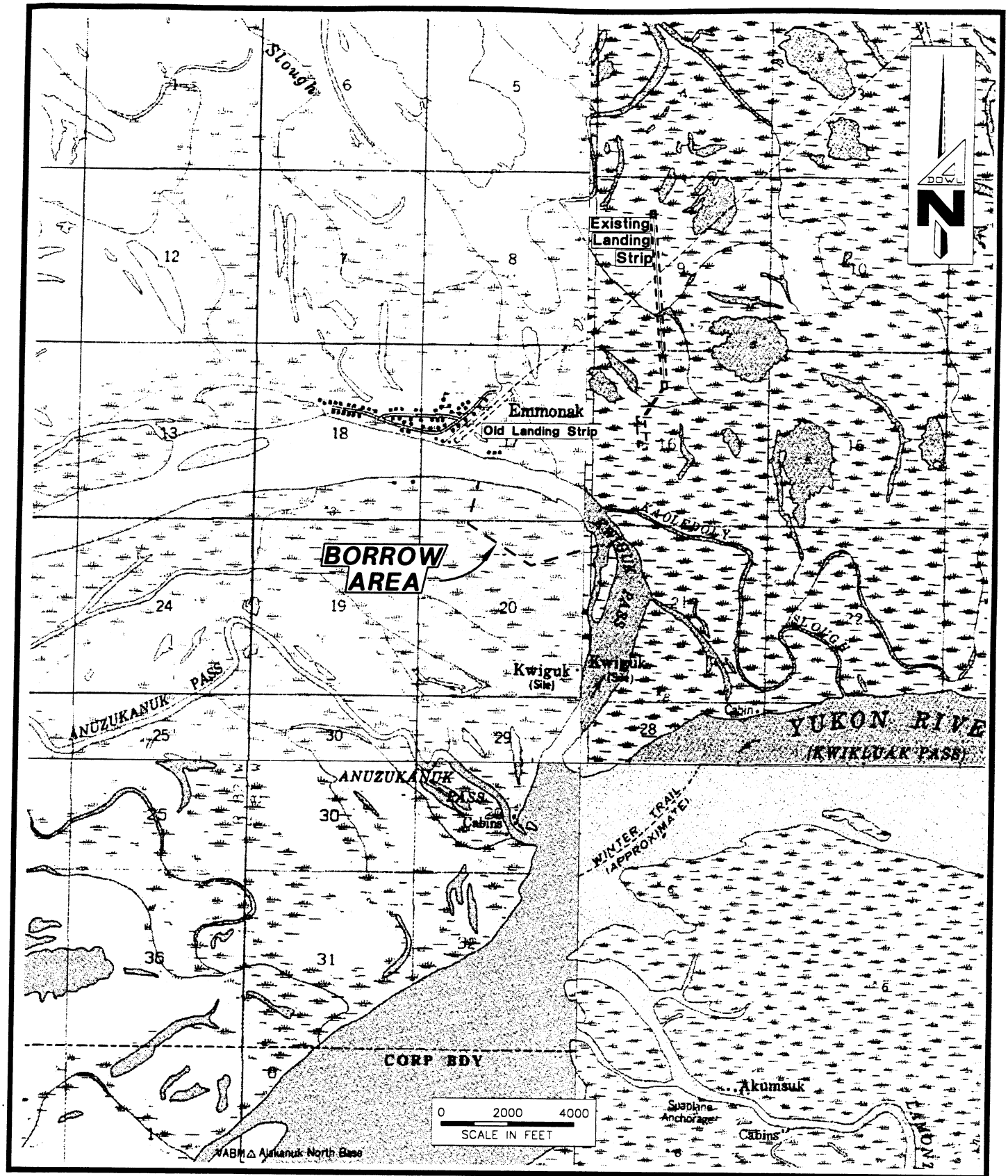
Borehole: B-5

Emmonak High School
Emmonak, Alaska

Drill: Skid Mounted CME 45
Sampling: Standard SPT
Logged By: CJB
Total Depth: 16.5 ft.
Groundwater: 10 ft.

Project: 2823-11
Date Started: 8/12/11
Date Completed: 8/12/11
Elevation: 2 ft below Parking Area
Frost Class: F4

Description	Graphic Log	Depth	Sample Type	Field Blows	N-Value SPT	MC (%)	Frost Depth	Remarks
Wet medium stiff brownish gray SILT w/ sand.		0				56.4		
				3-3-5	12	38.4		
Wet loose gray sandy SILT.		5		2-3-4	9	39.3		
				5-5-9	15	32.4		
		10		4-7-12	19	31.8		
		15		4-4-4	8	36.9		
Boring completed at depth of 16.5 ft bgs.		20						
		25						
		30						
		35						

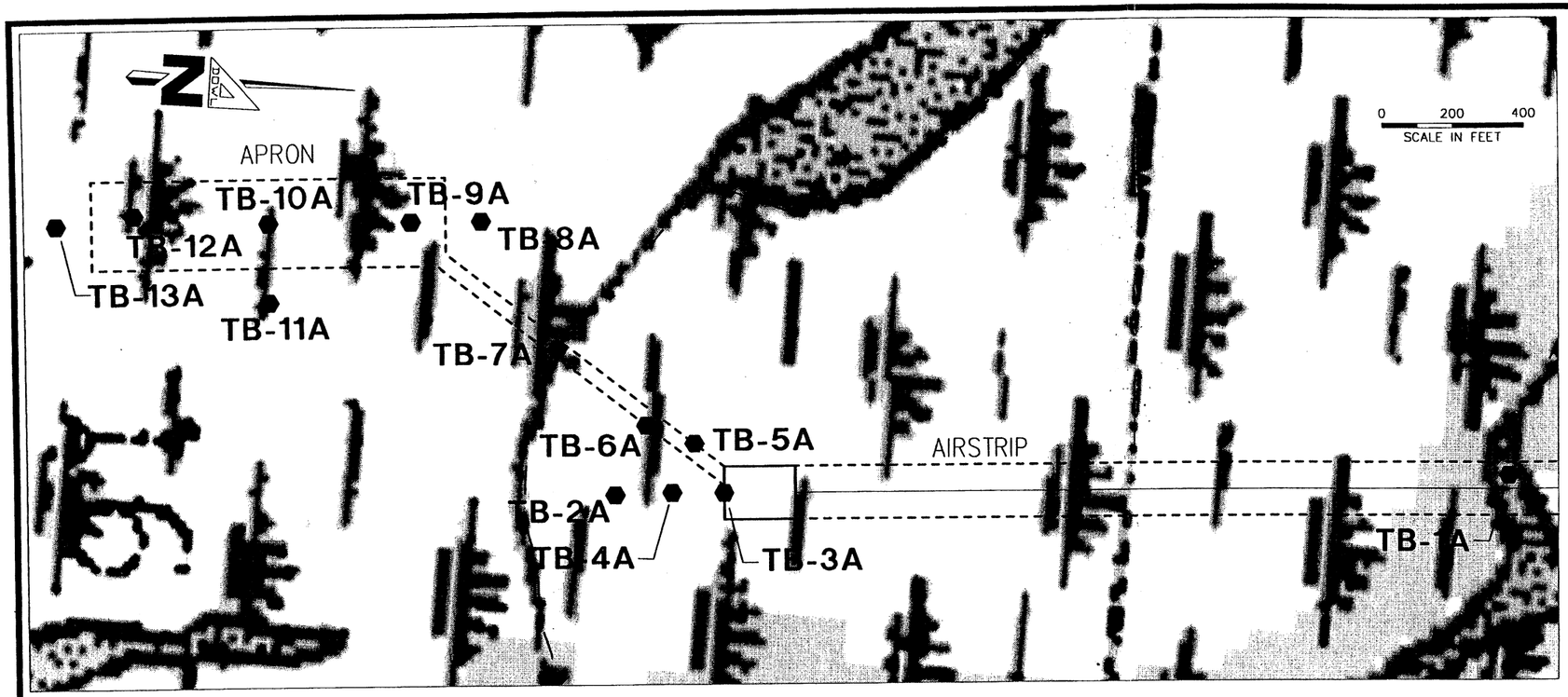


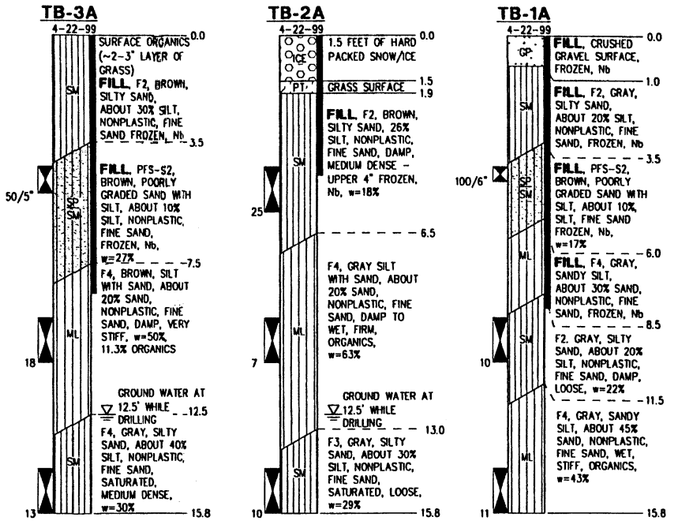
D56654 GTBEMKAL.dwg SITE.scr 11OCT99 USGS Base Map: KWIGUK (C-5,C-6,D-5,D-6) SCALE: 1"=4000'

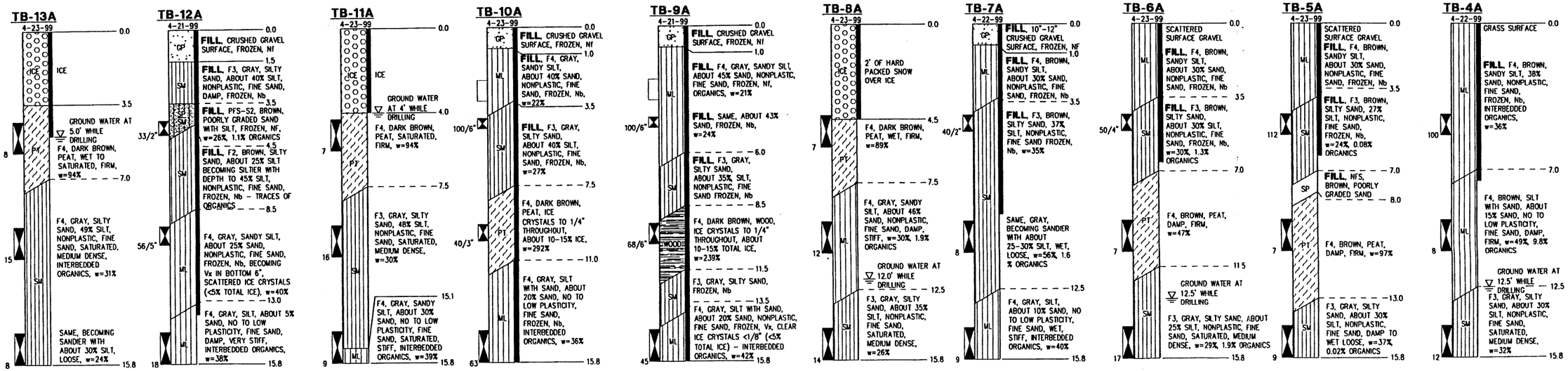
DOWL ENGINEERS

Vicinity Map
EMMONAK AIRPORT GEOTECHNICAL STUDY
Emmonak, Alaska

Figure 2







NOTES: 1) BORING LOGS HAVE ABBREVIATED SOIL DESCRIPTIONS AND ARE SHOWN ON THESE DRAWINGS FOR CONVENIENCE OF INFORMATION TO THE USER. REFER TO SOILS REPORT FOR FULL INFORMATION UPON WHICH TO BASE AN INTERPRETATION.

2) w = MOISTURE CONTENT

3) % 0.02mm = PERCENTAGE OF SILT BASED ON HYDROMETER ANALYSIS

D56654 GTBEMKAL.dwg EMTB.scr 13AUG99

SCALE: 1"=400'

DOWL ENGINEERS

Runway Test Boring Logs

EMMONAK AIRPORT GEOTECHNICAL STUDY – Emmonak, Alaska

Figure 19

Return To:- Hdqtrs. Matl's
Pavey

NORTEC

REVISION NO. 1

SOILS INVESTIGATION REPORT PROPOSED EMMONAK AIRPORT

EMMONAK, ALASKA

FOR

DOWL ENGINEERS

OCTOBER, 1982

NORTHERN TECHNICAL SERVICES

ANCHORAGE, ALASKA

LOG OF BORING NO. TH4

PROJECT: EMMONAK AIRPORT
LOCATION: 9 + 75 on ℄
TYPE BORING: HOLLOW STEM AUGER

DATE: 3/18/82
SURFACE ELEVATION:
COMPLETION DEPTH: 15 FT.

DEPTH, FT.	MOISTURE CONTENT (%)	BLOW COUNT *	SAMPLE	UNIFIED SOIL CLASSIFICATION	FROZEN	SOIL DESCRIPTION	DEPTH, FT.
				PT		F4, BROWN PEAT AND ORGANICS, CONSIDERABLE ICE IN SEASONAL FROST, SATURATED, SOFT	
		4				GROUND-WATER LEVEL WHILE DRILLING	
5						GRADES WITH GRAY SANDY SILT LAYERS	5
						F2, GRAY SILTY SAND, FINE GRAINED, NON-PLASTIC SANDY SILT LAYERS, 20-30% NON-PLASTIC SILT, SATURATED, LOOSE	
		11					
10				SM			10
		6					
15						TEST BORING COMPLETED 3/18/82	15
20							20

* NOTE
NUMBER INDICATES BLOW COUNT FOR 12" PENETRATION W/ 140 # HAMMER FALLING 30"

NORTHERN TECHNICAL SERVICES

LOG OF BORING NO. TH12

PROJECT: EMMONAK AIRPORT
LOCATION: 30 + 00 LEFT 600'
TYPE BORING: HOLLOW STEM AUGER

DATE: 3/27/82
SURFACE ELEVATION:
COMPLETION DEPTH: 15.5 FT.

DEPTH, FT.	MOISTURE CONTENT (%)	BLOW COUNT *	SAMPLE	UNIFIED SOIL CLASSIFICATION	FROZEN	SOIL DESCRIPTION	DEPTH, FT.
						WATER LEVEL AT SURFACE	
				PT		BROWN PEAT WITH GRAY SILT LAYERS, FIBROUS, SATURATED, SOFT	
5		5					5
				ML		F2, GRAY SANDY SILT, FINE-GRAINED, 60% NON-PLASTIC SILT, SATURATED, LOOSE	
		8					
10							10
						SILT CONTENT DECREASES	
		9					
15						TEST BORING COMPLETED 3/27/82	15
20							20

* NOTE
NUMBER INDICATES BLOW COUNT FOR 12" PENETRATION W/ 140 # HAMMER FALLING 30"

NORTHERN TECHNICAL SERVICES

LOG OF BORING NO. TH20

PROJECT: EMMONAK AIRPORT
LOCATION: 56 + 00 RIGHT 10'
TYPE BORING: HOLLOW STEM AUGER

DATE: 2/5/82
SURFACE ELEVATION:
COMPLETION DEPTH: 15.5 FT.

DEPTH, FT.	MOISTURE CONTENT (%)	BLOW COUNT *	SAMPLE	UNIFIED SOIL CLASSIFICATION	FROZEN	SOIL DESCRIPTION	DEPTH, FT.
				ML		F4, BROWN SILT WITH TRACE VERY FINE SAND AND WITH SOME ORGANICS, SLIGHTLY PLASTIC, SOFT, SATURATED (Vx, Vr)	
		27				F4, MOTTLED GRAY AND BROWN SANDY SILT, 30-40% VERY FINE SAND, LITTLE TO NO VISIBLE ICE, OCCASIONAL ICE CRYSTALS, WELL-BONDED, (Nbe, Vx)	
5							5
						COLOR CHANGE TO GRAY, NO VISIBLE ICE	
				ML			
10						SAND CONTENT INCREASES, OCCASIONAL ICE CRYSTALS	10
						ICE CONTENT INCREASES, 10% VISIBLE (Vx)	
15						TEST BORING COMPLETED 2/5/82	15
20							20

* NOTE
NUMBER INDICATES BLOW COUNT FOR 12" PENETRATION W/ 140 # HAMMER FALLING 30"

NORTHERN TECHNICAL SERVICES

LOG OF BORING NO. TH28

PROJECT: EMMONAK AIRPORT
LOCATION: 74 + 00 on ℄
TYPE BORING: HOLLOW STEM AUGER

DATE: 3/27/82
SURFACE ELEVATION:
COMPLETION DEPTH: 15 FT.

DEPTH, FT.	MOISTURE CONTENT (%)	BLOW COUNT *	SAMPLE	UNIFIED SOIL CLASSIFICATION	FROZEN	SOIL DESCRIPTION	DEPTH, FT.
				OL		F4, BROWN TO REDDISH BROWN ORGANIC SILT, ≈10% VISIBLE ICE IN RANDOM VEINS (Vr)	
5	47	40		ML/SM		F4, GRAY SANDY SILT, 30-40% FINE SAND, NON-PLASTIC, LITTLE TO NO VISIBLE ICE, INTERLAYERED WITH SILTY SAND (Nbe)	5
10	28	78				SAND CONTENT INCREASES	10
15	50	93				HORIZONTAL ICE VEINS TO 1/8" THICK ON 2" SPACINGS, 14-14.5' DEPTH (Vs) TEST BORING COMPLETED 3/27/82	15
20							20

* NOTE
NUMBER INDICATES BLOW COUNT FOR 12" PENETRATION W/ 140 # HAMMER FALLING 30"

NORTHERN TECHNICAL SERVICES

C4
C3
C2
C1
ALTERNATE "C" LOCATION
ALTERNATE "A" LOCATION
A4
A3
A2
A1
TH29
TH28
TH27
TH26/B4
TH25
TH24
TH23
TH22
TH21/B3
TH20
TH19
TH18
TH17
TH16
TH15
TH14/B2
TH13
TH11
TH12
TH10
TH9
TH8
TH7
TH6
TH5/B1
TH4
TH3
TH2
TH1
ALTERNATE "B" LOCATION
SELECTED BORROW SITE
BS1
BS2
BS3
BS4
BS5
BS6
RECENT DEPOSITION
N

LEGEND

TEST HOLE LOCATION

PHASE I BORROW INVESTIGATION SITES

LOCATION OF SOIL TEST BORINGS

DOWL ENGINEERS
EMMONAK AIRPORT

NORTHERN TECHNICAL SERVICES
ENGINEERS & CONSULTANTS

DRAWN BY: AWB	DATE: MAY '82	
CHECKED BY: WDP	SCALE: 1" = 500'	FIGURE 2

0 1 2 3 4

APPENDIX C

Salinity Test Results

HATTENBURG DILLEY & LINNELL
Engineering Consultants

Salinity Content

Job: EmmonakBFU Job No. 11-008
Lab Tech: TC/NM Date:
Sample Location:: Boring No.
Sample Description: Sample No.

Boring:	BH-04	BH-04		BH-05	BH-05			
Sample:	S2	S6		S8	S9			
Sample Depth:	10 FT	30 FT		40 FT	45 FT			
Tare:	899.3	581.1		572.9	579.3			
Wet + Tare:	3101.1	1483.9		3205.9	3394.1			
Added Water +Tare:	4519.5	1745.5		4086.4	4035.2			
Dry + Tare:	2557.3	949.6		2615.2	2647.0			
Measured Na (ppm):								
Water Added:								
% Moisture:								
Natural Water:								
Salinity (ppt):	0.25	0.75		0.20	0.47			
ΔT	0.01	0.04		0.01	0.03			

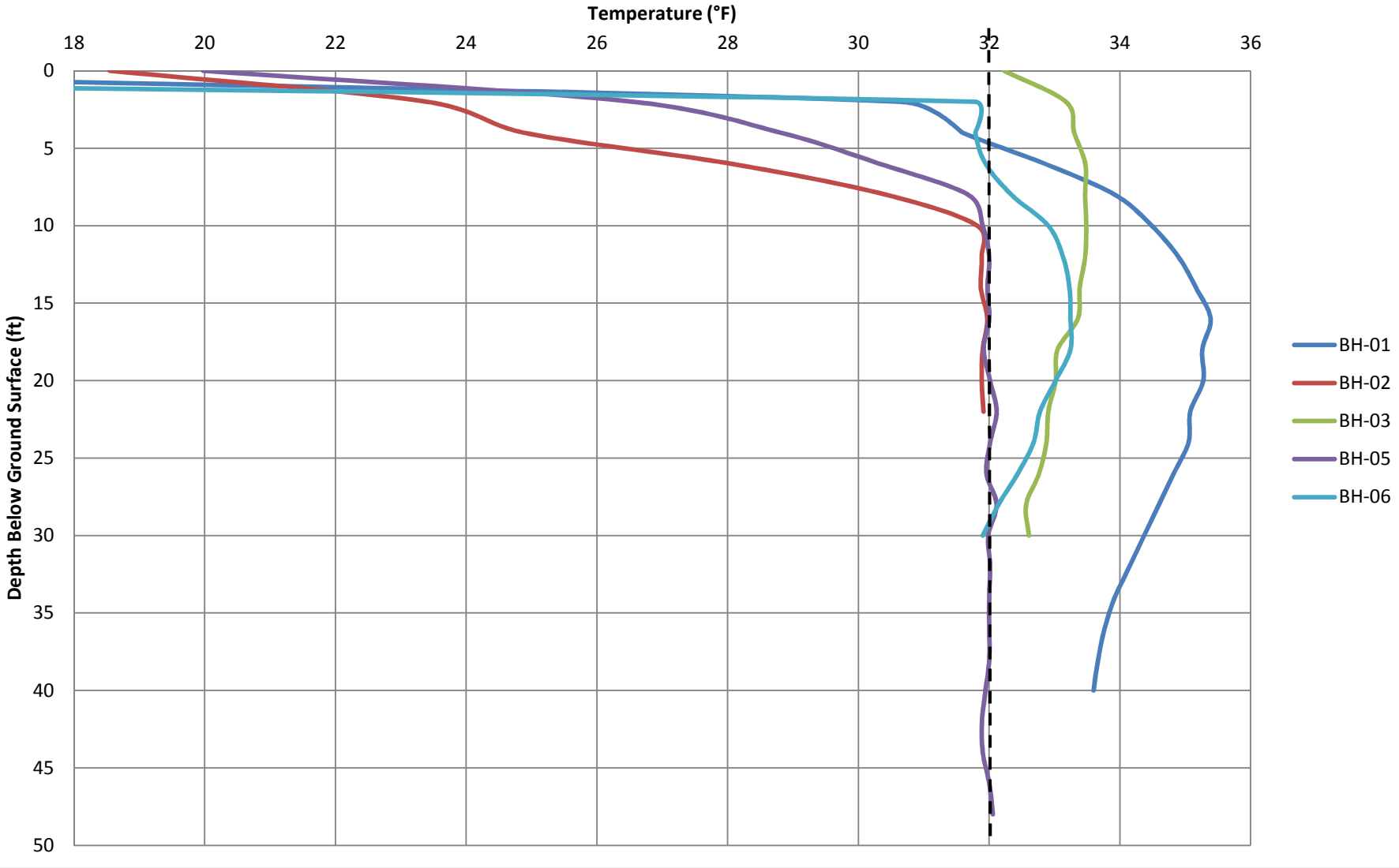
Boring:								
Sample:								
Sample Depth:								
Tare:								
Wet + Tare:								
Added Water +Tare:								
Dry + Tare:								
Measured Na (ppm):								
Water Added:								
% Moisture:								
Natural Water:								
Salinity (ppt):								
ΔT								

Tk*- reference temperature for sea salt (57 C)

APPENDIX D

Subsurface Temperature Profiles

Emmonak Bulk Fuel Storage Facilities
Subsurface Temperature Profiles
(March 2013)



February 1, 2013 113-95735

Mr. Jeff Stanley, PE
CRW Engineering Group, LLC
3940 Arctic Blvd. Suite 300
Anchorage, AK 99503

RE: GEOTECHNICAL EXPLORATION AND ENGINEERING RECOMMENDATIONS – EMMONAK WATER AND WASTEWATER UTILITY UPGRADES

1.0 INTRODUCTION

Golder Associates Inc. (Golder) is pleased to present this letter report to CRW Engineering Group, LLC (CRW) for the proposed water and wastewater upgrades in Emmonak, Alaska (Figure 1). CRW has requested Golder's geotechnical assistance for design of the vertical supports along the above grade portion of the water and wastewater utility pipelines. We understand that small dimensioned helical piles are being considered for the vertical supports. During the course of this project, Golder coordinated with Mr. Jeff Stanley, PE, of CRW.

Our scope of services was performed in general accordance with our proposal to CRW dated September 30, 2011. Our scope of work consisted of:

- Preparing a site specific Health and Safety Plan
- Reviewing readily available geotechnical data to assist in determining general subsurface soil and thermal conditions along the proposed alignments
- Conducting geotechnical hand probes along the alignments
- Determining shallow subsurface conditions and thermal states based on the field probes
- Identifying surface terrain features in the project areas which may impact shallow subsurface conditions and thermal state
- Developing geotechnical recommendations, including helical pile geometry and installation recommendations, based on field findings and our geotechnical experience in Emmonak

This letter report provides a summary of our field findings as well as a discussion of geotechnical design conditions and recommendations for the proposed utility upgrades.

2.0 EXISTING GEOTECHNICAL INFORMATION

Existing geotechnical reports were reviewed to provide a general understanding of the subsurface conditions in the Emmonak area. The reports reviewed are summarized below:

- **Harding Lawson Associates, "*Geotechnical Investigation Emmonak Water/Sewer Project*", 1985:** Harding Lawson Associates performed subsurface investigations in Emmonak for the wastewater treatment building, water storage tank and approximately 16,000 lineal feet of water distribution/sewer line. The investigation consisted of a total of 22 borings advanced throughout the community, dynamic penetration testing carried out at the sewage lagoon, and an electromagnetic survey conducted in select project areas. The soil types observed during the investigation generally consisted of 2 to 4 feet of soft organic rich material underlain by highly frost susceptible soft silt, and loose to medium

Golder Associates Inc.
2121 Abbott Road, Suite 100
Anchorage, AK 99507 USA
Tel: (907) 344-6001 Fax: (907) 344-6011 www.golder.com

dense silty sands. Groundwater was observed during the investigation and ranged from approximately 0.5 to 7 feet below ground surface. Variable permafrost soil conditions were reported throughout the community, with permafrost observed in some areas and only seasonal frost observed in others. Some boreholes were instrumented with sealed casing and ground temperatures were measured at approximately 31.8°F in these locations. The report recommended that the utility pipes be constructed on steel piling at 'strong points' and intermediate support be constructed of timber cribbing resting on the tundra. The report recommended that the water treatment building is constructed on a 'cold foundation' (above grade structure supported on either spread footings or isolated footings) and that tanks are constructed on fill pads with subgrade cooling.

- **Duane Miller & Associates (DMA), "*Foundation Investigation, New Elementary School*", 1991**: DMA conducted a subsurface investigation at the school in Emmonak, consisting of six borings. The borings were advanced to depths between 26 and 61 feet below ground surface. The observed ground conditions consisted of silt and sand extending to the depths explored. In general, loose non-plastic silt extended from 8 to 19 feet below ground surface, with sand and silt extending below. Trace organic material was observed mixed with the near surface silt. A four foot layer of organic material was observed below ground surface in the borings. Frozen soil was only observed in two of the six borings; one was frozen to 12 feet below ground surface, and the other was frozen from 12 to 36 feet below ground surface.

The subsurface soil and thermal conditions along the alignments are mostly inferred from existing subsurface data in the Emmonak area. We assume that soil conditions along the proposed alignments are reasonably consistent with the geotechnical borings reviewed for this report.

3.0 SITE EXPLORATION

The field exploration was conducted on October 17 and 18, 2012 by Golder engineer Jeff Levison. Three proposed alignments were identified by CRW and explored during our field effort, as shown in Figure 1. Mr. Levison advanced shallow depth hand probes at two of the alignments and conducted a visual site survey of each alignment as part of the field exploration effort. Prior to conducting the field work, a site specific health and safety plan was developed for the project.

Hand probes were conducted along the two alignments by advancing a slender steel rod, 1/2 inch in diameter, into the ground surface, typically until refusal or the safe working limits of the hand equipment. The hand probes were assembled in one foot steel sections with a total extension length of 12 feet possible. Refusal of the probes in the subsurface was interpreted as the surface of a denser layer of soil, permafrost, or relic seasonal frost. Hand probes are generally not able to differentiate between frozen soil and dense soil.

The thaw probes were advanced in late autumn, when probe depths generally indicate the maximum depth of seasonal thaw. The actual thaw depth will vary between years and time of season. At the time of the field exploration, several inches of seasonal frost were present at the ground surface. The thin seasonal frost layer was penetrated to the underlying unfrozen active layer. Probe refusal depths ranged from 2.5 feet to 5.5 feet. Approximate probe locations and refusal depths are shown in Figures 2 and 3.

4.0 SITE AND SUBSURFACE CONDITIONS

4.1 Geologic Setting

Emmonak is located near the mouth of the Yukon River, on the north bank of a distributary channel known as Kwiguk Pass. A maritime climate prevails at Emmonak.

The project lies near the northwestern end of the Yukon-Kuskokwim Delta. Pleistocene and recent delta building has played a major role in shaping the regional geography. Most near-surface deposits in the area are fine grained soils. Coastal wave action has probably sorted some of these silty and sandy

deposits and eolian silts are commonly intermingled with surface organic deposits. Permafrost is present in the region, but it is often discontinuous where surface disturbance has occurred. Permafrost is sporadic or totally lacking beneath large bodies of water and adjacent to flowing streams.

4.2 Climate Data

General historical and current design climate data including average thawing and freezing indices are presented in Table 1 for the Emmonak area (localized climate parameters). The indices are calculated and derived from public data available by the University of Alaska Fairbanks (UAF) Scenarios Network for Alaska and Arctic Planning (SNAP)[1]. Design indices are based on the three coldest winters (freezing index) or warmest summers (thawing index) observed during the analysis period.

By downscaling data, SNAP estimates historical and future climate conditions in regions of Alaska that do not have consistent climate records. It is important to note that these data are estimates, and are not necessarily based on direct temperature measurements at the site. SNAP downscaled data is a product derived from several global climate model outputs. Additional information is available at the SNAP group's website.

Table 1: Engineering Climate Indices for Emmonak, Alaska

	SNAP 1948 – 1978	SNAP 1979 – 2009	SNAP 2012 – 2042 (estimated)[1]
Average Air Temperature	27.2 °F	29.3 °F	30.7 °F
Average Freezing Index	4130 °F-days	3580 °F-days	3050 °F-days
Average Thawing Index	2370 °F-days	2610 °F-days	2560 °F-days
Design Freezing Index	5180 °F-days	4700 °F-days	3830 °F-days
Design Thawing Index	2720 °F-days	3050 °F-days	2880 °F-days

Notes: 1) Projected by UAF SNAP, Composite of 5 Global Climate Models, Emission Scenario A1B
2) Air temperatures are estimates prepared by UAF SNAP

This report utilized data over two historical time spans (1948–1978 and 1979–2009) to provide comparison of SNAP-derived climate parameters over the last half-century. Similarly, a 30-year span was reviewed from the five-model composite of SNAP global climate model (mid-range emission scenario A1B) output, to provide estimated future climate projections. Average air temperatures have increased over the past 60 years, and are modeled to continue increasing over the next 30 years. The SNAP-derived average and design freezing indices both exhibit a historical decreasing trend. SNAP predicts the average and design freezing indices to decrease, however the thawing indices are anticipated to remain relatively constant. This reflects potentially warmer winters. This condition of warmer winters has been predicted by UAF SNAP across the significant portion of Alaska.

4.3 Project Setting

Three proposed alignments; western, central, and eastern, were investigated during our field effort, as shown in Figure 1, photos of each alignment are presented in Figure 4. The surface and subsurface conditions for each alignment are presented in the sections below.

[1] Scenarios Network for Alaska and Arctic Planning (SNAP). 2012. Online: http://snap.uaf.edu (accessed April 2012).

4.3.1 Western Alignment

The western alignment is located near the northwestern edge of the community. Currently, this alignment is undeveloped. The alignment is located along the edge of an existing overhead powerline corridor which was cleared of brush. The power poles on the utilidor were attached to steel H-piles which did not exhibit excessive horizontal or vertical movement.

In general, the topography along the proposed alignment is flat, with surface conditions consisting mostly of uneven, poorly drained tundra. Outside of the cleared powerline corridor, dense willows up to 12 feet tall are present. Standing water up to 12 inches deep was observed in numerous areas along the alignment. Approximately 75 feet east of the eastern side of the alignment, an existing ATV trail traversed roughly north/south. The trail was significantly rutted by tire tracks, which were filled with water.

Subsurface conditions inferred by hand probes were generally consistent along the alignment. In general, the soft organic rich material was encountered in the top two feet, with silt encountered below. Probe depths averaged 4 feet below ground surface before encountering refusal. In most locations, probe refusal was not abrupt and the soil gradually became denser with depth. Therefore, refusal was estimated to be in dense soil, not frozen soil. Up to 3 inches of seasonal frost was observed at the time of probing.

4.3.2 Central Alignment

The central alignment is located east of the existing water treatment plant, and traverses east/west through the community. The proposed water and wastewater utilities will be located next the existing utility alignment. The existing utility alignment passes approximately 50 feet north of a partially developed residential area. No probes were advanced along the central alignment, however, visual observations of the existing water and wastewater utility lines were conducted, as well as observations of ground conditions along the alignment.

The existing water and wastewater utilities are at-grade, supported intermittently on timber pads. The utilidor appears to move seasonally with the ground surface.

Based on aerial imagery, the western side of the proposed alignment appears to be located in a relic drainage channel. Ponded water estimated to be 1 foot deep was observed in this area. Water and fuel tanks are located at the western edge of the proposed alignment. The existing utilities in the area are founded on elevated steel pipe piles with no excess movement observed. The water tanks are constructed on passively cooled gravel fill pads and elevated 3 to 4 feet above existing ground surface. No noticeable settlement observed at the water tanks. The adjacent fuel tanks were constructed on timber cribbing and no noticeable settlement was observed. The utility poles adjacent to the water plant are attached to H-piles and showed no obvious signs of horizontal or vertical displacement.

4.3.3 Eastern Alignment

The proposed eastern alignment is along an undeveloped area with no existing utilities. This alignment will connect two areas with existing utilities.

Aerial imagery of the alignment indicates that the alignment partially passes through a relic drainage channel. The ground conditions in the drainage channel are poorly drained, “boggy” tundra. The “boggy” areas contained standing water up to 2.5 feet deep and a thicker section of soft organic material was typically observed in this area. Outside of the drainage channel, dense mature willows, up to 12 feet high, exist. The ground conditions in the areas with dense willows consisted of hummocky ground with ponded water up to 1 foot deep in the lower areas. The ground was generally firmer in the higher areas.

Ground conditions near the clinic were similar to conditions observed in the old drainage channel; poorly drained “boggy” tundra.

Subsurface conditions were generally consistent along the alignment in areas with similar surface features. In general, soft organic rich material was encountered in the top two feet, with silt encountered below. Areas with "boggy" ground surface typically had a deeper section of soft, wet organic material. Probe depths averaged 4 feet below ground surface before encountering refusal. In most locations, probe refusal was not abrupt and the soil gradually became denser with depth. Therefore, refusal was estimated to be in dense soil, not frozen soil. Up to 3 inches of seasonal frost was observed at the time of probing.

5.0 DISCUSSION

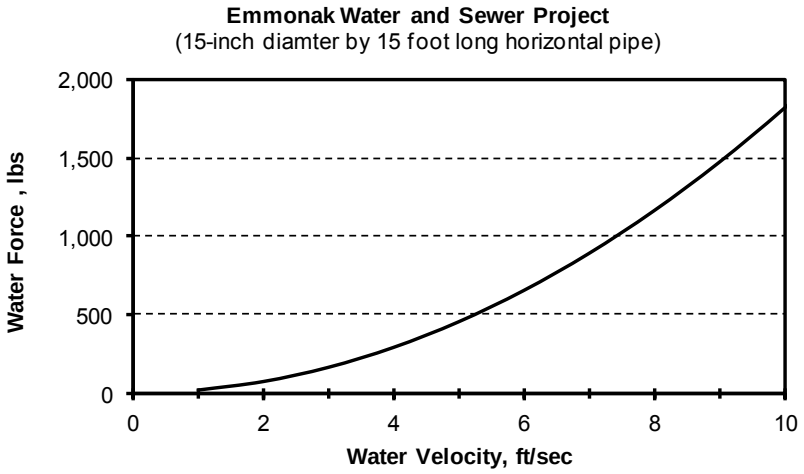
The soils along the majority of the proposed alignment include a variable thickness organic mat over organic silts grading to non-plastic mineral silt and fine sandy silt with depth. Groundwater is generally shallow. Permafrost is expected to vary widely throughout the improvement area and it is reasonable to assume areas along the alignment will have degrading permafrost or thawed soil conditions within reasonably expected utility foundation depths. However, permafrost should be expected in areas along the utility alignments. Long-term climate impacts coupled with local disturbances to the ground thermal regime should be expected to continue permafrost degradation and additional ground thawing along the alignments.

Based on discussions with CRW, we understand the new utilities will be above grade systems. Several foundation systems are feasible for the utilities including at-grade timber sills, helical screw piles and driven pipe or H-piles. We understand the utility pipeline design needs to include horizontal forces from water during floods. For our geotechnical analysis, we have used the following design considerations:

- Axial loads on vertical support members will be relatively light and seasonal frost forces will control vertical support member embedment depths.
- Soils will be organic rich (tundra mat) within the uppermost 1 to 3 feet then grade to non-plastic mineral silt below the organic material. Some organic silt may be present below the organic-rich surface mat, but the organic silt will exhibit geotechnical properties similar to non-plastic mineral silt.
- Winter freeze will extend to the permafrost or at least three feet below grade.
- Lateral forces will be control by flood water pressures along the horizontal pipelines. Per discussions with CRW's design team, impact loads along pipelines or vertical support members from floating ice or debris were not accounted for in our analysis.

Periodic flooding is expected to occur during spring breakup of the Yukon River. As such, limited seasonal thaw penetration along the vertical support members is expected during breakup flooding. Periodic flooding may also occur during fall storms and tide surges, but to a limited extent relative to river breakup flooding. Fall storm surge floods are expected to occur during periods of maximum ground surface thaw. The flooding along the utilities is expected to be primarily backwater stage flood conditions, not the main river channel flood conditions.

The geotechnical analysis and design recommendations include an assessment of water forces on the horizontal pipe section during flood periods. Reliable water velocities during flood periods for spring river breakup and fall storm surge backwater conditions were not found for the Emmonak area. Some river gauge data is available for Pilot Station, upriver of Emmonak but the Pilot Station data is not considered representative of backwater floodwater velocities in Emmonak. We used a generic 15-inch diameter horizontal pipeline for our analysis. We also assumed a 15 feet length between vertical support members. Based on these data, the following water velocity, water force plot was derived. For design purposes, we have used a 5 feet/sec (fps) flood water velocity for the Emmonak area, resulting in approximately 500 pounds force along the 15 foot pipe section.



We understand the vertical support section includes two vertical member installed 5 to 7 feet apart with horizontal support member installed between the vertical member for supporting the utility pipeline(s). Structural bracing is not planned between the vertical members, unless the horizontal member is more than 5 feet above grade. In this case, bolted "X" bracing may be used under the horizontal pipeline support member.

6.0 RECOMMENDATIONS

The preferred system for the vertical support members are smaller dimensioned helical (screw) piles. However, at-grade timber sill members with buoyancy tie downs may be used in select areas for the pipelines were flooding is not considered a significant design threat.

For our analysis, we have used both the spring and fall backwater flood conditions as the limited design condition state. Flood waters are expected to develop the largest lateral loading conditions along the vertical members. Axial loads will be controlled by seasonal frost forces acting along the vertical riser section.

6.1 Helical Pile Lateral Resistance

The lateral force from a flood water velocity of 5-fps is estimated to be approximately 500 pounds for a 15-foot long horizontal pipe section of 15-inch nominal outside diameter (OD). Two helical piles will be used at each vertical support section and we have applied a Factor of Safety of 2 to the flood water load for our lateral loads. A free head state is assumed at the vertical to horizontal member connection.

Based on discussions CRW, we understand that FEMA has funded a hazard mitigation proposal to install 2.5-inch diameter (2.875-inch OD) helical piles in the flood prone areas between 7th Street and Emmonak Road. The piles are intended to help mitigate damage to the pipelines in this flood prone area of the community. Two designs cases were considered; spring flood with limited thaw of subsurface soils and late fall flood with maximum thaw of subsurface soil representing the deepest active layer condition. In all cases, we have assumed the pipeline will be installed at a height of 1.5 feet above grade.

Estimated vertical riser deflections at the ground level summarized below are based on geotechnical models developed by Matlock and Reese, using the factored water force discussed above. Matlock and Reese models, and most other geotechnical lateral deflection models, are based on sustained lateral loads. The lateral loads due to flood conditions are not representative of sustained load conditions. However, they most likely do not reflect short-term, transient loading conditions either. Thus, the Matlock and Reese model, while having limitations, is considered generally suitable for this analysis based on the limited geotechnical data obtained during our site work. The deflection values summarized below are

considered conservative, provided the subsurface conditions are similar to our modeled sections. Being conservative, the actual deflections will most likely be less than the values summarized below.

Estimated Lateral Deflection at Ground Surface, inches

	Spring Breakup Flood	Fall Storm Surge Flood
2.5-in (nominal), sch 40	0.20	0.40
2.5-in (nominal), sch 80	0.15	0.35

Wind and other lateral loads are generally short-term transient load states and are expected to be lower than flood water loads. Short-term transient loads are not considered the limit state condition for our lateral analysis.

6.2 Helical Pile Axial Uplift Resistance

Seasonal frost is expected to control axial loads. For the 2.5-inch nominal diameter helical piles, we recommend each pile include at least two helices. The uppermost helix should be 12 inches diameter with lead helix of 12 or 10-inch diameter. The upper helix should be spaced approximately three helix diameters from the lead helix. The helix pitch should be 3-inch with a leading edge suitable for the expected soil and ground thermal conditions. We have assumed all helix material will be hot dipped galvanized or as advised by the design team. The helical piles can be provided as a single length section or a manufacturer fabricated sectional members. If sectional members are used, the connectors between sections should not be terminated within the active layer, estimated about 4 feet from the ground surface.

The helical piles should meet both a minimum embedment and a minimum installation torque. A minimum embedment to the uppermost helix of 15 feet below finish grade or at least 5 feet below the contact with continuous permafrost is recommended. A minimum installation torque of 1,500 ft-lbs is advised. The advised minimum installation torque should be the average over the final three feet of embedment.

Minimum embedment and installation torque recommendations can be refined with field load testing for axial loading conditions. Vertical members in critical design areas should have field axial and/or lateral load testing conducted on representative units. We can provide loading recommendations if verification field testing is required by the design team.

In areas not designated as flood-prone zones, smaller dimensioned helical piles, such as 1.5-inch square shaft units, can be considered as a cost saving option. These smaller dimensioned helical pile systems have been extensively used to successfully support above grade utility systems in the lower Yukon-Kuskokwim region for many years. Generally suitable helix geometries for the light axial and lateral loads for the utility pipelines are:

- 1.5-inch solid square shaft helical piles with two vertical member support sections as discussed above
- A helix geometry of 12-inch diameter. 3-inch pitch helix and leading edge suitable for the expected soil and ground thermal conditions
- Minimum embedment as recommended for the 2.5-inch nominal riser diameter units
- Minimum installation torque of 1,000 ft-lbs as discussed above

We understand All Weather Wood (AWW) at-grade sills may be used in some areas. If an AWW sill foundation system is being considered, the design team, local representatives, and the owner need to recognize the at-grade sill will experience season frost movements. At or near grade sill foundations may also create snow drifts that may act as ground insulators with potential impact to the underlying ground thermal state.

6.3 Construction Considerations

Helical piles should be installed in accordance with the manufacturer's installation recommendations. Helical piles should also be installed plumb and in a continuous manner and advanced at a rate equaling the pitch of the helix for each rotation. The anchor should be 'screwed' into the subsurface soil without 'augering'. 'Augering' installation may damage the soil fabric surrounding the helix resulting in greater axial and lateral movements. If the vertical riser section is not continuously plumb during installation, the soil fabric may be strained or damaged along the riser shaft resulting in larger lateral displacements. The helices on individual helical risers should be spaced at even multiples of the helix pitch to avoid soil fabric damage between the lead and trailing helices during installation.

Installation torques should be measured during installation. A common method is converting drive head hydraulic pressure to torque, based on the drive head manufacturer conversation data. The drive head should be calibrated prior to construction activities to determine the pressure torque ratio.

We understand that summer construction for the vertical support members may be conducted. If so, tundra protection to avoid damaging the organic mat and underlying soils is recommended. If winter vertical support member construction is being considered, cold seasonal surface frost may impact the helical pile installation or possibly exceed the manufacturer's maximum installation torque. If so, a pilot hole may be required to safely advance the helical piles. If pilot holes are required, special provisions for granular backfill along the riser shafts may be necessary to avoid lateral displacements in excess of our estimated values. We do not recommend use of steam or water thawing/jetting to aid with helical pile installation in the Emmonak area.

A qualified inspector should be on site during installation to record helical piles installation methods including torque per foot of embedment, rate of embedment, embedment depth, and date of installation. Golder should be retained for the construction observation services or to review as-built records recorded by a competent and experienced field inspector.

7.0 USE OF REPORT

This report has been prepared exclusively for CRW for the water and wastewater upgrade project in Emmonak, Alaska. If there are significant changes in the nature, design, or location of the proposed facility, we should be notified so that we may review our data findings in light of the proposed changes and provide a written modification or verification of the changes.

There are possible variations in subsurface conditions between explorations and also with time. Therefore, observation and testing by a qualified geotechnical engineer should be included during design and construction to provide corrective recommendations adapted to the conditions revealed during the work. In addition, a contingency for unanticipated conditions should be included in the construction budget and schedule. The work program followed the standard of care expected of geotechnical professionals undertaking similar work in the State of Alaska under similar conditions. No warranty expressed or implied is made.

It has been a pleasure to assist you with this project. Please contact us if you have any questions or require additional information.

GOLDER ASSOCIATES INC.

Brenton B. Savikko, PE
Project Engineer

Richard A. Mitchells, PE
Associate and Senior Geotechnical Engineer

Attachments: Figure 1 - Site Map
Figure 2 - Western Alignment Probe Location Map
Figure 3 - Eastern Alignment Probe Location Map
Figure 4 - Site Photos

BBS/RAM/mlp

LEGEND

INVESTIGATED/PROBED ALIGNMENT (APPROXIMATE)

0 250 500 750
FEET FEET

NOTES

1. AERIAL IMAGERY PROVIDED BY CRW ENGINEERING GROUP, LLC.
2. ALL PIPE ALIGNMENTS ARE REPRESENTATIVE OF APPROXIMATE LOCATIONS FROM MAP PROVIDED BY CRW ENGINEERING GROUP, LLC, DATED JULY 2012.

REV	DATE	REVISION DESCRIPTION	DES	CADD	CHK	RVW
1	2012-12-03		XXX	MSF	JL	BBS

PROJECT
CRW
WATER & SEWER UPGRADE
EMMONAK, ALASKA

TITLE
SITE MAP

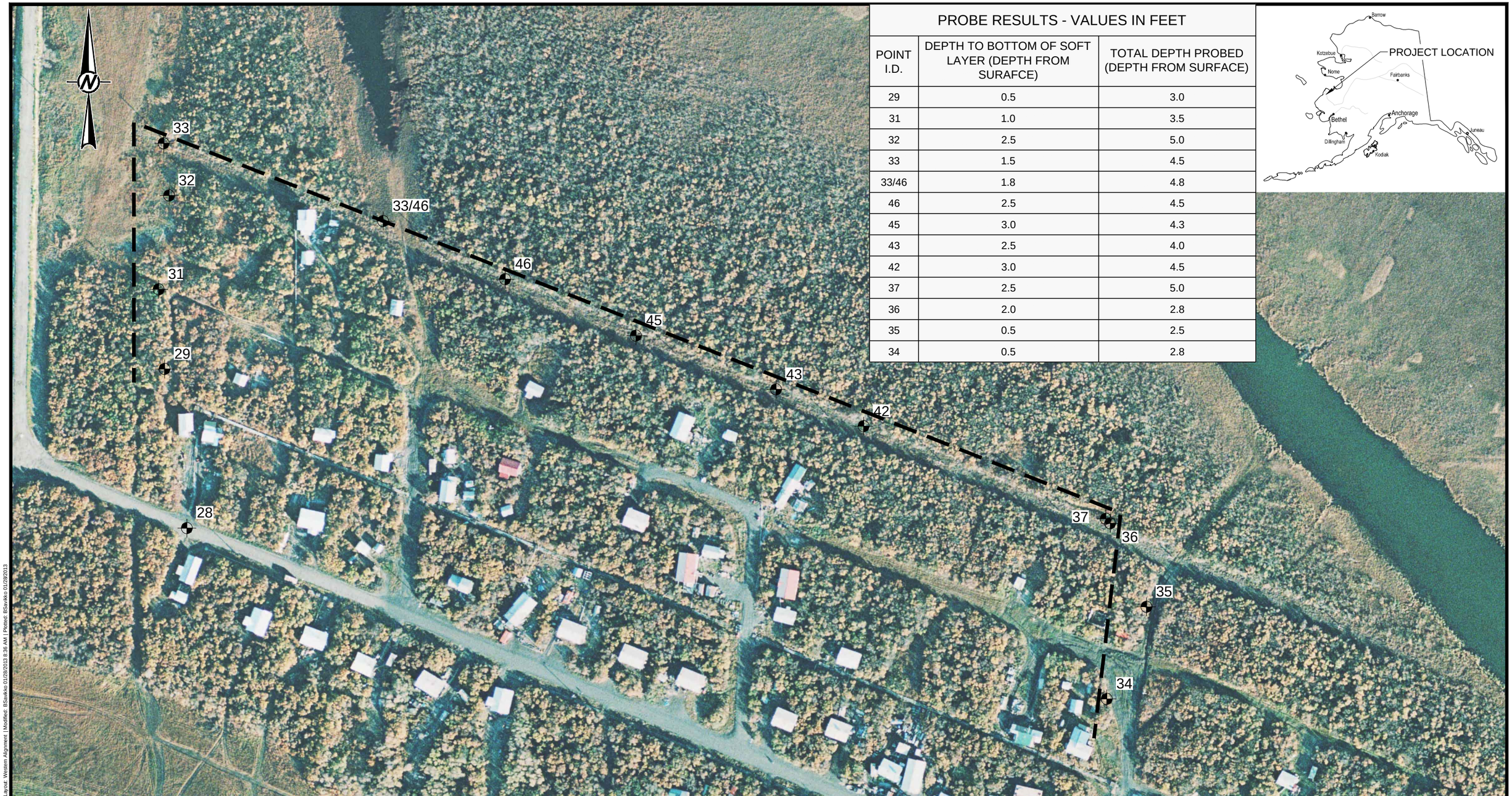
Golder Associates

CRW ENGINEERING GROUP, LLC

PROJECT No. 113-95735
FILE No. Probe_Figures
SCALE SCALE

FIGURE 1

J:\2011_Jobs\113-95735 Crw Emmonak W&s Upgrade\CAD\Probe_Figures.dwg | Layout: Site Map | Modified: BSwikko 01/28/2013 8:34 AM | Plotted: BSwikko 01/28/2013



PROBE RESULTS - VALUES IN FEET		
POINT I.D.	DEPTH TO BOTTOM OF SOFT LAYER (DEPTH FROM SURAFCE)	TOTAL DEPTH PROBED (DEPTH FROM SURFACE)
29	0.5	3.0
31	1.0	3.5
32	2.5	5.0
33	1.5	4.5
33/46	1.8	4.8
46	2.5	4.5
45	3.0	4.3
43	2.5	4.0
42	3.0	4.5
37	2.5	5.0
36	2.0	2.8
35	0.5	2.5
34	0.5	2.8

LEGEND

29 GOLDER 2012 PROBE LOCATIONS

INVESTIGATED/PROBED ALIGNMENT (APPROXIMATE)

NOTES

1. AERIAL IMAGERY PROVIDED BY CRW ENGINEERING GROUP, LLC.
2. ALL PIPE ALIGNMENTS ARE REPRESENTATIVE OF APPROXIMATE LOCATIONS FROM MAP PROVIDED BY CRW ENGINEERING GROUP, LLC, DATED JULY 2012.

REV	DATE	REVISION DESCRIPTION	DES	CADD	CHK	RVW
1	2012-12-03		XXX	MSF	JL	BBS

PROJECT
CRW
WATER & SEWER UPGRADE
EMMONAK, ALASKA

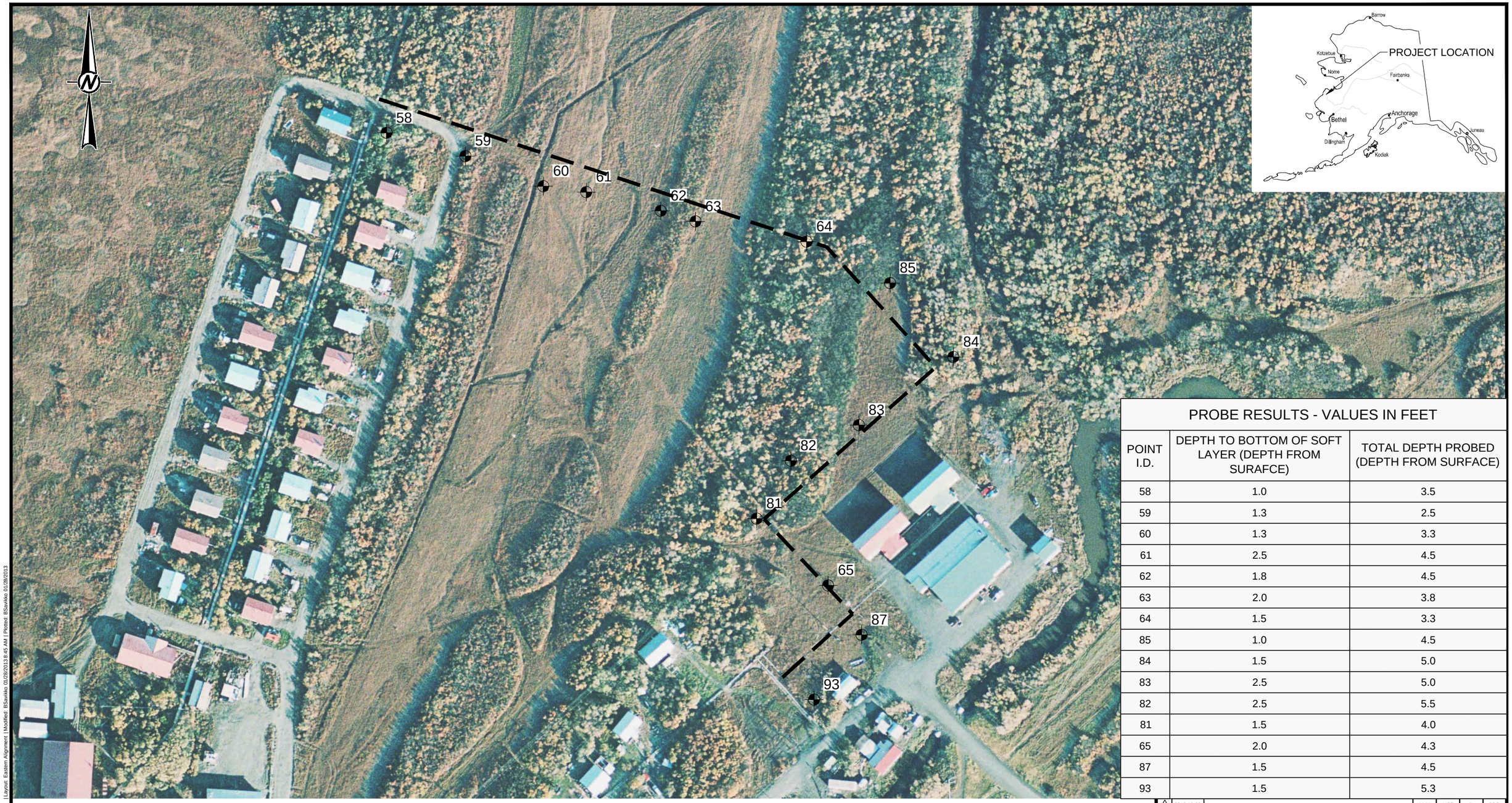
TITLE
WESTERN ALIGNMENT

Golder Associates

CRW ENGINEERING GROUP, LLC

PROJECT No. 113-95735
FILE No. Probe_Figures
SCALE SCALE

FIGURE 2



PROBE RESULTS - VALUES IN FEET		
POINT I.D.	DEPTH TO BOTTOM OF SOFT LAYER (DEPTH FROM SURAFCE)	TOTAL DEPTH PROBED (DEPTH FROM SURFACE)
58	1.0	3.5
59	1.3	2.5
60	1.3	3.3
61	2.5	4.5
62	1.8	4.5
63	2.0	3.8
64	1.5	3.3
85	1.0	4.5
84	1.5	5.0
83	2.5	5.0
82	2.5	5.5
81	1.5	4.0
65	2.0	4.3
87	1.5	4.5
93	1.5	5.3

LEGEND

28 GOLDER 2012 PROBE LOCATIONS

INVESTIGATED/PROBED ALIGNMENT (APPROXIMATE)

NOTES

1. AERIAL IMAGERY PROVIDED BY CRW ENGINEERING GROUP, LLC.
2. ALL PIPE ALIGNMENTS ARE REPRESENTATIVE OF APPROXIMATE LOCATIONS FROM MAP PROVIDED BY CRW ENGINEERING GROUP, LLC, DATED JULY 2012.

REV	DATE	REVISION DESCRIPTION	DES	CADD	CHK	RVW
1	2012-12-03		XXX	MSF	JL	BBS

PROJECT
CRW
WATER & SEWER UPGRADE
EMMONAK, ALASKA

TITLE
EASTERN ALIGNMENT

Golder Associates

CRW ENGINEERING GROUP, LLC

PROJECT No. 113-95735 | FILE No. Probe_Figures | SCALE SCALE

FIGURE 3

WESTERN ALIGNMENT - EXISTING POWER LINE CORRIDOR

EASTERN ALIGNMENT - VIEW LOOKING SOUTHEAST

CENTRAL ALIGNMENT - VIEW WEST

REV	DATE	REVISION DESCRIPTION	DES	CADD	CHK	RVW
1	2012-12-03		BBS	MSF	JL	BBS

PROJECT

CRW
WATER & SEWER UPGRADE
EMMONAK, ALASKA

TITLE

SITE PHOTOS

Golder Associates

CRW ENGINEERING GROUP LLC

PROJECT No. 113-95735

FILE No. Photo_Figures

SCALE SCALE

FIGURE 4